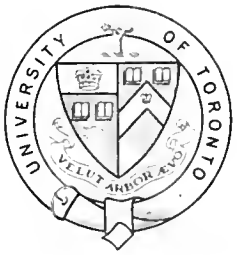

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ERRATUM.

This Journal, page 849, col. 2, for "*Catechol*" throughout read "*Catechin*."

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Messrs. Cross and Bevan. "The Volumetric Estimation of Alumina."

March 2nd.—Mr. V. H. Veley. "The Chemical Changes between Nitric Acid and Metals."

March 16th:—
Mr. W. Crowder. "Observations made in the Working of Vitriol Chambers."
Mr. A. H. Allen. "The Chemistry of Whisky and Allied Products."

April 6th.—Professor Vivian B. Lewes:—
1. "The Analysis of Illuminating Gases."
2. "The Products of Checked Combustion."

April 20th.—Mr. W. P. Rix. "Stoneware: and its Application to Chemical Apparatus."

May 4th. Professor Dewar, F.R.S., and Mr. Boverton Redwood, F.R.S.E. "A Process for the Conversion of Heavy Mineral Oils into Lighter Hydrocarbons suitable for Illuminating and other purposes."

June 1st. Dr. W. S. Squire. "The Artificial Production of Cold theoretically and practically explained."

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Meeting held Monday, January 5th, 1891.

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THE BASIC PROCESS AS APPLIED TO COPPER SMELTING.

BY PERCY C. GILCHRIST, A.R.S.M.

ARGUING from the great advantages which ensue from the replacement of the ordinary silicious linings of steel-melting furnaces by a lining composed of basic material, when phosphoric pig iron has to be converted, it might reasonably be expected that the substitution of a basic lining for the silicious lining hitherto employed in copper-smelting furnaces, should also be followed by similarly advantageous results, especially when the cupriferous material to be treated contains any notable percentage of arsenic or antimony. It was not, however, until comparatively recently that the author had the opportunity of practically testing whether or no any such advantage really resulted in practical working.

In the case of steel manufacture, the result aimed at in substituting a basic lining for the acid was well defined, viz., the removal of phosphorus, a problem incapable of solution in acid-lined furnaces, owing to the acid nature of the slags necessarily formed with such linings, but which was readily accomplished so soon as the presence of a basic lining in the furnace allowed of a basic slag being formed and maintained. No such direct improvement, however, was to be looked for in the case of copper smelting, as the only deleterious element occurring with any frequency in crude copper, viz., arsenic, can be very perfectly eliminated in the acid lining at present made use of. A careful study, however, of the composition of copper roaster and refinery slags reveals the facts that, unlike steel slags from acid practice, the copper slags formed during the removal of the arsenic are basic and not acid in character, the basicity being chiefly due to the presence of copper oxide in quantity more than sufficient to neutralise the silica, which latter, in the roaster and refinery furnace, originates almost wholly from the sand or clay used to form the furnace bath. Lime or lime and soda ash are used very generally in the ordinary sand-lined refinery, but the quantity which can be added without detriment to the lining is not large, and does not compensate for the large amount of silicious material which is dissolved away from the sides of the furnace. It was therefore rather in the direction of lessened oxidation, and therefore increased yield, that the author expected improved results by the use of basic linings and more calcareous slags in copper smelting.

In May 1889 the technical adviser of one of our largest copper-smelting companies was exceedingly anxious to make a trial of a basic lining in one of their roaster furnaces. This lining was accordingly put in and is still in perfect condition. The results obtained with this first lining were so satisfactory that at the present time the company have nine roaster furnaces at work treating arsenical "metallic bottoms" and white metal. The process has been very thoroughly examined by the technical advisers of the company, and the author has pleasure in acknowledging the very valuable assistance rendered by these gentlemen. As the old roaster furnaces require renewing, they are being rebuilt with basic hearths, so that, shortly, probably all the roaster furnaces employed at these works will be furnished with basic linings. Further on in this paper will be found some figures showing the comparative yields obtained from a basic and an acid roaster working side by side, together with analyses of the blister and slag obtained in each case.

These roaster furnaces have cast-iron bottom plates, underneath which a free current of air circulates; by this means the bottom of the furnace is kept cool, it likewise prevents the possibility of any fusing action taking place between the basic hearth and its support, which might be the case were the basic hearth built directly upon the ordinary silica arch. The basic material is ground and mixed with tar in the usual way, and the furnace bottom is formed by throwing this material into the hot furnace and burning it on in layers, well beating down each separate layer and giving it fire for some hours before applying a fresh layer. It usually takes four or five days to burn on a bottom in this way. When the bottom is properly shaped it should be seasoned by melting on it some rich copper precipitate or good blister copper. It was at first considered that the basic hearth absorbed less copper than the ordinary sand ones, but there appears to be very little, if any, difference between them, much depending on the way the bottom is formed and seasoned. The tap-hole of the furnace is shut by throwing a little basic material against it from the inside. In other respects the working of the furnace is conducted in the usual way. After each charge any slight repairs that the banks may require are made by throwing some basic material against the place needing repair; the repairs required are, however, very slight in comparison with an acid furnace, the tendency being for the furnace banks to grow rather than to eat away.

TREATMENT OF ARSENICAL METALLIC BOTTOMS IN BASIC-LINED FURNACES.

The mineral in use at these works is arsenical, and although in the crude ore the arsenic is not high, yet when the ore is allowed to oxidise in heaps and the copper afterwards precipitated from the solution, obtained by lixiviating the ore, arsenic is concentrated in the precipitated copper to a considerable extent, the resulting precipitate usually containing some 3 to 3½ per cent. of arsenic. Very

large quantities of this precipitate are treated. It is added to the mixture of slag and metal charged into the smelting furnace, and according to the amount of precipitate so added to the charge, more or less of the produet tapped from the smelter consists of impure copper, known as "metallic bottoms." An average analysis of these bottoms gives :—

	Per Cent.
Copper	83 to 87
Arsenic	5 to 7
Sulphur	1 to 3
Iron	0·5
Lead	3 to 5
Silica	0·5

It is in the conversion of these metallic bottoms into blister copper containing under 1 per cent. of arsenic that the basic furnaces have shown themselves to the greatest advantage. The followiog comparative statement of the results obtained when treating some 400 tons of such arsenical bottoms in acid- and basic-lined furnaces will best show the large increase in yield which results from the lessened oxidation in the basic-lined furnaces.

COMPARATIVE STATEMENT OF METALLIC BOTTOMS ROASTED, RESPECTIVELY, IN BASIC- AND SAND-LINED FURNACES.

——	Basic Furnaces.	Average Sand Furnaces.
	t. c. q.	t. c. q.
Metallic bottoms used during 12 weeks ending September 30th, 1889	400 10 0	400 10 0
Average analysis 84·52 per cent. copper and 5·91 per cent. As		
59 charges made, averaging per charge	6 15 1	6 15 1
Blister copper produced from same	323 6 2	191 15 0
Average produce per charge	5 9 2	3 5 0
Average arsenic 1·11 per cent.		
Slag made from above charges	102 16 3	221 15 0
Average weight per charge	1 14 3	3 15 0
Average copper percentage	25 %	55 %
Time occupied per charge, including fettling, charging, &c.	29½ hours.	38 hours.

Calculating from the above figures, we find that taking the real copper in the "metallic bottoms" at 84·5 per cent., and the real copper in blister at 98·5 per cent., there was obtained in the form of blister 94 per cent. of the real copper from the basic furnace and 56 per cent. of the real copper from the acid furnace, showing a gain of 38 per cent. in favour of the basic furnace. The real copper in the slag works out to 25 tons 14 cwt. from the basic furnace, and 121 tons 19 cwt. from the acid furnace. The tonnage figures given in the above table are as correct as the weighers could get them and are taken from the weighers' books. The deductions drawn from them are not absolutely correct, as they show a slight gain of copper in the case of the basic furnace. This is easily accounted for by the analytical figures given for the copper percentages being averaged over a large quantity.

The following is an example of a charge of metallic bottoms worked down into blister in a basic roaster furnace, together with analyses by Mr. E. Riley of the slags skimmed off :—

PARTICULARS OF WORKING CHARGE NO. 79 IN NO. 27 BASIC FURNACE.

Charged Monday, 4th November 1889, at 3 p.m.

Seven tons of metallic bottoms, containing 87·4 per cent. of Cu and 4·6 per cent. As.

Six cwt. of lime added with the charge.

Charge under air for five hours, clear off bottom at 10 p.m. = 10 hours.

Sample.			c. q. lb.
No. 1	10 0 p.m.	1st skimming	9 1 6
No. 2	11 20 p.m.	2nd „	3 1 0
No. 3	5 30 a.m.	3rd „	7 2 8
Sample of blister gave at this time 1·42 per cent. arsenic.			
..	7 0 a.m.	Six shovels of lime added.	
No. 4	10 15 a.m.	4th skimming	4 2 16
Sample of blister gave at this time 1·36 per cent. arsenic.			
Six shovels of lime added.			
No. 5	10 45 a.m.	5th skimming	2 1 8

The furnace was then tapped, the blister giving 1·36 per cent. arsenic.

	t. c. q. lb.
Weight of blister tapped	6 19 0 6
Weight of slag tapped	1 7 0 20
Lime used	0 6 0 20
Fettling used, 12 per cent. tar (30 per cent. of this for tap-hole.)	0 2 1 6

The analyses of the different skimmings of slag are as follows :—

——	1.	2.	3.	4.	5.
Silica	18·62	5·70	6·30	6·73	6·76
Lime	19·20	14·80	17·57	23·38	20·16
Ferrous oxide	7·35	2·42	3·45	2·16	2·06
Cuprous sulphide	1·25	Trace.	8·50	1·50	Trace.
Cuprous oxide	8·76	30·12	23·30	19·10	27·74
Arsenic acid	11·70	23·07	20·80	35·55	31·30
Lead oxide	24·00	12·44	7·16	2·20	2·20
	90·88	88·55	86·98	90·62	90·22

By calculation from the weight and copper percentage of each slag drawn, it will be found that the total real copper contained in the 1 ton 7 cwt. of slag drawn is 5 cwt. 23 lb., which equals on the real copper contained in the 7 tons of bottoms charged, 4·1 per cent. of copper slagged.

In addition to the largely increased yield of blister obtained from the basic furnace over the sand-lined furnace when treating metallic bottoms, there is a further advantage, viz., that these metallic bottoms have a most deleterious effect upon the sand lining of the furnaces, the bottom nearly always requiring repair after three or four days' working. It is partly owing to this fact that the production of these metallic bottoms (except in small quantities accidentally) has nearly ceased in England, except at the works of one or two firms. Other firms usually prefer to throw the copper back from the state of precipitate to sulphide in the smelting furnace, and this is no doubt the more preferable way where no basic-lined furnace is available. But from the results given above, where large quantities of arsenical precipitate have to be treated, the formation of metallic bottoms, with subsequent treatment in a basic-lined roaster furnace, is, in the author's opinion, by far the more economical method of procedure, especially as the metal tapped simultaneously from the smelting furnace with the copper bottoms is far lower in arsenic and other impurities than when no copper bottoms are allowed to form. In practical working, the whole of the smelter charge, consisting of a mixture of metallic bottoms with more or less white or pimple metal attached, is charged into the basic roaster furnace, without any stripping or separation of the two. The results given above, however, were made on charges of metallic bottoms alone, the metal having been separated previous to use.

Treatment of White or Pimple Metal in the Basic Roaster Furnace.

Although it has been found, when working in a basic-lined furnace, that the greatest advantage results when treating metallic bottoms, yet a very considerable gain in output is obtained when treating white or pimple metal.

The following comparative results show about what this gain amounts to, the figures in each case being the totals of six *consecutive* charges, taken at random from the weigher's books:—

Furnace.	Metal Charged.	Blister Tapped.
	t. c. q	t. c. q.
Six charges from first basic furnace.	57 0 0	39 15 3
„ „ second „ „ .	57 0 0	37 15 1
„ „ third „ „ .	57 0 0	39 3 3
„ „ fourth „ „ .	57 0 0	32 10 0
„ „ fifth „ „ .	57 0 0	38 13 2
„ „ first acid furnace .	63 0 0	34 19 2
„ „ second „ „ .	63 0 0	31 2 0

These figures show a gain in the output of about 13 per cent. in favour of the basic furnace. Another series of comparative charges of white metal in sand- and basic-lined furnaces were made, of which the results are shown in tabular form below. It will be seen that these also show a large gain in output in favour of the basic furnace:—

Comparative Statement of White Pimple Metal Roasted respectively in Basic- and Sand-Lined Furnaces.

——	Basic-Lined Furnaces.	Sand-Lined Furnaces.
	t. c. q.	t. c. q.
White pimple metal used during two weeks ending October 14th, 1889.....	87 0 0	87 0 0
Average analysis 76·46 per cent. copper, and 1·68 per cent. As		
11 charges made, average per charge ..	7 18 0	7 18 0
Blister copper produced from same	59 6 0	38 10 0
Average produce per charge.....	5 7 3	3 10 0
Average per cent. arsenic, 0·85 per cent.		
Slag made from above charges.....	11 17 2	41 7 0
Average weight per charge	1 1 1	3 15 0
Average per cent. copper contents.....	25 per cent.	55 per cent.
Time required per charge, including fettling, charging, &c.	16 hours	16 hours

Calculating from the above figures, we find that of the real copper charged, 87 per cent. is obtained from the basic furnace, and 57 per cent. from the acid furnace in the form of blister, showing a gain of 30 per cent. in favour of the basic furnace. Of the real copper charged, 1·13 per cent. is found in the basic slag and 31·1 per cent. in the acid slag.

Still another comparative series gave per 100 tons of white metal charged 77 tons real copper, 42 tons from acid furnace and 62 tons from basic of copper as blister, showing per 100 parts of real copper charged a gain of 26 per cent. in favour of the basic.

It should be stated that, owing to the arsenic remaining in the bath when the blister arrives at blister pitch, the copper cannot be at once tapped, as is usual in cases where low arsenical stuff is worked, but it has to remain in the furnace until a test shows the arsenic in the blister to be below 1 per cent. With 10-ton charges in acid-lined furnace this takes on an average nine hours after the bath has become blister. In the basic-lined furnace six hours is found sufficient.

Samples taken from the bath of an acid and basic roaster furnace just as they came blister gave the following results:—

——	Basic Furnace.	Acid Furnace.
	Per Cent.	Per Cent.
As in pimple metal charged	2·16	1·71
As remaining in bath at blister	2·22	3·13
As in copper tapped	0·78	0·90
Hours in furnace after becoming blister..	6½	10

The increase of arsenic at blister pitch in the acid furnace shown in the above analysis is, however, probably exceptional.

The following table, giving full details of weights, &c. of six charges of white metal made in a basic roaster and six made in a sand-lined roaster. The following are the analyses by Mr. E. Riley of the metal charged, the blister obtained, and the slag produced from these charges. Samples of each charge and slag were taken, and the samples afterwards mixed as shown below, so as to get for the analysis the average of the six both for the basic and the acid.

Average Analysis of Six White Metal Charges worked in	Basic Furnace.	Acid Furnace.
	Per Cent.	Per Cent.
Copper	75·56	76·10
Tin.....	Not determined.	Not determined.
Silver.....	Do.	Do.
Iron	1·54	1·30
Lead	1·25	1·20
Arsenic	·47	·51
Sulphur	17·44	17·80
Oxygen loss, &c.	1·90	1·57
Nickel and cobalt	·25	·18
Phosphorus.....	Trace	Trace
Silica.....	·50	·35
Alumina.....	·50	·38
Lime	·42	·45
Magnesia.....	·17	·16
	100·00	101·00

Average Analysis of the Blister Copper tapped from the	Basic Furnace.	Acid Furnace.
	Per Cent.	Per Cent.
Copper	97·780	98·275
Tin.....	·039	Nil.
Silver.....	·024	·033
Iron.....	·026	·019
Bismuth.....	·033	·035
Lead	·008	·013
Arsenic.....	·596	·580
Antimony	·047	·028
Sulphur	·031	·012
Oxygen and loss, &c.	1·415	1·005
	100·000	100·000

Experimental Charges, March 1890.

No. 3 Furnace, Basic Lining.

	Charge.		Product.				
—	White Metal.	Blister Copper.	Slag.	1st Charge.	2nd Charge.	3rd Charge.	Time taken.
	t. c. q. lb.	t. c. q. lb.		t. c. q. lb.	t. c. q. lb.	t. c. q. lb.	
1st Charge	10 10 0 26	7 16 3 10	1st skim	1. 0 5 2 8	1. 0 4 0 0	1. 0 7 0 12	47 hours.
2nd Charge....	10 11 0 26	6 11 3 18	2nd skim	0 4 0 24	0 5 3 20	0 5 0 0	62 hours.
3rd charge	10 10 0 8	6 4 3 2	3rd skim	2. 0 2 2 0	0 1 3 12	2. 0 3 0 0	42 hours.
			4th skim	0 6 1 0	2. 0 2 1 12	3. 0 16 0 4	
			5th skim	0 8 3 24	0 10 3 24	0 7 1 16	
			6th skim	3. 0 13 1 12	3. 0 6 0 0	4. 0 17 2 0	
			7th skim	0 16 3 12	0 11 3 12	.. ..	
			8th skim	4. 0 9 0 0	4. 0 8 2 16	.. ..	
Total	31 11 2 4	20 13 2 2	.. ..	3 6 2 24	2 11 2 12	2 10 0 4	Average 50 hours.

No. 4 Furnace, Acid Hearth.

	Charge.		Product.				
—	White Metal.	Blister Copper.	Slag.	1st Charge.	2nd Charge.	3rd Charge.	Time taken.
	t. c. q. lb.	t. c. q. lb.		t. c. q. lb.	t. c. q. lb.	t. c. q. lb.	
1st charge.....	10 10 0 12	4 8 3 26	1st skim	0 12 0 0	1 3 2 20	0 8 0 20	44 hours.
2nd charge....	10 10 1 22	3 14 1 12	2nd skim	1. 0 4 3 12	0 1 2 4	0 9 1 12	50 hours.
3rd charge	10 11 2 6	5 1 0 12	3rd skim	0 8 2 4	0 5 2 8	0 12 3 4	44 hours.
			4th skim	0 8 2 12	0 5 1 20	0 11 0 20	
			5th skim	2. 0 9 2 24	0 5 1 12	0 6 2 24	
			6th skim	0 9 3 0	0 7 3 16	0 9 0 8	
			7th skim	0 8 3 12	0 16 1 16	0 9 1 0	
			8th skim	3. 0 16 2 6	0 5 0 0	0 6 1 12	
			9th skim	0 10 3 20	0 13 1 0	0 6 0 12	
			10th skim	1 2 3 12	0 12 0 24	0 8 3 20	
			11th skim	.. ..	1 2 0 8	0 18 3 20	
Total	31 12 0 12	13 4 1 22	.. ..	5 12 2 18	5 18 1 16	5 6 3 12	Average 46 hours.

Experimental Charge, April 1890.

No. 3 Furnace, Basic Lining.

	Charge.		Product.					
—	White Metal.	Blister Copper.	Slag.	1st Charge.	2nd Charge.	3rd Charge.	Time taken.	Remarks.
	t. c. q. lb.	t. c. q. lb.		t. c. q. lb.	t. c. q. lb.	t. c. q. lb.		
1st charge	10 10 3 16	6 10 1 18	1st skim	0 6 3 24	0 4 1 0	0 7 0 0	57 hours	..
2nd charge	10 10 1 2	8 19 2 16	2nd skim	1. 0 2 2 20	1. 0 2 3 0	1. 0 2 2 0	66 hours	Repairs.
3rd charge	10 10 2 2	4 8 0 26	3rd skim	2. 0 2 1 12	0 3 1 12	2. 0 4 2 12	54 hours	Bad tap-hole, not tapped dry.
			4th skim	3. 0 7 2 16	2. 0 3 11 20	0 8 0 20		
			5th skim	0 7 0 8	0 6 2 24	3. 0 9 3 44		
			6th skim	4. 0 7 1 20	3. 0 5 3 2	0 10 0 8		
			7th skim	.. ..	0 4 2 24	4. 0 8 2 8		
			8th skim	.. ..	4. 0 7 0 0	.. ..		
Total ...	31 11 2 20	19 18 1 4	.. ..	1 14 0 16	1 17 3 26	2 10 2 24	Average 59 hours	

No. 4 Furnace, Acid Hearth.

Charge.			Product.				
—	White Metal.	Blister Copper.	Slag.	1st Charge.	2nd Charge.	3rd Charge.	Time taken.
	t. c. q. lb.	t. c. q. lb.		t. c. q. lb.	t. c. q. lb.	t. c. qr. lb.	
1st charge	10 16 1 6	4 9 1 22	1st skim	1 0 0 10	0 10 2 16	0 6 1 0	43 hours.
2nd charge....	10 10 2 12	5 5 0 0	2nd skim	1. 0 11 1 12	1. 0 7 1 12	1. 0 8 1 8	52 hours.
3rd charge	11 11 2 22	4 19 1 10	3rd skim	0 13 0 12	0 11 0 12	0 2 3 0	48 hours.
			4th skim	2. 0 14 3 4	0 8 0 8	0 1 0 4	
			5th skim	0 12 3 16	2. 0 6 2 20	2. 0 7 2 0	
			6th skim	3. 0 11 0 16	0 7 2 12	0 10 2 0	
			7th skim	4. 0 19 0 8	0 9 1 16	3. 0 5 1 12	
			8th skim	.. ..	3. 0 7 3 8	0 9 2 20	
			9th skim	.. ..	0 14 2 24	0 11 1 14	
			10th skim	.. ..	0 9 0 20	4. 0 14 1 12	
			11th skim	.. ..	4. 0 8 3 16	0 3 2 0	
			12th skim	.. ..	0 14 2 12	.. ..	
Total	31 12 2 12	14 13 3 4	.. ..	5 2 1 22	5 16 0 8	4 0 2 14	Average 48 hours.

The various slag samples from these six basic and six acid charges were mixed into two lots in each case, as the slags drawn off towards the end of the process are, as is well known, considerably richer than those at first drawn off :—

Particulars.	Slags from Basic Furnace.		Slags from Acid Furnace.	
	Skimmings 1 to 4.	Skimmings 5 to 8.	Skimmings 1 to 3.	Skimmings 4 to 12.
	Per Cent.	Per Cent.	Per Cent.	Per Cent.
Silica.....	14·22	11·90	22·72	10·55
Ferric oxide	16·33	3·25	8·23	1·30
Alumina.....	1·34	0·70	1·64	0·40
Suboxide of copper	30·14	42 24	46·71	76·25
Oxide of lead	1·71	1·69	7·86	3·25
Oxides of Ni and Co.	1·70	0·92	1·38	0·82
Lime	16·72	17·73	3·10	1·05
Magnesia	3·12	5·00	0·46	0·50
Phosphoric acid	Trace	Trace	Trace	Trace
Arsenic acid	4·89	12·97	5·24	6·50
Sulphuric acid.....	9·40	0·45	3·00	Trace
Moisture	Trace	Trace	Trace	Trace
	99·57	99·85	100·34	100·62

As the total weight of the slags drawn from the six basic charges is only 14 tons 11 cwt., against 31 tons 17 cwt. from the six acid charges, and as the copper content of the basic slags is, as shown above, less than the acid, it follows, as the yields prove, that the oxidation in the case of the basic furnace is very much less than in the acid furnace, that is a gain in blister of 26 per cent. per 100 parts of real copper charged.

Another white metal charge in the basic roaster, of which the various slags drawn were separately analysed, is as follows :—

Charged Tuesday, 5th November 1889, at 3.30 p.m.
7 tons metal, 77·2 per cent. Cu, ·99 per cent. As.
2 cwt. lime thrown on top.

Clear off bottom at midnight, 9 hours.

		c. q. lb.	
12.15 a.m.	1st skimming	7 1 12	.. ..
5.30 a.m.	2nd skimming	4 3 13	.. ..
11.0 p.m.	3rd skimming	1 1 16	.. ..
3.0 a.m.	4th skimming	6 1 10	Now blister
6.0 a.m.	5th skimming	5 1 0	1·14 % As
9.30 a.m.	6th skimming	5 2 4	1·14
10.0 a.m.	.. ..	.. ..	·85
10.30 a.m.	Tapped	.. ..	·82
		30 2 27	

	t. c. q. lb.
Produce of blister	6 4 0 8
Produce of slag.....	1 10 2 27
Lime used.....	0 2 0 0

Good heat kept on furnace throughout the charge.

The analyses of these six skimmings are as follows :—

—	1.	2.	3.	4.	5.	6.
Silica	3·61	3·20	4·13	7·50	7·14	6·97
Lime	15·82	15·26	6·80	22·34	14·77	19·97
Ferrous oxide.....	7·42	3·42	4·72	3·12	3·37	2·00
Cuprous sulphide...	54·60	51·35	62·50	16·20	3·20	1·50
Cuprous oxide	5·83	5·30	12·87	21·61	32·69	28·72
Arsenic acid	5·70	5·80	1·70	15·07	22·14	29·05
Lead oxide.....	2·60	2·20	3·11	3·00	6·22	3·20
Total	95·48	86·53	95·83	88·81	83·83	91·41

As regards the removal of antimony in the basic-lined roaster furnace, another firm found as the result of working up in a basic roaster a considerable amount of arsenical stuff, that simultaneously with the removal of 84 per cent. of the arsenic present, they removed also 87 per cent. of the antimony contained in the charge.

For the purpose of testing whether any material chemical difference existed between the blister produced in the basic-lined roaster furnace and that produced in the ordinary sand lining, charges of blister (1) from a basic roaster, and (2) from an acid roaster, were separately refined in the ordinary sand-lined refinery; the following analyses show the results obtained in each case. It will be seen that there is no practical difference between the refined copper produced from the basic blister and that produced from the acid blister when an acid-lined refinery was used.

COPPER AND COPPER SLAG ANALYSIS MADE BY T. W. WESTMORELAND, LEEDS.

Particulars.	Copper.			
	Blister from Basic Roaster charged into No. 4 Acid Refinery. 23 April 1890.	Refined from Basic Blister charge No. 4 Acid Refinery. 25 April 1890.	Blister from Acid Roaster charged into No. 4 Refinery. 29 April 1890.	Refined from Acid Blister No. 4 Refinery. 30 April 1890.
Copper	Per Cent. 98·25	Per Cent. 99·40	Per Cent. 98·50	Per Cent 99·30
Arsenic	·72	·315	·68	·43
Antimony...	·08	·02	·029	·01
Phosphorus.	·014	·007	·003	Trace
Lead	·02	Trace	Nil	Nil
Bismuth	Trace	Trace	Nil	Nil
Iron	·035	·021	·023	·019
Nickel.....	·049	·026	·018	·015
Sulphur.....	Trace	Trace	Nil	Nil
Silver.....	·024	·024	·030	·028
	99·192	99·813	99·283	99·802

	Slags drawn from Acid Refinery.		
	From Basic Blister charged into No. 4 Acid Refinery. 23 April 1890.		From Acid Charge No. 4 Refinery. 30 April 1890.
	Averages No. 1 to Nos. 7 to 9.		
	6 Skimmings.	Skimmings.	Average of 7 Skimmings.
Suboxide of copper (Cu_2O) :—	Per Cent.	Per Cent.	Per Cent.
Copper	61·00	63·02	62·07
Oxygen	7·68	7·93	7·82
Oxide of lead ...	(Pb ·58) ·62	(Pb ·45) ·49	Trace
Silica	20·31	19·33	20·12
Alumina	·63	·64	·68
Peroxide of iron.	(Fe 1·97) 2·82	(Fe1·036)1·48	(Fe 1·59) 2·27
Oxide of manganese.	Trace	Trace	..
Oxide of zinc....	Nil	Nil	..
Lime	3·01	4·05	4·15
Oxide of nickel .	·36	·25	·16
Magnesia.....	·39	·57	·20
Sulphuric acid..	(S ·04) ·11	(S ·03) ·07	(SO_3) ·07
Arsenic acid	(As 1·1) 1·68	(As 1·17) 1·79	(As 1·09) 1·67
Tetroxide of antimony.	(Sb ·27) ·35	(Sb ·08) ·105	(Sb ·15) ·20
Phosphoric acid.	·21	·12	(P ·03) ·08
Oxide of bismuth	..	..	Trace
	99·17	99·645	99·49

THE BASIC LINING APPLIED TO COPPER REFINING.

After carefully investigating the results obtained from the substitution of a basic lining in the roaster furnace for the ordinary sand lining, it was resolved to test whether any substantial improvement resulted from a similar change in the refinery furnace.

The margin for improvement in the case of the refinery furnace is far less than in the case of the roaster furnace process; it is therefore still a little uncertain whether the extra cost of the initial basic lining and of the current repairs are compensated for by the slightly increased yield, when making ordinary tough cake. When, however, it is a question, not of making ordinary tough cake, but of producing best selected copper from ordinary arsenical blister (containing about 1 per cent. of arsenic) there is in the author's opinion a very great saving in waste effected by the use of a basic lining in the refining furnace.

The basic refinery has so far been used chiefly for the production of best selected copper from B.S. precipitate only, or from pure blister containing only some ·2 to ·3 per cent. of arsenic, but some charges have recently been made from blister containing 1 per cent. As, which have been worked down into B.S. ingots with very good results as regards yield, but as might naturally be expected longer time is required. The following is an example of the results obtained when producing B.S. ingots from rich precipitate.

CHARGE A.

	t.	c.	q.	lb.
Charged in rich precipitate	12	13	0	2
„ scrap copper	0	5	0	17
Products:—				
B.S. ingots	9	2	1	22
Scrap and moulds.....	0	18	1	23
Slags, 1st skimming	0	10	0	14
„ 2nd „	0	6	2	18
„ 3rd „	0	6	0	12
„ 4th „	0	8	0	6

The precipitate charged contained 7·7 per cent. of moisture and there was used during the charge 3 cwt. of lime and 2 cwt. of soda ash.

CHARGE B.

The analyses and weights of another charge of good precipitate worked down into B.S. ingots may here be quoted, the analyses in this case being by Mr. Stead of Middlesbro'.

The furnace was charged with 10 tons 2 cwt. 1 qr. of copper precipitate of the following composition, the sample being dried at 212°.

Copper	88·83
Iron.....	0·63
Arsenic.....	0·15
Antimony	0·01
Tin.....	0·01
Lead	0·03
Bismuth.....	0·05
Sand	1·12
Graphite	0·55
Sulphur	0·06
Phosphoric Acid.....	0·46
Combined Water	0·88
Oxygen combined	7·15
	100·02
Moisture	7·31

The B.S. ingots produced from the above precipitato gave:—

Copper	99·83
Iron.....	0·02
Nickel.....	Trace
Zinc.....	Trace
Lead	Trace
Bismuth.....	0·03
Antimony.....	Trace
Tin.....	Trace
Arsenic.....	0·068
	99·948

The slags drawn were separately sampled and mixed in proportion to the weights drawn, so that the following is the average analysis :—

	Per Cent.
Suboxide of copper	61·36
Oxide of copper	2·74
Lime	6·82
Soda	1·51
Magnesia	2·80
Oxide of manganese	0·14
Protoxide of iron	1·90
Alumina	2·12
Oxide of zinc	0·04
Oxide of bismuth	0·07
Oxide of lead	Trace
Oxide of tin	0·03
Oxide of antimony	0·06
Silica	8·25
Phosphoric acid	1·83
Sulphur	0·17
Carbonic acid	1·28
Arsenious acid	2·30
	99·51
Copper	56·64

Charge C.

Another precipitate charge, in which the material charged in and refined copper produced were fully analysed by Mr. Riley, gave the following results.

Precipitate charged :—

Metallic copper	89·88
„ iron	1·14
„ lead	0·03
„ bismuth	0·04
Oxygen	5·51
Arsenic	0·26
Phosphorus	0·28
Silica	1·10
Combined water	1·25
Graphitic carbon	Trace
Antimony	Nil
	99·79

The B.S. ingots produced from the above precipitate had the following composition :—

Copper	99·895
Tin	Nil
Silver	Trace
Bismuth	·015
Antimony	Nil
Arsenic	Nil
Lead	·022
Iron	·029
	99·961

The analysis of the slag from above charge gave :—

Silica	15·05
Suboxide of copper	25·72
Oxide of iron	18·09
Oxide of lead	·24
Alumina	7·05
Oxide of manganese	·68
Lime	19·65
Magnesia	6·35
Arsenic acid	1·55
Phosphoric acid	1·00
Sulphur	·19
Combined water	·85
	99·38
Metallic copper per cent.	22·84

Charge D.

As an example of the results obtainable from the basic refinery when making ordinary tough cake from fairly arsenical blister, the following analyses were made by Mr. Westmoreland. The details of the charge were as follows :—

The charge consisted of 15 tons 9 cwt. 3 qrs. of blister of the following composition :—

	Per Cent.
Copper	98·150
Arsenic	·770
Antimony	·067
Iron	·078
Nickel	·029
Sulphur	·005
Phosphorus	Trace
Bismuth	·025
Lead	·011
Silver	·008
	99·143

The tough cake laded contained :—

Copper	98·870
Arsenic	·710
Antimony	·075
Iron	·059
Nickel	·026
Sulphur	·004
Phosphorus	Traces
Bismuth	·027
Lead	·023
Silver	·069
	99·863

The furnace was not wholly emptied, only some 12 tons being laded out, but the slag was weighed and carefully sampled so that the amount of copper oxidised in the slag is easily got at. The total slag weighed 1 ton 5 cwt. 3 qrs., and had the following average composition :—

Sample dried at 212° F.

Copper	38·15	
Oxygen	4·80	
Oxide of lead	1·91	= 1·80 % Pb
Oxide of bismuth	·04	
Arsenic acid	2·60	= As 1·70
Oxide of antimony	·22	= Sb ·17
Silica	29·84	
Peroxide of iron	3·21	
Alumina	2·03	
Oxide of manganese	·15	
Oxide of nickel	·22	
Lime	12·69	
Magnesia	3·00	
Sulphuric acid	·17	
Phosphoric acid	Traces	
	99·06	

Calculating from the above figures we find that the total real copper which passed into the slag was in this case 9·8 cwt., or per 100 parts real copper charged, 3·2 parts passed into the slag. A similar charge in an acid-lined furnace gave per 100 parts of real copper charged into the furnace 5·1 parts of copper in the slag.

Charge E.

Another B.S. charge which was made from blister containing rather a high percentage of arsenic, is given below.

The charge consisted of :—

	Tn.	cwt.	qr.	lb.
Blister	8	13	2	25

and 1 cwt. of lime and 3 cwt. of soda ash were used in working down the charge.

The charge was in the furnace for 48 hours, and was laded in the form of B.S. ingots. The products were :—

	Tn.	cwt.	qr.	lb.
Best select ingots	7	18	0	7
Total slag	2	7	1	17

The analyses by Mr. Westmoreland of the blister charged and refined copper obtained are as follows :—

	Blister charged.	Refined Copper.
Copper	96·420	99·940
Arsenic	1·050	·020
Antimony	·020	·007
Iron	·155	·050
Nickel	·023	·004
Sulphur	·017	Nil
Phosphorus	Traces	Traces
Bismuth	·020	·022
Lead	·013	·011
Silver	·009	·011
Insoluble silicious matter	1·570	..
	99·327	100·065

The different skimmings of slag were separately sampled and then mixed in proportion of the weight of each separate skimming, so that the following is an average analysis of the slag :—

Cu_2O :		
Copper	22·53	
Oxygen	2·83	Per Cent.
Oxide of lead	0·60	= Pb 0·56
Oxide of bismuth	0·05	
Arsenic acid	5·15	= As 3·36
Tetroxide of antimony	0·20	= Sb 0·14
Silica	24·18	
Peroxide of iron	6·70	= Fe 4·69
Alumina	2·90	
Oxide of manganese	0·30	
Oxide of nickel	0·13	
Lime	17·82	
Magnesia	8·75	
Sulphuric acid	0·58	(SO_3)
Phosphoric acid	0·13	(P_2O_5)
Carbonic acid	1·24	(CO_2)
Combined water	0·73	
Soda calculated as Na_2O	5·33	
	100·15	

By calculation from the above figures we arrive at the result that from 100 parts of real copper charged, 94 parts were obtained in the form of B.S. ingots and 6 parts passed into the slag.

Charges F. and G.

As the working down of blister rather high in As into B.S. ingots is considered by the author as of considerable importance, the details of two other charges worked in the basic refinery are given :—

	Charge 259.	Charge 265.
	Tn. cwt. qr. lb.	Tn. cwt. qr. lb.
Blister charged	7 17 0 6	9 3 0 21
B.S. ingots laded	6 18 2 0	7 12 1 21
Scrap and moulds	..	1 7 1 17
Total slag drawn	2 4 2 2	3 3 0 8

The analyses of these charges by Mr. Stead gave :—

	Blister charged.	
Copper	97·50	97·77
Iron	0·05	0·04
Arsenic	1·95	1·52
Antimony	0·02	0·02
Tin	0·02	0·02
Lead	0·01	0·01
Zinc	0·02	0·02
Bismuth	0·05	0·06
Sand	0·20	0·21
Sulphur	0·06	0·07
	99·88	99·74

The B.S. ingots produced had the following composition :—

Copper	99·86	99·89
Iron	0·02	Trace
Nickel	Trace	Trace
Zinc	Trace	Trace
Lead	Trace	Trace
Bismuth	0·03	0·02
Antimony	Trace	Trace
Tin	Trace	Trace
Arsenic	·062	0·05
	99·972	99·96

Mr. Stead informs me that by "Trace" in the above analyses he means under ·01 per cent.

An average analysis of the slags drawn from the above charges, each skimming being sampled and mixed in proportion to the weight, gave :—

	Charge 259.	Charge 265.
	Per Cent.	Per Cent.
Suboxide of copper	48·42	33·22
Oxide of copper	7·77 –	6·12
Lime	10·65 –	16·32
Soda	5·04 –	4·77
Magnesia	3·17 –	5·81
Oxide of manganese	0·18 –	0·14
Protoxide of iron	5·04 –	4·05
Alumina	2·82 –	6·97
Oxide of zinc	0·04 –	Trace
Oxide of bismuth	0·07	0·10
Oxide of lead	Trace	Trace
Oxide of tin	0·02	0·02
Oxide of antimony	0·06	0·05
Silica	10·90	16·85
Phosphoric acid	0·35	0·53
Sulphur	0·18	0·19
Carbonic acid	1·90	1·56
Arsenic	2·25	2·47
Oxygen, &c. by difference	1·14	0·83
	100·00	100·00
Copper	49·16	34·67

From the analyses of the blister, and from the weight and copper percentage of the slags drawn, it is found that from 100 parts of real copper charged, 14 parts went into the

slags in charge 259 and 12 parts in charge 263. These high percentages being due to the large amount of arsenic which had to be removed.

From the above example it will be seen that, although the increase of yield when producing tough cake is not so considerable in the refinery furnace as the gain in the roaster furnace is, yet that there is without doubt a considerably lessened amount of oxidation when the refinery is furnished with a basic lining, which is the more apparent the higher the blister charged is in arsenic and the lower the produce laded is required to be, that is, the more the impurities that have to be eliminated by oxidation the greater the saving of copper when using basic linings in the refinery.

Although from the results given, and from a vast number of others which space does not permit of detailing, there is no question about the increase of yield resulting from the lessened oxidation when using basic linings; yet experience has shown that acid-lined furnaces will get rid of impurities as completely as the basic furnaces do, if one does not mind the amount of copper that has to be slagged in so doing. But if one stops each furnace when a similar amount of copper has been wasted in each, it will be found that the purification of the acid charge is very much less complete than in the basic charge.

In order to test what effect a basic lining has on the elimination of antimony and bismuth as compared with their elimination in acid-lined furnaces, a series of charges were made, starting with crude metallic bottoms, which were first worked through the basic- and acid-lined roaster furnaces, the blister obtained from the basic roaster charges refined in a basic-lined refinery, and that from the acid roaster charges in an acid-lined refinery. By this method of procedure it was expected that any difference in the rate of elimination of these and other elements would be magnified by the passage of the material through the two furnaces. The analyses of the bottoms charged in the acid and basic roaster furnaces respectively were as follows, the analyses being made by Mr. Westmoreland: —

	Bottoms charged into	
	Acid Roaster.	Basic Roaster.
Copper	92·32	92·70
Sulphur	·95	1·02
Lead	·92	·97
Bismuth	·062	·06
Arsenic	5·09	4·18
Antimony	·27	·26
Phosphorus	·055	·055
Iron	·024	·028
Nickel and cobalt	·116	·084
Silver	·021	·021
	99·828	99·378

The blister produced from the roaster charges when treating the metallic bottoms of the composition given above contained:—

	Blister produced from	
	Acid Roasters.	Basic Roasters.
Copper	98·46	98·37
Sulphur	·004	·017
Lead	·018	·046
Bismuth	·037	·04
Arsenic	·84	·97
Antimony	Trace	·063
Phosphorus	·060	·042
Iron	·022	·039
Nickel and cobalt	Trace	·025
Silver	·021	·026
	99·828	99·638

The slag produced during the conversion of the metallic bottoms into blister had the following composition, the samples analysed being a mixture from each skimming mixed in proportion of the weight of each slag drawn:—

	Sample of Slag drawn from	
	Acid Roaster.	Basic Roaster.
Cu_2O, Copper	57·41	37·17
Oxygen	7·23	4·68
Oxide of lead	2·03 = Pb 1·88	3·90 = Pb 3·62 %
Oxide of bismuth	·14	·11
Arsenic acid	7·66 = As 5·00	15·65 = As 10·21 %
Tetroxide of antimony	·47 = Sb ·37	·70 = Sb ·55 %
Silica	18·14	15·26
Peroxide of iron	3·48 = Fe 2·43	7·59 = Fe 5·31 %
Alumina	·63	1·01
Oxides of nickel and cobalt	·33	·65
Oxide of manganese	Trace	·05
Lime	2·31	9·49
Magnesia	·31	3·47
Sulphur	·37	·48
Phosphoric acid	·19	·29
	100·73	100·43

Free sulphur separated on treating the slag with nitric acid, sp. gr. 1·42.

The charge put into the refinery consisted of the above blister with a certain amount of scrap copper to make up the weight. The composition of the two charges was:—

	Acid Refinery.	Basic Refinery
Copper	98·65	98·71
Arsenic	·825	·93
Antimony	·012	·019
Phosphorus	·005	·014
Lead	·015	·030
Bismuth	·041	·082
Iron	·014	·016
Nickel	·013	·031
Sulphur	·007	·019
Silver	·020	·017
	99·602	99·868

The refined copper produced from the above charge had the following composition:—

	Acid Refinery.	Basic Refinery.
Copper	98·98	98·91
Sulphur	·003	·007
Lead	·013	·030
Bismuth	·003	·073
Arsenic	·72	·72
Antimony	Trace	·023
Phosphorus	·005	·011
Iron	·014	·014
Nickel and cobalt	Trace	·015
Silver	·026	·026
	99·764	99·820

The slag produced in each case was as follows :—

	Slag drawn from	
	Acid Refinery.	Basic Refinery.
Cu_2O. Copper.....	68·50	44·12
Oxygen	8·63	5·55
Oxide of lead	·23 = Pb ·20	·44 = Pb ·39
Oxide of bismuth ...	·08 = Bi ·07	·06 = Bi ·06
Arsenic acid	2·05 = As 1·34	2·36 = As 1·54
Tetroxide of antimony	·02	·16 = Sb ·12
Silica.....	16·83	27·12
Peroxide of iron.....	1·24 = Fe ·87	2·14 = Fe 1·50
Alumina	·39	1·34
Oxides of nickel and cobalt	·09	·14
Oxide of manganese.	Trace	·07
Lime	1·03	10·40
Magnesia.....	·16	4·95
Sulphuric acid (SO_3)	·08	·11
Phosphoric acid.....	·16	·18
	99·49	99·14

It will be seen from the above figures that the acid-lined furnaces have removed the antimony and bismuth more completely than the basic furnaces. This is doubtless due to the thicker more calcareous slags formed in the basic furnaces which prevent the oxidation of the antimony and bismuth more than the thinner cupriferous slags in the acid furnaces do.

For the acid roaster charges 28 tons of metallic bottoms were treated. These gave from the roaster charges 15 tons 8 cwt. 2 qrs. of slag. For the basic roaster charges 20 tons of metallic bottoms were treated ; these gave 5 tons 16 cwt. of slag. From the analyses given above of these slags it may be seen that the real copper slagged was very considerably less in the basic charges than in the acid ones, the actual figures being 34·2 per cent. slagged in the acid roasters, and 11·6 per cent. slagged in the basic roasters.

Summing up, therefore, the results so far obtained in basic copper smelting, it would seem that where the basic process has shown itself to be of most use is in the treatment of highly arsenical material tapped from the smelting furnaces. Such material, being produced from the poorer arsenical precipitates, generally gives a great deal of trouble in the ordinary way of working, with a very high loss of copper in the slags, which necessitates extra labour and expense to rework.

Another very important point to which the basic process shows itself well adapted is in the refining of blister rather high in arsenic (say from 1 to 1½ per cent. or higher) for the purpose of making B.S. ingots.

The action of arsenic upon copper is not, in the author's opinion, altogether similar to the action of phosphorus upon iron. In the case of copper, arsenic up to something like 7 parts in a thousand rather promotes malleability and the expulsion or absorption of oxygen in both basic- and acid-lined furnaces. This cannot be said to anything like the same extent of phosphorus in a basic-lined furnace, and cannot be said at all when speaking of the action of phosphorus upon iron in acid-lined furnaces.

The above statement is illustrated by the fact that good tough cake may (and probably ought to) contain ·5 per cent. of arsenic.

The author knows of no steel or wrought iron that is of any commercial use at all that contains anything like this percentage of phosphorus.

The author would remark, finally, that the results that he gives this evening are to be considered merely as sufficient to encourage copper smelters to obtain infinitely better results.

In conclusion, the author wishes to place upon record his indebtedness to the various companies as represented by their directors and officials who have with so much enterprise and skill employed the basic process in the manufacture of copper. To a former assistant of his, Mr. Joseph Cooper of Middlesbro', he is also indebted for his untiring zeal and for the great ability that he showed when superintending the putting in of the first basic lining to a coal-fired copper roaster, and when superintending the working of this and other similar furnaces. To his valued assistant and friend, Mr. Thomas Twynam, he is also deeply indebted for supervising the working of the basic roasters and refinery furnaces, and for the valuable assistance that he has rendered in the compilation of this paper.

Discussion.

The Chairman complimented the Section on having the paper brought before it, and considered that the author had fully made out his case, viz., the superiority of a basic lining in the refining of copper.

Prof. W. C. Roberts-Austen said that it was very difficult for those who were not actually engaged in copper smelting to realise how bitter an enemy to the smelter small quantities of impurity could really be, and it was still more difficult, perhaps, for those who had not made the relations of "traces" of impurity to masses of metal a special study to understand how important, and at the same time how hard it was, to get rid of small traces of impurities. Speaking from the point of view of the Mint, he might observe that even so small a quantity as one-tenth per cent. of bismuth in copper would render it impossible to use that copper for coinage purposes when added to gold. Arsenic was not quite so bad; but a very small proportion of it would in the same way render copper wholly unfit for coinage purposes when added to gold. Again, arsenic exerted a remarkable influence in increasing the electrical resistance of copper, and it was well known that the copper used for the electric wires of the present day would carry double the number of messages that could be carried by the old wires made in the days when the necessity for the purification of the copper was not so well understood. That alone showed the great importance of eliminating the impurities. But with the old acid-lined furnaces it was extremely difficult to get rid of the arsenic without basic additions to the charge or without much loss of copper, and it was also difficult to dissociate by heat the arsenical compounds which were formed. He would like to ask the author whether he thought that, in the case of the Manhés process (where the acid lining of the converter played so important a part in the reactions), the substitution of a basic lining at any stage of the process would afford anything like the service which it had been shown to render in the metallurgy of iron. Mr. Gilchrist had incidentally referred to the belief that the "nature," or what should be called the molecular structure of the metal, was of much importance in the case of both iron and copper. Prof. Austen regarded the molecular grouping of a metal as being of the greatest importance. It had been proved in the case of iron that there was an α and a β form of the metal, each with distinct properties of its own. He believed that it would be found that copper was in a similar case, and that a very minute quantity of foreign matter might be able to change the normal form into the allotropic. He had had very little actual experience of copper smelting, but he fully appreciated its difficulties, and it was most unusual for anyone who, like Mr. Gilchrist, had won his laurels in connexion with one particular metal, to come forward again and distinguish himself in connexion with another and very different metal.

Mr. David Howard inquired whether the furnaces with the basic lining were worked in all respects the same as with the acid lining, or whether a different flux was used in each case.

Dr. B. Mouat said he did not think that the converter so far had been successful for copper smelting. When used for concentrating copper ores or matte, by slagging off the iron in form of a silicate, the large amount of slag so formed greatly interfered with the operation. When treating white metal or blister copper in an acid-lined converter with the view of removing arsenic and other impurities, the rapid oxidation of the copper under a high pressure blast would cause an excessive quantity of copper to be converted into silicate or slag. Here better results might be expected from a basic-lined converter. The removal of arsenic, however, had been successfully carried out in a basic-lined reverberatory furnace which had the advantage of being much simpler and more economical in its working.

Mr. Bertram Blount said that as an analyst he was accustomed to see specifications, drawn by engineers experienced in copper, for such things as locomotive firebox plates, and in such specifications different percentages of impurities were put down as the maximum limit to be permitted. A very common maximum for arsenic was 0·15 per cent. The engineers who drew those specifications—and, presumably, their chemical advisers also—had arrived at the opinion that that percentage was the maximum allowable; but their reasons for doing so were not evident. He knew that work had been done in the past on the determination of arsenic and other impurities in copper; but it was difficult to find anything like an adequate account of the possible ill effects of that body on the metal. Would Mr. Gilchrist be inclined to fix for refined copper, such as was used for firebox plates, a definite maximum of impurities which should not be exceeded, and would he as an analyst condemn without hope of appeal copper which exceeded that limit? Also would he consider that such limit might be altered by the contemporaneous presence of other impurities in the copper? Until some such information were available, analysts could, it was true, determine the precise percentage of arsenic and similar impurities, but were unable definitely to advise their clients when that percentage so far exceeded the maximum permissible as to unequivocally condemn the copper.

Mr. W. Gowland regarded the paper as one of the most valuable contributions to the literature of the subject published since Dr. Percy's great work. Mr. Gilchrist's results might be accepted as correct; and, as far as works were concerned, the process was likely to be successful on a commercial scale.

Dr. W. S. Squire said that he had been attracted to the meeting by curiosity excited by the title of the paper. His curiosity was aroused by the fact that the process of copper smelting was well known to be an acid process from beginning to end. As the members were no doubt aware, the object of smelting copper was, first, to convert the sulphides of iron into oxide, and dissolve them out by means of silica as a slag. Having got rid of a certain quantity of the iron in that way, the ore was roasted again, and again smelted with silica, and so became richer in copper. In fact, silicic acid was used just as hydrochloric acid was used in other processes, to dissolve out impurities. Yet he gathered that the basic process might be applied to refining copper. He joined Professor Roberts-Austen in congratulating Mr. Gilchrist on having dealt successfully with two different metals, and both by the basic process. But it appeared to him that just as the basic process was applied not to the smelting of iron but rather to its refining, in the process of making steel, so in the present case it was applied to the refining of copper, and not to its smelting, the arsenic being removed from the copper much in the same way that the phosphorus was eliminated in the steel process.

Mr. J. Smith, who said that he had come from St. Helens expressly to hear Mr. Gilchrist read his paper, wished to express his sympathy with the gentleman who had spoken about engineers tying copper producers down in their specifications to certain percentages of impurities. They had as a rule to give guarantees that their product should consist of 99·5 of copper and ·5 of impurities, and of that ·5 not more than ·15 should be arsenic. The remaining 3·5 might be anything they liked. There was no doubt in his mind about the ·15, for during close on the 28 years he had been engaged in the copper trade it was a subject that had given them an immense amount of trouble, and they had more trouble now than formerly in guaranteeing the tests required by engineers. Would Mr. Gilchrist recommend the production of metallic bottoms and their treatment in the basic roaster as the best way of treating arsenical precipitates? The treatment of those precipitates had become an important question for copper smelters. Last year they had to deal with them up to 2 and 3 per cent. of arsenic, and at the present time up to something like 5 per cent. They were expecting a great deal of trouble with the precipitates in the current year, as there would be almost double the quantity of arsenic to be got rid of. He would therefore be grateful for any hints as to the best way of dealing with that extra quantity.

Mr. E. Riley did not know upon what grounds engineers based their requirement that copper should contain not less than 99·5 of pure metal; it was a very high limit to fix. There was always oxide of copper present, and the whole question of the limit of allowable impurities might well form a subject of discussion between chemists and engineers. In his own practice he made a point of giving no figures. He certified that the materials were, in his opinion, fit for certain purposes. If he gave an analysis it might be a specially good analysis, and then the probability was that his clients would want more material exactly like that certified. That would be most unfair to the manufacturer. In the case of iron he simply certified that it was fit for the Bessemer or Siemens process, and in the case of steel, that it was of good quality, and fit for its purpose. At the same time, he of course entered in his own books the figures of the analysis. He thought that the same plan should be adopted with regard to copper. Anyone who had had a long experience of metals was better able to judge what their chemical composition should be, and whether they were suitable for a given purpose, than an engineer who had perhaps only a little experience of them. Engineers should, he thought, confine themselves to the mechanical tests. It would be a subject well worthy of examination to fix the actual amount of pure copper in good commercial copper. He had made many experiments himself, and he fixed it at 99½. He thought that 99⅔ was decidedly too high.

Mr. T. Gray had been much interested in this paper, having, for years, smelted copper by basic methods, though not on basic bottoms. For the paper, as a whole, he had nothing but approval. The lines on which Mr. Gilchrist had gone were right, and the principles on which he had done so much in steel had given such results in copper as one would have expected from his own experience in smelting basic charges. The smelting on acid bottoms, of which details were given for comparison with the basic process (see pp. 5, 6, 7, 8) must, at this day, be considered very bad. With modern skill in smelting not only should there never be such a result as 191 tons of blister from 400 tons of bottoms, but in each example of smelting on acid bottoms, given on the pages cited, the quantity smelted, in the time, should not have been much less than double, whilst a much smaller proportion of copper should have been slagged. It did not appear from the paper, but would be, of course, known to all present, that the copper slagged was not lost, and that the oxide of copper in those slags played an important part in bringing sulphides forward to metallic copper in the usual operations of copper smelting. Referring to remarks by previous speakers, with regard to engineers' specifications, he thought a want of knowledge of the chemistry of copper was apparent when smelters were tied down to ·15 per cent. of arsenic in locomotive fireboxes. For this and most uses of tough-cake copper it might contain nearly 1 per cent., and be all the better for it. It had been fully proved that fireboxes containing ½ per cent., and more, of arsenic, were much better than those of pure copper. In fact, for every purpose for which copper was used in sheet or wire, except electrical conductivity, it was

all the better for ½ per cent. of arsenic, and the greater part of the tough-cake copper now made contained that proportion or more. Best select copper rarely contained more than ·05 of arsenic, and very much contained only ·02. He might say to Mr. Riley that they did not miss the arsenic in their analyses. If it was there, even in the third decimal place, it was accurately estimated. With regard to the elimination of arsenic from precipitates, Mr. Smith need have no doubts or fears on that point. All he had to do to overcome the difficulty of increasing quantities was to follow the lines laid down by Mr. Gilchrist or work with basic mixtures. That would enable him to make satisfactory tough copper, although for B.S. copper he would do well to smelt for copper bottoms rather than rely on oxidation only.

Mr. Gilchrist, referring to Mr. Gibb's remarks on the results shown on page 5, inquired what Mr. Gibb would consider a fair average yield from an acid furnace in lieu of those results, bearing in mind that they started with 6 per cent. of arsenic.

Mr. Gibb replied that from 400 tons of copper bottoms he should expect at least 250 tons of blister, and a considerably larger yield than this could be attained on acid bottoms. Even beginning with such material as Mr. Gilchrist had referred to, no such large proportions of 55 per cent. slag, as that given, should ever be approached.

Mr. E. Riley, referring to Mr. Gibb's statement that certain coppers might contain as much as 1 per cent. of arsenic and be all the better for it, wished to ask that gentleman whether, under such circumstances, the other elements contained in the copper ought not to be taken into account. It was well known that a steel containing ·12 per cent. of phosphorus and ·15 per cent. of carbon would stand all the mechanical tests for axle steel. But if one put in a steel containing nine-tenths per cent. of carbon and only ·04 of phosphorus and made it into bullets, the bullets would all go to pieces. In fact the amount of phosphorus one might have in steel depended upon the amount of carbon present. If the carbon were low, the phosphorus might be high, and *vice versâ*. He would suggest to Mr. Gibb that some such rule might apply to copper, and that therefore all its constituents ought to be taken into account.

Mr. Claude Vautin said that, having spent a considerable portion of his life in the copper works of Cobar in Australia, where they were greatly troubled with bismuth in their refined copper, he had hoped that Mr. Gilchrist would have been successful in eliminating bismuth as well as arsenic. He found, however, that the bismuth had given him as much trouble as it had other investigators. It was during some of the experiments with the Cobar copper that the metallic bottoms were fused with basic material, the result being that the arsenic had been reduced fully 50 per cent., but the bismuth practically remained the same after as before treatment. As to the effect of basic lining in converters for Bessemerising copper, he had worked at this for over two years at Cobar, and the result was a larger output of copper with a less percentage of slag than when using acid-lined converters. The Bessemerising of copper mattes was abandoned on the score of cost. It still remained a problem how to successfully remove bismuth from copper during the ordinary smelting operations.

Mr. A. G. Phillips said that the process struck him as being one for obtaining more copper and less slag from a given quantity of bottoms, rather than a method of copper purification. For example, on page 6 an analysis of the metal charged into a basic and an acid furnace respectively showed 0·47 and 0·51 per cent. of arsenic, and the blister copper turned out by the basic furnace contained 0·59 and that from the acid furnace 0·58 per cent. Again, on page 9, he saw that a copper precipitate containing 0·15 turned out 0·068 of arsenic in the refined copper, and on page 10 a charge of blister containing 0·77 of arsenic turned out a tough cake containing 0·71. Those results could be easily attained in an acid furnace, and therefore the process was essentially one for obtaining more copper and less slag rather than for purifying copper. If so, the whole question became one of cost, and would depend upon whether the extra copper obtained was sufficient to pay for the greater expense—if it were greater—of the basic lining. But as far as purification went, the process did not seem to have anything like the same effect as in the treatment of iron, in which case practically the whole of the phosphorus was removed with the slag.

Mr. Percy Gilchrist, in his reply, said: Professor Roberts-Austen had asked him whether he thought that the basic lining would render the same amount of service in the Manhés process of Bessemerising copper that it had in the reverberatory furnace. On that point he quite agreed with the gentleman from Australia, and would say that if one applied the basic lining to a converter, one would get a greater yield of copper and less slag than when using an acid lining. But he did not believe in applying any system of Bessemerising to copper at all. Copper was for all practical purposes 40*l.* a ton, and therefore the question of yield was of great importance, and time and labour minor points. In his opinion it would be impossible to pick up as completely as if they had never fallen the projections that must be thrown out in any system of Bessemerising, and therefore there must be greater waste. To take another point of view: In the case of steel making, we were gradually coming to produce steel in the open hearth furnace as cheaply as it could be produced in the Bessemer. One of the greatest engineers of our century (the late Alex. Holley) said some 10 years ago that he was of opinion that the open-hearth furnace would eventually attain results as good as the Bessemer. He (the speaker) did not know whether that would ever be the case in acid steel making, but he certainly thought that it would be so in the case of the basic process. If that were so in the case of steel, still more likely was it to happen in the case of copper. He was not one of those who thought that the copper manufacturer needed no improvements. No metallurgy that he knew of needed so much improvement as that of copper. The copper manufacturer wanted not only people who could make analyses, but people who could tell him how to use the analyses when made. There was one improvement obvious to all, and which had already been made by a gentleman present, who was rather ahead of some of those in the trade, as he had applied gas-producers to copper smelting, *i.e.*, using gas instead of the good old wasteful fire-grate of South Wales. He did not say that it was necessary to use regenerative chambers. He doubted if it was. But he thought if gas-producers were used instead of the old fire-grates they would be able to defy any system of Bessemerising.

Mr. Howard had asked whether the basic furnaces were worked in all respects as with an acid lining, or whether different fluxes were employed. The acid-lined furnaces, when they were used to treat arsenical materials, had some very small percentage of slaked lime added to the charge. When a basic lining was employed, there was used, he thought, as many hundredweights of lime as there were pounds used in an acid-lined furnace. But in all other respects, bearing in mind that lime was used for stopping the tapping-hole, the working was the same. The quantity of sand required for fettling an acid-lined furnace, if taken by weight, would, he thought, surprise some principals, if not their managers. When one had seen a thing done every day of one's life, one got used to it, but if one came fresh to the matter and weighed up the sand used in treating blister copper, it would make one reflect a little.

He had been asked whether he would be inclined to fix any limit for arsenic in copper. Their great master, Dr. Percy, always impressed on his students that analysis would teach nothing unless one started by analysing either a success or a failure. In other words, if one had something that answered either well or badly, they knew what to do. But unless they could so work, analysis was of no use at all. There were copper works which had for many years employed a considerable staff of analysts, and had got into the way of using their results, and they knew very well what percentage of arsenic suited for a particular purpose. It was perfectly well known that if one had, say, 1 per cent. of carbon and as little manganese as possible in a sample

of steel, that was a good razor steel, while if one had fifteen hundredths per cent. of carbon and low manganese, that would be a good boiler plate steel. And so with copper. The proportion of arsenic that would suit very well for tough cake purposes would not do at all for electrical purposes, and so on. The suppliers of the material should, and the best of them did, analyse both their successes and their failures, and when a man required copper for a particular job, he had only to repose confidence in the copper maker and he would be well served. If he did not place that amount of confidence in the maker he did not deserve to be well served.

He was much indebted to Mr. Smith for the compliment he had paid him in coming so far to attend that meeting. In reply to both his questions, he would say emphatically, Yes! He was willing to stand or fall by the results given in the paper, and he was sure they would bear out what he said, viz., that the best way of treating arsenical or impure ores was to produce metallic bottoms in a basic-lined furnace. And he would recommend a basic roaster for treating white metal, a basic roaster for making bottoms into blister, and a basic refiner for refining the blister, whether into B.S or a quality beyond B.S.

He would now reply to the last speaker (Mr. Phillips), who thought that, because he found in some results 0·7 of arsenic, and so on, they could not get lower. He would refer him to a few of the other analyses, but before doing so he would remind him that there was an old saying, that one should not throw pearls before—people who did not appreciate them. He would point out to him that copper was worth 40*l.* a ton, and arsenic, as found in tough cake, nothing. It seemed to him a very elementary commercial principle that if one could get 40*l.* a ton for the arsenic with the copper, it would be very foolish not to leave it in, provided the copper would suit the job it was required for. In that particular case they did not want anything purer. But if he would look at page 11, amongst other places, he would see that 1·93 of arsenic had been reduced to ·062, and that 1·52 had been reduced to ·05. And there was one other case in which Mr. Riley had reported that the arsenic was reduced to nil. Mr. Riley had told them that he never failed to find arsenic when there was arsenic to find. He (the speaker) had his certificate, and he had no doubt that it was correct. But whether it was nil or ·01, the point he wished to make clear was this; that if one wanted ·02 or ·07 per cent., one could get it if one started with blister containing 1·5 to 2·0 per cent., and if one wanted a mere trace, one could get it when starting with blister containing ½ per cent. of arsenic.

Dr. Squire had attacked the title of the paper, and, the author thought, quite rightly. But one had to be terse sometimes; for instance, to talk of basic steel was unscientific. At the same time, it conveyed the meaning one wished to convey. With respect to the basic process as applied to copper smelting, he did not think that one could call a roaster a refiner; but if any gentleman could suggest a better word than that which he had used, and the rules of the Society allowed of it, he would be happy to adopt that word.

Mr. Gibb had, he thought, acted very fairly as the spokesman of a good many smelters, who said that the 191 tons shown on page 5 was a bad yield for an acid furnace. There was just one question he would like to ask him and his friends. He did not want them to tell him what they thought their yield would be when they treated bottoms containing 6 per cent. arsenic, but what it *had* been under similar circumstances. That would be interesting, and would show whether the 191 tons was really too low. Whatever their figure might be, he thought it would allow the basic process some gain. But with regard to the percentage of arsenic, given at 6 per cent., he thought he could show—and it might increase the interest of the paper if he did so—that 6 per cent. of arsenic was a low average. If there were any errors of that kind in the paper, they were due to the fact that, being lazy, he had found it easier to understate his facts rather than take the trouble to state them exactly, as he should have done. In many cases "metallic bottoms" contained as much as 9 per cent. of arsenic, and he would remind them that to sample bottoms was by no means an easy job. The analyses of them was bad enough, but the sampling was worse. If any error had been made, it was on the lower side and not on the higher. He would also remind them that every ½ per cent. extra of arsenic to be got rid of enormously increased the waste, so that if 6 per cent. of As was sometimes 7, 8, and 9 per cent. arsenic, the waste would then enormously increase, especially in an acid-lined furnace. He was sure that Mr. Smith and other practical men would corroborate him in that.

He thought that he had now dealt with all the questions put. If he had not, however, and the rules of the Society permitted it, he would be happy to reply to any further queries which members might wish to put after reading the paper. As he had said in the paper, he regarded the statements and results given therein as merely the starting point. He looked to those practical men who spent their lives in making copper to develop the method, and if they did, he predicted that they would, when using a basic lining, be able to get any result they desired.

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Meeting held on Wednesday, December 10th, 1890.

MR. A. NORMAN TATE IN THE CHAIR.

AN APPARATUS FOR THE DEVELOPMENT OF PHOTOGRAPHIC PLATES WITHOUT THE USE OF A DARK ROOM.

BY ALEXANDER WATT, F.I.C., F.C.S.

THE apparatus which I bring before you to-night was in use for two months before I learned that a "portable developing box" similar to it in many respects, had been described by Dr. T. W. Harvey in the International Annual of Anthony's Photographic Bulletin for 1888. But as the apparatus about to be described differs from it in principle, and is based on the photochemical investigations of Messrs. Hurter and Driffield, I have thought that this communication might be of interest to the Society.

In the paper which we had the pleasure of listening to last session (this Journal, IX., 455—469), Messrs. Hurter and Driffield have shown that of all the conditions involved in the production of a "perfect negative," those relating to the exposure are by far the most important, and if the exposure factors are so adjusted as to give the "correct exposure," the development is of secondary importance, as the density gradations of the negative are entirely due to the action of the light.

It therefore occurred to me that with a correctly exposed plate, development might be carried on quite mechanically, as the required density can be regulated by the length of time of development.

On trying the experiment of allowing plates which had been exposed by the aid of Hurter and Driffield's actinograph, to remain in the ferrous oxalate developer for different lengths of time, it was found that with the same quality of plate satisfactory negatives could be obtained in 10 minutes with a strong solution, and in 15 minutes when the solution was diluted with an equal volume of water. When the time required to obtain a suitable printing density had been ascertained for a particular plate, it was found that there was nothing gained by watching the progress of the development, and consequently the dark room might be dispensed with if means could be found to keep the plate in the dark during development and in its transference from the dark slide to the developing vessel.

In order to attain this object I have devised the apparatus which I have named a dark developing bath.

It consists of a metallic case, A (Fig. 1), only slightly larger than the plate for which it is intended, which can be closed light-tight by means of the lid B. It is furnished with two tubes, one, C, entering at the bottom of the bath, which can be connected by a piece of india-rubber tubing, E, to the funnel D; the other is near the top, just above the level of the plate P. The former serves to introduce the developer into the bath, and the latter, F, allows the air to escape and also acts as an overflow.

Fig. 1.

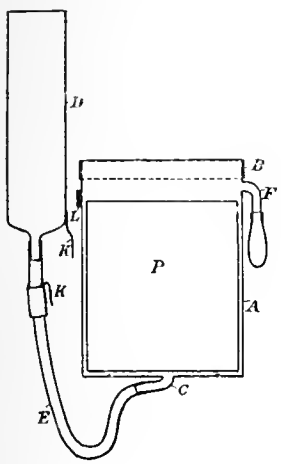
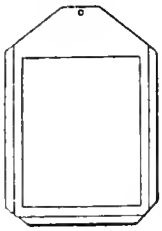


Fig. 2.

Fig. 3.

Fig. 4.



The funnel D and the india-rubber tube E are supported by means of the hooks K K, which fit into the eye L. The tubes are so bent that no light can enter the bath. An end view of the bath is shown in Fig. 2, in which a moveable hook, I, fitting into the socket J, serves to fix the bath to any convenient support.

A section, Fig. 3, shows the plate P, the film side of which is kept from contact with the side of the bath by means of the metallic strips H.

When the bath is intended for the development of films or paper prints, it is furnished with a carrier (Fig. 4) into which the film or paper is inserted before being put into the bath, and when required for the development of several plates at one time, it is constructed with grooves as in an ordinary plate box.

The bath is used as follows:—The dark slide containing the exposed plate and the bath are placed in a changing bag, into which it is only necessary to insert the hands. The plate is then transferred from the slide to the bath, care being taken to keep the film side towards the back of the bath.

After being closed, the bath is withdrawn from the bag into daylight, and fixed vertically to any convenient support by means of the hook. A vessel is placed under the overflow tube, and the inlet tube is attached to the funnel, which after being filled with the developing solution, is raised and lowered several times, to alternately fill and empty the bath, and so ensure the removal of air-bells from the surface of the plate. After standing sufficient time to complete the development, the solution is run off from the bath. The plate is washed by running water through the bath (either by means of the funnel or by attaching the india-rubber tube direct to a water tap), after which it is taken out, in daylight, and "fixed" in a covered tray.

If it be desired to "fix" entirely in the dark, the operation may be conducted in the same bath or in a similar one to which the plate has been transferred in the changing bag.

The final washing of plate may be done either in the bath or in the usual way.

The best developer for use with the dark bath is ferrous oxalate, on account of its property of not producing "fog," even when a plate has been left in it for an hour (Hurter and Driffield, loc. cit. p. 459). It should be made just before use from the following solutions prepared according to Thomas's formulæ—

No. 1.

Potassium oxalate	300 grms.
Potassium bromide	2·2 "
Water to make	1,000 cc.

No. 2.

Ferrous sulphate	400 grms.
Sulphuric acid	3 cc.
Water to make	1,000 cc.

To *four* parts of No. 1 *add one* part No. 2, and water to make *eight* parts.

When the developer is used at once with Thomas's "Extra Rapid" plates, from 12 to 15 minutes in the bath at about 15° C. is sufficient to give a satisfactory negative, if the exposure has been correct.

The time required to obtain a suitable density is found by placing the exposed plate in the bath and adding the amount of developer required to fill the bath, in four equal portions at intervals of five minutes. Four densities are thus obtained by developing for 5, 10, 15, and 20 minutes respectively, from which observations the time that gives the desired density is selected.

A very small bath to contain *four plates* (a $\frac{1}{4}$-plate cut into four) is useful for the development of test plates exposed in the camera on a landscape in order to ascertain the speed of the plate, as recommended by Mr. V. C. Driffield (Photographic Soc. Reporter, April 1889).

A developing bath constructed as above, besides enabling plates to be developed *without a dark room*, has some other advantages over the ordinary developing tray. The bath being used vertically presents a very small surface of liquid to the air, thereby preventing the rapid oxidation of the developer. As the solution is introduced at the bottom, under pressure, it flows up evenly over the plate, carrying the air before it and so prevents air-bells. The plate is completely immersed in the solution during development. The bath being quite light-tight, there is no risk of "fog" from access of light to the plate, and is therefore especially suitable for the development of isochromatic and other very sensitive plates. The tubes attached enable the solution to be readily run off and replaced by one of altered composition, and also allow of a continuous flow of developer through it.

As this apparatus has been designed for the development of correctly exposed plates, any plates developed in it which are either over- or under-exposed will be more or less defective. If, however, the exposure has been nearly correct a passable negative will obtained, but if it has been *widely different* from the correct one, as no provision is made for remedying the defect, the negative will be a failure, but if such a result should lead to more attention being paid to the exposure it will not be altogether to be regretted,

REVERSAL AND SECOND NEGATIVE.

BY H. J. L. RAWLINS.

In their paper, read before this Society in May last (this Journal, 1890, 456 seq.) Hurter and Driffield showed, by means of a diagram, a curve representing the action of light on a sensitised plate, the action producing, on development, increasing density as its duration was continued up to a certain point, after which a further action of light caused reversal to commence, and the density diminished. The following experiments were undertaken in order to ascertain whether, and at what point, this decrease of density ceased and gave place to a second increase.

An Ilford ordinary plate was exposed to direct sunlight in 15 sections, the first for a second or two, in order to thoroughly fog it, the second for one minute, and the remaining sections for 2, 4, 8, 16, 32 minutes, and so on, up to the last, which received 8,192 minutes exposure. The plate was then developed with a weak quinol (hydroquinone) developer, when the following result was obtained:—Section 1 showed clearly the usual action of light on a plate. In section 2 (one minute exposure) reversal had already commenced, and was clearly seen in all the sections up to that which had received 128 minutes' exposure, where it was very complete. After this point density again increased, and in the section that had received 8,192 minutes' exposure it was very considerable.

With a view to finding out whether, beyond this point, a diminution of density set in, a second (Ilford ordinary) plate was exposed in four sections, the first for one or two seconds, the second for 128 minutes (the point of most complete reversal in the first experiment), the third for 8,192 minutes, and the fourth for 16,384 minutes. The plate was then developed as before, and the following result was obtained:—Section 1 showed the density of, say, a rather weak sky in a landscape negative. Section 2 was practically clear glass. Section 3 was about equal in density to section 1; and section 4 had nearly double the density of section 3.

Reasoning from these experiments, and assuming that the curve representing increasing and decreasing density would continue to be formed as it was up to the point of 16,384 minutes exposure, a diagram was prepared, in order to ascertain the length of exposure required to obtain a second period of reversal. Of course, such a diagram was of necessity largely approximate, as it was quite impossible to keep an accurate record of the intensity of the light acting during the experiments; but it appears at least probable that the condition of second reversal would not be produced until direct sunlight had acted upon the plate for something like seven years. An experiment to prove this was, however, not undertaken.

GREASE-SPOT PHOTOMETER MEASURES.

BY CAPTAIN ABNEY, C.B., D.C.L., F.R.S.

As I may not be able to be present at the meeting of the Liverpool Section of the Society of Chemical Industry, on December 3rd, I have thought that I might in some way add to the interest of the papers which I understand Messrs. Hurter and Driffield are to read on that evening. I have already appeared in the Journal of the Society as a critic of their former paper, but I have one or two new points to bring out as regards my own photometer and that which they use, as, owing to their kindness, I have been temporarily put in possession of some negatives which they have measured, and of which I have also recently determined the transparency.

In the first paper read by these authors there was a blow aimed at the sector photometer which, in my subsequent communication, I thought I had successfully parried. Messrs. Hurter and Driffield, however, have continued to make the allegation of incorrectness against it, but have so far given no experimental proofs to warrant their assertion, and this I challenge them to do, by experiments made by direct measures of naked light which do not involve the measurement of the density of negatives.

In their paper we had a statement that the semi-shadows which the sectors must of necessity cast upon a screen when a source of light like a lamp is used, vitiated the results, and that there was a mathematical proof of the fact, which up till now has not been forthcoming, though it possibly may be in the paper about to be read. Such a proof would be very interesting, but I expect would contain some fallacy if Dr. Hurter's own admission be conceded as correct. The following line of argument may recommend itself to the meeting, though it contains no mathematical formula:—In a letter to me, which I hope Dr. Hurter will not think I ought not to quote, he states that the sector photometer is right theoretically when the source is a point of light; and on this one admission it is not hard to build up the truth of its correctness for a source of light of any practical dimensions. If we take as a source an argand burner, we may consider it made up of a large number of small points of light of very small dimensions. Could we isolate one of these points, the illumination of a screen would be diminished exactly proportionally to the apertures of the sectors rotating between it and the screen. (This Dr. Hurter admits.) Another point would do the same, and so on as each one was isolated. If this be true for each individually, the same is true for these all collectively. Hence, the proposition seems very fairly proved, on the admission made, and that the size of the source of light has nothing to do with the correctness of the measures, and the question of what is called the semi-shadow, which must naturally exist, vanishes.

Most people, however, prefer practical experiment to theory, and I now propose to put before the meeting the results of measurements obtained by the sector photometer, the ordinary Rumford photometer, and the grease-spot photometer, the last measures not made by myself, but by Messrs. Hurter and Driffield themselves, so that in them there is no bias in the readings. In my criticism of these gentlemen's paper, my contention was that from experiments made and from theoretical considerations, which I tried to fully explain, as to the scattering of light by the silver particles, the measurements made by them of the light passing through a negative were too small, and consequently that the density of deposit they arrived at was too great, and this I believe the subsequent experiments will amply prove. But besides this, they will prove practically that the sector photometer at all events contains no elements of the error, though it was scarcely necessary to show this again after the results which I gave in my criticism.

The method of measuring densities, which I consider to be devoid of all error, except those inherent to the eye, I have recently discussed at the Camera Club, and I will briefly recapitulate it. If a square of about half an inch size be cut in an opaque plate, such as a ferrotype plate, and the whole covered over with white paper of the consistency of Saxe paper, and an oblong of black paper, one inch by half an inch, be pasted over the white paper, so that half the aperture is over the hole and the other half over the opaque white surface, we have two white squares side by side, one translucent and the other opaque to transmitted light. We can place behind such a screen a light, and the translucent space will be bright whilst the other will be dark.

If we place another light in front of the screen both the squares will be illuminated by reflected light; but by placing a rod between this front light and the screen we can cause a shadow to be cast, so that only the opaque white square is illuminated by the front light. We can now make both squares equally bright, either by placing rotating sectors between the light and the rod, and altering the apertures, or else by shifting the light nearer or further from the screen. The light which illuminates the translucent square is best kept as the stationary light, as then any reflected light which might chance be in the room will not vitiate the results. Reflected light on the front side of the screen is of no moment, as it equally illuminates both squares. As a matter of precaution care has been taken to prevent any light except that from the two sources reaching the screen. Now, if a piece of a negative be placed in contact with the aperture in the screen so that the back light shines through

it on to the white paper, evidently all the light which *can* pass through the negative will reach the paper which is not the case, as can easily be tried if it be removed away from the screen (as it practically is in Hurter and Driffield's photometer). The brightness of the illumination of the translucent square can again be equalled on the other white square by the front light, by means of the rotating sectors, or by moving that light away from the screen. Both these plans were used by me for measuring the light transmitted through three different negatives, marked and measured by Messrs. Hurter and Driffield, as No. 1, No, 2, and No. 3, which are stated in a table which accompanies them, to be made by cutting a plate into three portions, after exposing different slips for 10, 20, 40, and 80 seconds to light, so that each negative contains the same four exposures. The development of each negative was different, however, No. 1 being carried on for 2 minutes, No. 2 for 4 minutes, and No. 3 for 6 minutes in the same developer. The densities derived from these measures were marked by them on the negatives, and correspond with those given in the tables. My results are given in the following tables, but I believe the sector photometer readings are slightly the better of the two.

These measures of No. 1 negative I will give in detail from my note-book—

Phot. Measured.	Aperture Readings.	Mean Reading.	Light Transmitted.	Density	A.'s Density less Fog.	H. and D.'s Density
Naked light	81, 81, 79½, 79, 80.	80	1,000	0	..	..
Fog on plate	72, 72, 72	72	·900	·046	..	..
10 sec.	45, 46, 46, 46, 45, 46.	45·7	·571	·243	·197	·235
20 sec.	30, 32, 31, 32, 32.	31·4	·392	·406	·360	·445
40 sec.	22, 22, 22, 22.	22·0	·275	·560	·514	·680
80 sec.	14½, 13½, 14, 14, 14.	14·0	·175	·760	·715	·920

Measures by moving Lamp from the Screen.

Phot. Measured.	Distance of Lamp from Screen.	Mean Reading.	Light Transmitted.	Density	Density less Fog.	H. and D.'s Density
Naked light.	21·3, 21, 20·7, 20·7, 21·3.	21	1,000	0	..	..
Fog..	22, 22, 21·8, 22·3	22	·911	·041	..	..
10 sec.	27·8, 27·8, 27·8	27·8	·570	·244	·203	·235
20 sec.	33·2, 33·1, 33·8, 33·3.	33·4	·389	·410	·369	·445
40 sec.	40·1, 40·3, 40·3	40·2	·273	·563	·522	·680
80 sec.	49, 50, 51, 50	50	·176	·754	·713	·920

In all three negatives Hurter and Driffield's measure of the fog was ·110.

Another independent measure made with the sectors gave the densities :—

Photo. Measured.	Densities.	Density less Fog.
Naked light.....	0	..
Fog.....	·043	..
10 sec.	·243	·200
20 sec.	·399	·356
40 sec.	·557	·514
80 sec.	·756	·713

No. 2.

Sectors Measure.

Phot. Measured.	Mean Reading of Aperture.	Light Transmitted.	Density.	Density, less Fog.	H. & D.'s Density, less Fog.
Naked light..	80	1·000	0	..	..
Fog.....	72·6	·907	·043	..	..
10 sec.	33·3	·416	·381	·338	·410
20 sec.	19*	·237	·626	·583	·740
40 sec.	9·6	·120	·921	·878	1·085
80 sec.	4·75	·059	1·229	1·186	1·490

Hurter and Driffield's measure of the fog, ·110.

Measures by moving the Lamp from the Screen.

Phot. Measured.	Mean Reading of Distances.	Light Transmitted.	Density.	Density, less Fog.	H. & D.'s Density, less Fog.
Naked light..	21	1·000	0	..	..
Fog.....	22	·911	·041	..	..
10 sec.	32·5	·418	·378	·337	·410
20 sec.	43·5	·233	·633	·592	·749
40 sec.	60	·122	·915	·873	1·085
80 sec.	87	·057	1·244	1·203	1·490

No. 3.

Sector Measures.

Phot. Measured.	Mean of Readings of Aperture.	Light transmitted.	Density.	Density less Fog.	H. & D.'s Density.
Naked light..	80	1,000	0	..	..
Fog.....	72	·930	·045	0	..
10 sec.	28·4	·355	·450	·405	·470
20 sec.	14·0*	·175	·777	·732	·865
40 sec.	6·28*	1078	1·108	1·063	1·335
80 sec.	2·51*	·031	1·509	1·464	1·800

Hurter and Driffield's measure of the density of the fog was ·110.

Measures by moving the Light.

Phot. Measured.	Mean Distance.	Light transmitted.	Density.	Density less Fog.	H. & D.'s Density.
Naked light..	14	1,000	0	..	..
Fog.....	14·8	·900	·045	..	..
10 sec.	24	·338	·471	·426	·470
20 sec.	33·7	·172	·765	·720	·865
40 sec.	51·0	·076	1·119	1·074	1·335
80 sec.	81·0	·030	1·523	1·478	1·800

The numbers marked * were obtained by moving the back lamp closer to the screen and obtaining higher readings, which were reduced by a factor. The first readings gave the same within the limits of error of reading the sector scale.

Now a look at these tables will show two things: First, that the readings by sector photometry and the ordinary shadow photometry are in reality the same, and any difference is due to error of observations; and secondly, that in every case the densities obtained by these measures are *invariably much smaller* than those obtained by Messrs. Hurter and Driffield with the grease-spot photometer; even the fog of the negative they show has more than double the density that I obtained. Now there is one thing perfectly evident, that whatever influence a negative placed in the path of the beam can have as regards the readings obtained, say with the Rumford method, it can never make them show that the light which appears to be transmitted is *greater* than it is in reality, though it would easily make it appear to be less owing to the scattering of light. It is to be presumed, therefore, that the smaller measures are nearer the truth than the larger, and I do not hesitate to say that the values obtained by my measures are correct within the limits of the error of observation.

I quite expect to be told that the method of using the screen is wrong; I am not merely going *to assert* it is right, but will give a reasonable proof of its correctness, though I would have you remark that, as the two sets of measures were obtained under the same conditions, even were the screen wrong, the comparison between the sector and Rumford methods would still hold. If we have a fixed light which is sufficiently intense to print through the negatives on to platinum paper, we can then arrange to compare the density of one part of one negative with that of another part of another negative by placing these negatives at proper distances from the source of light and comparing the blackness produced under each part. Now, acting on these lines and knowing that from the colour of the negatives (they were probably developed by ferrous oxalate, as the authors say they always use that developer) the photographic and optical densities were very nearly alike, a comparison was made between the *smallest (the fog)* density on No. 1 and the *greatest density* on No. 3. Messrs. Hurter and Driffield measured the difference of these densities as 1·800,* which is equivalent to saying that the light transmitted by the latter was $\frac{1}{63{\cdot}2}$ that of the former.

My measures gave the difference in density as 1·464, or $\frac{1}{29{\cdot}1}$ of light was transmitted, a difference of over 100 per cent. If we wish to test Messrs. Hurter and Driffield's measures of fog density on No. 1, and of the greatest density on No. 3, we ought to place No. 1 negative $\sqrt{63{\cdot}21}$ or 7·95 times further from the light than No. 3 negative, and then the blackness produced on the platinum paper, with the same exposure under the fog part of No. 1 negative, should be the same as that under density 1·800 of No. 3. If my measures are to be taken, then No. 1 negative should be placed only 5·39 times further away from the light than No. 3.

This test was applied, with the results which are instructive and confirmatory of my measures, and which I show. With the first-named distance, the fog density of No. 1 had scarcely permitted any printing action; but the light passing through density 1·800 had greatly blackened the paper. With the last-named distances derived from my measures the two are equal to the eye, and when the blackness is measured by the method I have often described, the print from the part of No. 1 negative, which represents fog, reflected 52 per cent. of white light; whilst the print from that part of negative No. 3, which had the greatest density, reflected 50 per cent. of white light, which are practically the same. The prints are before you. No. 3 negative was placed, in both cases, at 20 inches from the points of an arc light, and the other negatives at distances of 159 inches and 108 inches respectively, and both in approximately the same line and on a level with points.

In No. 1 there is a density marked by Messrs. Hurter and Driffield as ·415, through which I make the light transmitted to be ·392. I compared this density with that of their density 1·800 in No. 3, which, as before, I made transmit ·031 of the total light. If my measures were correct, then if No. 3 negative was placed 20 inches away from the light, and No. 1 placed 71 inches away, the blackness produced by these two densities should be the same. The results are before you; it will be seen that they are alike. Again, from a scale of blackness produced by light of different intensities it was easy to arrive at the light giving that blackness under No. 1 negative. The light transmitted through the various densities on No. 1 I have found to be: fog, 101; 10 sec., 63; 20 sec., 44; 40 sec., 30·1; 80 sec., 19·2; making this comparable with No. 1, we have: fog, ·900; 10 sec., ·556; 20 sec., ·402; 40 sec., 268; 80 sec., 171, which is not unlike the Table I.

It may be urged that Messrs. Hurter and Driffield's measures may still be right, and that the lack of concordance is due to a variation in the photographic and optical densities. Now, if one thing is more certain than another, it is that a photographic density *can never be less than its optical density*. It may be, and often is, greater. If it were greater, then Messrs. Hurter and Driffield's measures being taken as correct, No. 1 negative ought to have been moved *further away from the light*, as No. 3 would be comparatively more dense, which would have made the results worse. If the photographic density had been greater than the optical density when my measures were used, the blackening under No. 3 negative would have been less than that under No. 1 at the parts compared; but it is not so.

I think these last experiments are fairly conclusive, at least they are to myself and to those who have so far seen the measures and the results, and I hope they may be equally so to the meeting. I have now twice given proofs of the correctness of the sector photometer; and twice given proofs of the incorrectness of the measures made by their grease-spot photometer, once by measuring negatives made by myself, and once by measuring new negatives which they themselves have measured. I consider now that any further proofs on my part are unnecessary, until Messrs. Hurter and Driffield can indicate error in what I have said regarding my photometer and their own. The methods of proving the truth or the contrary are in the hands of those who are interested in the subject, and, so far as I am concerned, I leave the matter to them. I think that before any definitely accepted theory can be applied as to the inter-dependence of density and exposure either in negatives or in positives it is necessary that the mode of measuring densities should be above suspicion, and certainly this is not the case in the method adopted by Messrs. Hurter and Driffield. They have shown by weighing the deposit on a negative that amount of silver varies with the optical density of deposit as arrived at by their measures which are in fault, and if so that part of their theory will not hold. I have believed otherwise, my belief having been arrived at before they published their paper.

I admire, as I have said before, the way in which their investigations have been carried out, and there is much that I agree with in their original paper; but I believe that they have introduced a fatal mistake, which they will have to rectify when they become fully conscious of what that mistake entails.

* In the tables it seems they show the density of each part as its measured density less the measured density of the general fog of the plate. If this be not so, then their case is worse than it will appear to be from the succeeding results.

THE SECTOR AND GREASE-SPOT PHOTOMETERS AND THEIR RESULTS.

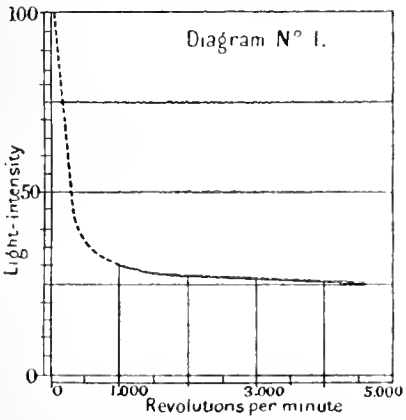
BY F. HURTER, PH.D., AND V. C. DRIFFIELD.

It will be within the recollection of the Section that, in a paper read at the end of last session, we very briefly criticised an instrument which Captain Abney devised for measuring the transparencies of negatives. In consequence, Captain Abney practically accuses us of having, to use his own words, "blown upon" his instrument without sufficient investigation. Such a proceeding on our part would have been most unjust, and we hope that our present paper will prove to the satisfaction of this Society that the charge is perfectly groundless.

In our former paper we based our criticisms entirely on experimental grounds; our conclusions were, however, even more strongly based upon an investigation of the results Captain Abney obtained by means of his photometer. Of these results we purposely said nothing; but the course Captain Abney has since seen fit to take, leaves us no alternative, but, in self-defence, to bring them forward. We shall therefore proceed to show that, by our experiments and by a careful analysis of Captain Abney's own researches, we were driven to the conclusion that we must warn our readers against the use of his instrument. We wish, at the same time, to answer disparaging criticisms of our own photometer and of our results. We shall do this as shortly as is consistent with the importance which has been attached, by many journals, to our paper.

The instrument which Captain Abney uses as a standard measure for light consists of a revolving disc with angular apertures which can be opened and closed whilst the disc is revolving, and which he shortly terms a "rotating sector." When this disc is caused to revolve in front of a lamp, a screen, illuminated by this lamp, appears darker and darker as the sector is gradually closed. The screen really receives the full intensity of the light but, owing to the rapid revolution of the sector, periods of illumination and periods of darkness intervene so rapidly that, to the eye, they coalesce and produce the impression of continuous illumination of lesser intensity; and the real question at issue is: can the eye judge the exact arithmetical average of the various intensities of light which act upon the nerves in rapid succession? If the eye can do this, the rotating sector is a perfect photometer and our criticism was unjust; but, if the eye cannot do this, our criticism was just, and the angular aperture of a rotating sector is not an accurate measure of light intensity.

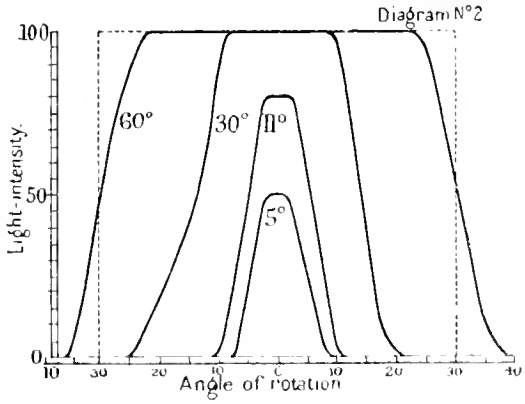
Now, if the aperture of the sector be large enough and the sector be at rest, a lamp placed behind it will illuminate a portion of a screen with the same intensity as if the sector were not present. On revolving the sectors slowly, the eye still perceives that intensity as long as it can follow the image of the sector opening on the screen; as the revolutions are increased and the eye can no longer follow the image of the sector opening, a complete circle of light of considerably reduced intensity is the visible result. If the opening of the sector extend over half the circumference (180°) and the revolutions be made very rapidly indeed, a point is reached when the intensity of this circle of light approaches more and more nearly the exact half of the intensity of direct illumination of the lamp. It requires, however, from 4,000 to 5,000 revolutions per minute to attain this result. Diagram No. 1 shows how, with



increasing revolutions, a sector of 90° opening (two openings of 45° each) gradually gave light of less and less intensity. This was measured by the grease-spot photometer, the first measurement being made at 900 revolutions per minute. The curve between this point and complete rest is imaginary only, and simply indicates the alteration in intensity which must take place as the sector passes from complete rest to 900 revolutions per minute. A sector opening of 90° should, of course, give 25 per cent. of the original light intensity, but it will be seen from this diagram that this fraction of the original intensity was only reached when upwards of 4,000 revolutions of the sector were attained.

We consider it a most serious objection to the rotating sector that its indications depend upon the number of its revolutions.

With large openings of the sector the task which the eye has to perform is comparatively simple. It receives a number of impressions of the full intensity of the light interrupted by periods of darkness, and it has to average these. But the task becomes more difficult as the openings become smaller. Diagram No. 2 represents the



light intensities measured by the grease-spot photometer as the opening of the sector revolves slowly past a line joining the grease-spot and the centre of the flame. The abscissæ represent the various positions of the sector in angular measure, 0 being the position when the sector opening was bisected by the line joining grease-spot and flame. The diagram shows the variations of illumination which the grease-spot received when sectors of different angular openings, viz. 60°, 30°, 11°, and 5°, were interposed. It will be seen that, with the largest opening of 60°, there was measurable light, not for 60°, but for 76° of its revolution. The full intensity of the light of the lamp (taken as 100) is maintained during 45° to 46° of the revolution.

The light gradually grows from darkness at one end, and gradually diminishes to darkness again at the other. These periods of growth to and from the full intensity we called in our paper the "semi-shadow at both edges of the sector opening." As the sector opening is reduced, a point is reached when the full intensity of the light is no longer obtained; an opening of 11° giving only 81 per cent. of the full intensity, and one of 5° only 51 per cent., the semi-shadow being all that is left. The total amount of light which reaches the grease-spot during the complete passage of the sector opening is proportional to the sector opening; it is so theoretically, and it is so practically. The areas of these diagrams were measured by means of Amsler's planimeter, and the following results were obtained:—A rectangle, shown in dotted lines on the diagram, one side being equal to 60° and the other side to the full intensity of the light, measured 2,938 = 60°. The diagram for 60° measured 2,942 = 60·1°; for 30°, 1,445 = 29·5°; for 11°, 469 = 9·5°; for 5°, 239 = 4·9°. These measurements leave no doubt that the amount of light transmitted by a revolving sector is proportional to the opening of the sector. This may also be proved by means of photographic plates. If the light passing through a revolving sector fall upon a sensitive plate, the number of revolutions will have no effect so long as every point of the plate receives each intensity equally often.

When, however, we tried to average these rapidly varying intensities by means of the eye, we found that it was not equal to the task. We still hoped that the eye might prove capable of averaging alternate periods of

illumination and darkness with tolerable accuracy if the intensity of the light itself were constant, as it would be if the source of light were a luminous point or a bundle of parallel rays; but we found that, even in this case, the eye is unable to average correctly, as we shall now proceed to show you practically.

For this purpose we shall employ an ordinary optical lantern, which is our source of light. We place in it a black disc having two openings of equal angular dimensions. Upon causing this disc to revolve, we produce two concentric circles of equal light intensities. This proves that our apparatus does not introduce errors, in that the two equal openings in the disc produce upon the eye equal effects.

In order to show you the difference between the two intensities due to openings of 60° and 70°, we place into the lantern another disc having such openings. The difference is, of course, small, but you will probably have no difficulty in deciding which intensity is due to the 60° and which to the 70° opening. We show you this in order that in our next slide you may be prepared not to look for any very striking difference.

We now place the third slide into the lantern and leave it to you to decide which circle of light, if either, is the brighter.*

We ourselves think the inner circle decidedly the brighter; but assuming them to be equal in intensity, they clearly demonstrate the errors of the sector for this reason:—The inner circle has a single opening of 60°; the outer circle has six openings of 12° each, or a total of 72°; yet it was this inner circle which was, if anything, the brighter. This clearly proves that, to the eye, 6×12 is not equal to 72, but is more nearly equal to 60. So much for the effect upon the eye. Upon a sensitive plate, however, the effect is different, the action of the light being strictly proportional to these openings. We produce a plate exposed to the action of light passing through this same disc, and the resulting densities measure, for the inner circle of 60°, 0·820, and for the outer circle of 72°, 0·920.

These experiences point to but one conclusion, viz., that the impressions made on the eye by rapidly changing intensities of light are not sufficiently accurate to serve as basis for photometric experiments. Captain Abney claims great accuracy for his apparatus, and we ourselves stated that its errors only became seriously appreciable in the case of high densities; but an analysis of his results obtained by means of it, and of which we proceed to give a short epitome, entirely corroborates the experimental proof we have given that the rotating sector is not a reliable instrument of research.

Captain Abney, like ourselves, investigated the action of light on sensitive plates, and, from measurements made with the sectors, he arrived at a law which expresses the relation of transparency to the number of a hole in a particular sensitometer which he uses. After making the necessary algebraical transformations in order to substitute the relative intensity of the light for the purely arbitrary number of the hole, the formula stands thus:—

$$T = \epsilon^{-u(\log. I)^2}.$$

Taking logarithms on both sides we find—

$$-\log. T = u(\log. I)^2,$$

u being a constant and I the intensity of light which produced the transparency T, the unit of light being that due to the sensitometer hole which just failed, on development of the plate, to produce any deposit. This law Captain Abney terms the "law of error," and upon examination it leads to very extraordinary conclusions. It tells us, in the first place, that as the intensity of the light is increased indefinitely, the transparency diminishes indefinitely also; that is, the amount of silver on the plate increases indefinitely and without limit with increased exposure. The camera would, if this were true, become a kind of alchemistic laboratory wherein silver may be produced from nothing. Captain Abney knows perfectly well that the density of a negative is limited by the amount of silver placed on the plate by the manufacturer, and we trust he will now see reason to doubt the truth of a law which leads to so absurd a conclusion. If this were the only fault to be found with his law, it would be of comparatively little consequence, as many other laws, generally accepted, lead to similar absurdities when pushed to extremes.

A much more serious objection to the formula, as a law, is that symbols enter into it, the meaning of which is ill-defined. It starts from a perfectly arbitrary number of a hole in a particular sensitometer, and it contains a constant of which we do not know the meaning. The real truth of the formula is this: The law, when deprived of its transcendental character, represents a parabola; and, given a short piece of any curve having no singular point, it is always easy to find a parabola which resembles it as closely as desired; for it is always possible to lay a parabola through four points of any given curve, and that is all Captain Abney can claim for his formula.*

Captain Abney further showed that if the quantity of silver on a plate be gradually increased, the transparency follows the same law—

$$T = \epsilon^{-m(\log. Q)^2},$$

which is again our algebraic transformation of his. From this law an equally absurd conclusion follows as from the last, and that without pushing the formula to extremes. According to Captain Abney's results, if we were to super-impose on a plate which permitted 26 per cent. of light to pass another plate of equal density (*i.e.*, double the amount of silver), the combination would allow 12·3 per cent. of the original light to pass. (Photographic News **33**, 631, gives the necessary data for this calculation.) Thus the second plate becomes greatly more transparent than it would be if used as a first since it allows $\frac{12{\cdot}3}{26{\cdot}0} = 47{\cdot}3$ per cent. of the light which it receives to pass. This result is amazing indeed; the more silver we deposit on the plate the more transparent becomes each single unit of silver! We need not say that this is in direct contradiction to all researches hitherto made in this direction. With ordinary transparent media Bunsen and Roscoe, and Vierordt also, proved those laws which we gave in our former paper, and we shall presently see that a negative behaves almost exactly like a deeply-coloured transparent solution.

By a combination of the results of these two investigations Captain Abney arrives at the deduction that the amount of silver reduced by the light and subsequent development is simply proportional to the intensity of the light which acted on the plate. This conclusion cannot be deduced mathematically from his formula; nor is it true, except for very short illuminations, or very feeble intensities of light.

Then Captain Abney showed that a plate, after intensification, still obeyed the "law of error." After the necessary algebraic transformations of his formula, the relation between the transparencies of the intensified plate and of the original plate is simply expressed—

$$\frac{-\log. T_1 \quad 0{\cdot}01015}{-\log. T_0 \quad 0{\cdot}00603} = 1{\cdot}68.$$

It will perhaps be remembered that we called the negative logarithm of the transparency T the density, and that, for an intensified plate, we also made the assertion that the ratio of densities was constant. When, however, we examine Captain Abney's numerical results, we find that they deviate very considerably from this constant ratio, the deviations ranging from 1·0 to 2·27, the true mean being 1·64. From these large deviations we judge that the rotating sector is not so accurate a tool, even in Captain Abney's hands, as the grease-spot photometer is in our own. And when our critics find fault with deviations

* Opinion was divided; some members thinking the inner circle the brighter, others the outer circle, and others again that they were equal in intensity. All agreed, however, that the difference between the two circles was decidedly less than in the case of the second slide.

* Our results, however, clearly show that this curve *cannot* be a parabola.

in ratios of 5 per cent., we think we may fairly point to these results which deviate from 30 per cent. to 40 per cent. from the mean.

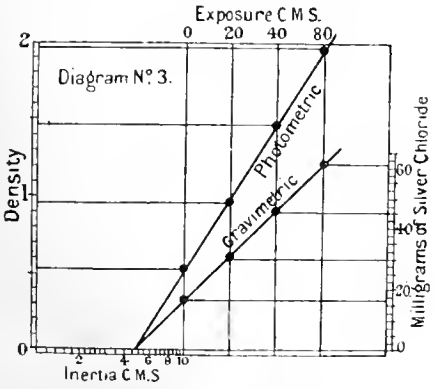
A further very curious result is brought to light if the "law of error," as applied to quantity of silver, be combined with the "law of error," as applied to intensification. It is not difficult to combine them, and we will only say that the result of so doing is that a given atom of silver will precipitate, from a solution of mercuric chloride, various amounts of mercury which depend upon the number of the sensitometer hole behind which that atom of silver was reduced. This, of course, is utterly untrue; it is entirely opposed to all chemical experience, and, in the face of Mr. Chapman Jones' researches on intensification, it is simply absurd.

We trust we have now said sufficient to prove to the Society that we have not warned our readers against the use of the rotating sector without cause. We are certain that Captain Abney is as able an experimental investigator as anyone living, and we ascribe these erroneous results solely to the faulty measuring instrument which it has been his misfortune to adopt.

We have ourselves, on the other hand, made use of the grease-spot photometer throughout our research. We asserted that its indications were proportional to the weight of silver on the plate, and we never made any claim that it was absolutely accurate, or that it measured the whole of the light transmitted in all directions by the negative. The main practical result of our investigations, which we communicated to the Society, was a method of determining the speed of a sensitive plate. As the results of our investigations have been called into question, owing to some alleged inaccuracy in the measurements of the plates, we have made a determination of the speed of a plate both by gravimetric analysis and by photometric measurements. For this purpose we used four half-plates, exposed respectively for 10, 20, 40, and 80 seconds to a standard candle at a distance of one metre. The four plates were developed together, and, after carefully fixing, washing and drying, they were measured photometrically. The films were then removed from the plates, and the silver determined. The results obtained were as follows:—

Exposure C.M.S.	Measured Density.	Calculated Density.	Weight of Silver Chloride.
			Grm.
10	0·525	0·525	0·0163
20	0·960	0·963	0·0299
40	1·470	1·449	0·0450
80	1·970	1·968	0·0611

On the assumption that density, as indicated by photometric measurement of plates developed with ferrous oxalate, is proportional to the weight of silver, the densities calculated from the weights are as given in the above table. Diagram No. 3 shows the graphic method of finding the inertia of



the plate, and the absolute coincidence of the gravimetric and photometric results proves the extent to which the grease-spot photometer may be relied upon; and it also proves that there is, as we asserted there was, a range of exposures during which the weight of silver reduced by the light is proportional to the logarithm of the exposure. This is proved by the almost entire coincidence of the points and the straight line drawn through them. The abscissæ are the logarithms of the exposures, and the ordinates the milligrammes of silver chloride weighed. This experiment, we consider, disposes, once for all, of the adverse criticism which has been passed upon our photometer.

Captain Abney has discovered that negatives "scatter" so much light that our instrument cannot possibly measure all the light which a negative transmits; and owing to our instrument measuring the correct amount of light transmitted directly plus an excess of "scattered" light, as he told the Camera Club, we ought to find the transparency too great. But, in his criticism in the Journal of this Society, he found that a negative, measured by our method, gave a transparency of $\frac{1}{100}$ which, when measured by his "new and correct" plan (still using the sector) transmitted one-fortieth of the light. These criticisms, which are in direct antagonism, demand no reply.

In connexion with this "scattering" of light we wish to show you one or two experiments made by Captain Abney to prove what he thinks an insurmountable difficulty in our method of measuring plates.

We project upon the screen, by means of a lantern, a well-defined disc of light. Holding in front of the lens a piece of ground glass, this disc absolutely disappears and the light is now spread over the whole screen. This phenomenon is what Captain Abney terms the "scattering" of light. The fact is that the ground glass has itself become a source of light, and in calculating intensities of light as from this source, the distance of the illuminated screen would have to be measured from this ground glass.

If two pieces of the ground glass be placed in front of the lens, you will see that the general illumination is but slightly diminished.

If, instead of the ground glass, we place in front of the lens a solution of ammonio-cupric sulphate, the phenomenon is essentially different. The disc of light remains as it was (except that it is blue), and there is a very faint general illumination of the screen. Simply breathing upon the cell containing the solution will produce the "scattering" effect.

We now exchange this solution for a fairly dense negative which measures about 1·8, and again the phenomenon is slightly different. A well-defined disc of light is the most conspicuous effect, and around this disc you will perceive a halo of diffused light. There can be no doubt, however, that this phenomenon resembles much more closely that produced by the transparent solution than by the ground glass.

If a second negative of the same density be now placed in front of the first, both the disc and the halo are very considerably reduced in intensity—in fact vanish—which was not the case with the ground glass. This proves that both the directly transmitted light and the scattered light diminish, as the amount of silver on the negative is increased. And if, as in our photometer, the distance of the illuminated screen from the source of light and from the "scattering" negative be identically the same, then the total intensity of the light both "scattered" and directly transmitted by the negative, diminishes as the silver is increased, in accordance with the laws which we published in our former paper.

Many other criticisms have been passed on our paper which are too frivolous to call for notice, though we may just instance one respecting our use of logarithms and the effect which the employment of other systems of logarithms would have had upon our results. We would, in reply, to this, simply refer our critic to Chapter XVII. of Knight and Hall's Algebra.

We admit that, to many of the readers of our paper, the use we made of the word density proved a stumbling block. We can now see that if we had converted all the results into

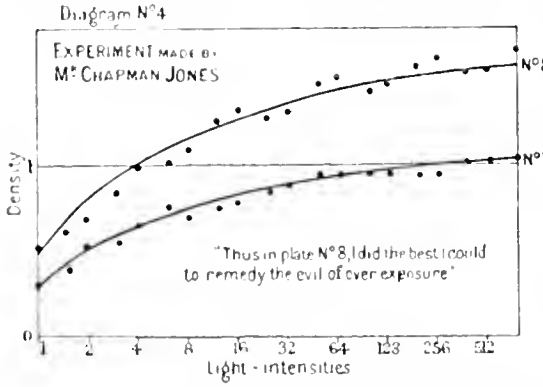
milligrammes of silver, we should have been better understood. Our "density" is in reality, however, synonymous with weight of silver.

It was by referring our results to weight of silver that we discovered that important and interesting curve, the characteristic curve of the sensitive plate. No other way of stating the results; no other method of plotting this curve would ever have revealed such a simple and important explanation of photographic phenomena. On this ground alone we claim a distinct score for our grease-spot photometer. The "law of error" is, on the other hand, utterly opposed to the photographer's every-day experience of the existence of distinct periods of under-, correct-, and over-exposure.

Another very important fact brought to light by means of the grease-spot photometer is that the photographer has no power to alter the ratio of the weights of silver reduced in various parts of the negative by alterations in development. These ratios are due to the action of the light alone.

To this statement many have taken exception, notably Mr. Chapman Jones, who, while he agrees with us that under-exposure cannot be corrected by development, still believes that, in some measure, over-exposure can be remedied. To prove this he made an experiment, and sent us the plates for measurement. The experiment consisted in illuminating two plates equally by means of a sensitometer, so as to obtain a similar series of gradations on each plate. The time of exposure was, in the case of both plates, 30 times that needed to give a perceptible deposit with the smallest hole of the sensitometer. The light intensities ranged from 1 to 775. One plate (No. 7) was developed for two minutes in a strong developer of soda and pyrogallol. The other plate (No. 8) was first immersed in a solution of potassium bromide, and the entire development occupied no less than 38 minutes, the alkali being added in minute quantities from time to time. Of this experiment Mr. Chapman Jones wrote:—"Thus in Plate 8 I did the best I could to remedy the evil of over-exposure." Diagram No. 4 shows you how far he succeeded. The

Diagram N°4.



curve No. 7 is a mean path on which the points which indicate the densities, as measured on Plate No. 7, ought to have been situated. The higher curve, No. 8, is exactly the same curve as No. 7, each ordinate being multiplied by the mean density ratio 1·54. This simply means that, had the development of Plate No. 7 been prolonged for one minute, the densities of Plate No. 7 would have been situated on the same curve as are those of Plate No. 8. In other words, Mr. Chapman Jones, in doing his best to remedy the evil of over-exposure, only succeeded in making one plate generally denser than the other, but the ratios of the silver deposited are, on the whole, the same in Plate No. 8 as in Plate No. 7. The density ratio between the extremes of Plate No. 7 is 3·22, that between the extremes of Plate No. 8 is 3·25, so that the density ratio was increased by less than 1 per cent. We do not therefore think that Mr. Chapman Jones can claim to have remedied the evil of over-exposure, considering that a correct representation of his light intensity would have demanded a density ratio between the extremes of at least 1:30.

This experiment clearly shows the inability, even of an expert, to correct over-exposure in development. Mr. Chapman Jones does not agree with us, however, because he regards the errors in these results as evidence that he *has* done something to remedy over-exposure. But when we arrange the true density ratios of the corresponding squares of Plates Nos. 7 and 8 in their original sequence on the plate, as we have done in Diagram No. 5, the errors

Diagram N°5.

				MEAN
1	2	3	4	
1·60	1·48	1·29	1·50	1·47
8	7	6	5	
1·67	1·54	1·32	1·52	1·51
9	10	11	12	
1·69	1·52	1·50	1·57	1·57
16	15	14	13	
1·66	1·55	1·51	1·61	1·58
17	18	19	20	
1·70	1·52	1·52	1·61	1·59

group themselves in such a way as to leave no doubt that they are due, almost entirely, to inequalities in the coating of the plates, particularly on the left-hand margin, where it will be seen the highest density ratios all lie. In our former paper we pointed out that inequalities in the coating of the plate constitute the most serious source of error of all. Mr. Chapman Jones bases his claim to have remedied over-exposure chiefly upon the averages of *four* groups, each consisting of *five* consecutive density ratios. The diagram will show the fallacy of such a proceeding, as two of the groups each include two of the high marginal density ratios, one group includes only one, and the fourth group does not include any at all. The averages of *five* groups, each consisting of *four* consecutive density ratios, as indicated on the diagram, fail altogether to support Mr. Chapman Jones' claim.

We ourselves consider that this experiment upon which Mr. Chapman Jones exerted his utmost skill a most striking proof of our assertions, and, as experiments of this kind are most welcome to us, we here record our thanks to him for the trouble he has taken to put our conclusions to a practical test.

We will conclude this paper with a quotation from an address by Captain Abney to the British Association at Newcastle. He said: "Photography deserves to have followers of the highest scientific calibre, and if only some more real physicists and chemists could be induced to unbend their minds and study the theory of an applied science which they often use for record or for pleasure, we might hope for some greater advance than has hitherto been possible."

We do not flatter ourselves that we are physicists or chemists of the highest scientific calibre, nor do we claim to have had Captain Abney's opportunities and experience in photographic matters; but we do claim, for our investigations, superiority over his, in that they are based upon a scientific and satisfactory nomenclature and system of units, and that they were carried out in such a way as to be capable of repetition by anybody else.

We claim also to have given formulæ which, unlike Captain Abney's, lead to truth, explain photographic phenomena, and admit of practical application. We have had the misfortune to discover the errors of his results, and have thereby incurred his serious displeasure.

Manchester Section.

Chairman: Ivan Levinstein.
Vice-Chairman: Edw. Schunck.
Committee:

J. Angell.
G. H. Bailey.
R. F. Carpenter.
G. E. Davis.
H. Grimshaw.
Harold B. Dixon.
J. Grossmann.
P. Hart.
A. Liebmann.
Sir H. E. Roscoe, M.P.
C. Ruby.
D. Watson.

Hon. Local Secretary:
J. Carter Bell.
Bank House, The Cliff, Higher Broughton, Manchester.

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

Meeting held on Friday, 9th January 1891.

MR. PETER HART, F.I.C., IN THE CHAIR.

SOME LABORATORY EXPERIENCES.

BY DR. B. W. GERLAND.

A.—Thymol as Preservative for Standard Solutions of Oxalic Acid and Tartar Emetic.

The convenience of oxalic acid as standard solution is counterbalanced by its tendency to decompose under uncontrollable circumstances. I have succeeded in preserving the solutions (normal and tenth normal) already for two years by adding a small crystal of thymol. This does not interfere with its use for standardising alkaline solutions. Permanganate also acts normally on the solution containing thymol either cold or warm, but a short time after the pink has become established, the solution turns muddy brown. Nevertheless the value of the solution against permanganate is the same, whether it contained thymol or not, as long as the quantity of permanganate necessary to produce the pink colour is taken.

The standard solution of tartar emetic which I use in my process for the estimation of tannin is also preserved by a small quantity of thymol without interfering with its use.

B.—Estimation of Basicity of Solutions of Aluminium Salts.

The determination of the excess of acid in an aluminium salt by titration with soda using methyl orange as indicator, has been repeatedly recommended. I have for a long time availed myself of this valuable indicator for estimating the basicity of aluminium salts by titration with a mineral acid. I prefer for this purpose to measure off twice the same quantity in two similar beakers, colour both equally very faintly with the methyl orange and add the standard acid (nitric, hydrochloric, or sulphuric acid) until the pink has become constant. After a while the pink changes again to yellow, but for the last drops so slowly that the distinction of the colour becomes difficult. This operation is facilitated by having the two samples before the eyes and adding alternately a drop of the standard acid to the one and the other until both retain the same shade of pink.

In this operation the first quantity of acid added colours the liquid pink for an instant, which changes quickly to yellow, but the more the point of neutrality is approached the slower this takes place, so that for the last drops hours are required to produce the chemical equilibrium, and sometimes midsummer day would not be long enough to finish the test with the strictest accuracy. It is this surprising retardation of chemical reaction between the substances in solution which induced me to mention the matter here.

The titration is expedited by heat. If it should be preferred to add at once an excess of standard acid and measure the excess of the same by standard alkali, it is preferable to use an alkaline carbonate, as this precipitates the alumina in a more flocculent form, which is redissolved quicker than with caustic alkali.

C.—Observations with Bleaching Liquor and Solutions of Bleaching Powder.

Many years ago I tested daily the casks of bleaching liquor which were delivered by two firms. The liquor from one firm was invariably normal in its behaviour and contained the stipulated quantity of chlorine. It was delivered through the railway carriers, and may have been days old. The other firm delivered their liquor at odd times in a warm state, and as a rule with only 5 per cent. chlorine. They were both tested in the same way by adding excess of one-tenth standard arsenite, starch paste, and titrating back with standard iodine solution. To my amazement I found that the liquor appeared the poorer the quicker the process was worked, so that after some practice the 5 per cent. liquor could be made to yield only 2 per cent. of chlorine. Having no time to investigate this surprising behaviour I communicated and demonstrated these observations to several chemical friends, but so far have not had the satisfaction to see them supported by others.

After some time the bleaching liquor was replaced by solutions of bleaching powder produced at the works, and I interested myself in the behaviour of this solution, but could never find any material change in its strength from the time of its production to the age of seven days, except, as was to be expected, a slight deterioration.

About the same time this solution was used for the oxidation of an organic substance in alkaline solution. This process took a characteristic course. After mixing, the temperature rose gradually to 40°, and then at a highly accelerated rate until, if no special attention was paid, it would come to a violent boil and the experiment was lost. But the course of reaction was so regular that, after having once learned to manage it, I had no mishap in the great number of operation conducted in the course of several years. The reaction completed, the solution contained no more hypochlorite. This operation was taken up again after long interruption, but now its course was essentially different.

After the mixing, the temperature did rise, but much slower than before, and would retrograde before the 40° was reached, whilst the liquor still contained hypochlorite, and no further reaction would take place. Accidentally I treated a part in a copper vessel, and after a time the process started again and continued under the same phenomena as before. This induced me to add a minimal quantity of a copper salt to the bulk of the mixture in the wooden vat, and the result was that the reaction set in and continued under rise of temperature until all hypochlorite had disappeared, and the result was the same I had been accustomed to in former years.

I took much pains in inquiring about the materials used formerly and now, and could only arrive at the conclusion, with a high degree of probability, that the only difference was that in the older manipulations bleaching powder, made by the Deacon process, whilst for the recent ones certainly bleaching powder made by the Weldon process, was used.

It is not improbable that in the Deacon process minimal quantities of copper are carried off by the gases and become fixed in the bleaching powder. I have never noticed any statement to that effect nor anything alluding to a different behaviour of bleaching liquors and solutions of bleaching powder.

Induced by this experience I turned my attention again to the solutions of bleaching powder, and found that the numbers of samples tested increased in strength by 0·2 to 0·4 per cent. for the 6·5 per cent. solution in the course of a few days.

These observations suggest a number of questions of theoretical as well as practical interest, which I should have gladly worked upon had not circumstances interfered and deprived me of my opportunities and preparations.

To any chemist inclined to take up this investigation I heartily wish success and give him the assurance that I have most carefully tested and taken extensive precautions to avoid self-delusion in my observations on account of the unexpected and so far unaccountable results.

Discussion.

The Chairman wished to know what was the advantage of oxalic acid over other acids as a standard solution?

Dr. Grossmann said: While he had not had any experience of bleaching powder made by Deacon's process he had had some years' experience of the Weldon process, and as far as Weldon bleach was concerned he had always found that its solution lost strength on standing. Bleaching powder in the solid state would also deteriorate in time, and it was said that it would sometimes decompose suddenly with strong evolution of oxygen, and so violently as to resemble an explosion. Weak old bleaching powder generally contained chlorate, and if the temperature in the chambers was allowed to rise too high, fresh bleach would also contain chlorate. It would depend upon the way in which it was tested whether the chlorate present would appear in the test as active chlorine, or not at all. Dr. Gerland's observation that copper salts caused an evolution of oxygen might be due to the acidity of the copper compound, but if that were not the reason it would be very important to carry these experiments further and see what other compounds would have the same effect. In the manufacture of chlorate of potash there was always an evolution of oxygen, even if the temperature were carefully regulated; and the question arose whether this might not be due to the presence of minute quantities of copper, or other compounds of like properties, in the lime used for the purpose.

Dr. Gerland, in reply, said that the presence of chlorate could not have interfered with the results because there was always a large excess of alkali or milk of lime present. The spontaneous decomposition of bleaching powder was, in his opinion, caused by the evolution of free oxygen, and that the formation of chlorate was quite subordinate. The explosions referred to were caused by the evolution of free oxygen. The thymol acted as a preservative on the solution of tartar emetic used by him for the estimation of tannin.

TURKEY RED OIL.

BY J. ARTHUR WILSON.

Historical.—Turkey Red oil, the product of the reaction of sulphuric acid and castor or olive oil, was introduced about the year 1876, at least so far as being placed on the market is concerned. It is probable, however, that it was made secretly some time previous to this. In 1874 there appeared the so-called soluble oil, made by the saponification of castor oil by caustic soda, and hence consisting of the sodium salts of ricinoleic and iso-ricinoleic acid.

Mercer and Greenwood patented the product of the reaction of sulphuric acid and olive oil, and it is said that the German chemist Runge prepared this compound even still earlier; but who was the first to suggest the use of castor oil in place of olive oil is not positively known. Turkey Red oil was originally intended for use in the fabrication of Turkey Reds, and hence possess the exclusive right to the name Turkey Red oil, although scientifically speaking it is not correct. In commerce it is usually called oleine, a term somewhat confusing, it being different from the olein of fats, or the olein of Yorkshire grease.

Manufacture.—The manufacture of Turkey Red oil is a comparatively simple operation; it requires no expensive plant, and very little skilled labour, although there are several details to be attended to. It may be divided into two parts—

1. *Hydrolysis of the Fatty Oil.*

2. *Purification of the Products of the Interaction and Partial Neutralisation.*

The first operation takes place in rectangular wooden vessels, occasionally lined with lead, and preferably fitted with an apparatus for agitation of the contents of the vats. These vats are fitted with stop-cocks at suitable heights in order to run off the wash-waters and the finished products. Castor oil (if castor Turkey Red oil is desired) is run off, and the contents gauged, the weight of which may be found from the specific gravity of the oil. The proper quantity of oil of vitriol is then added slowly, the whole contents being thoroughly agitated by means of the apparatus, or in default of this by large paddles made of wood. The amount of vitriol used varies from 15 to as much as 40 per cent. of the weight of oil, being most in winter and least in summer, and both of which differ according to the practice of the manufacturer. Again, some add the whole of the vitriol at one time, others at two periods, one half on one day, and the other the day following. The heat is not allowed to get too high, which would produce a dark-coloured product; but in any case, evolution of sulphur dioxide is perceived by the smell, but it probably results from decomposition of the albuminoids and other extraneous matters of the oil. After allowing to stand another 12 or 24 hours, it is ready for washing.

This is done by hot water containing more or less common salt, in order to reduce to a minimum the loss due to solubility. Some makers work first with ordinary water and finally with brine.

In washing with brine, it is important not to commence with too hot a solution, otherwise the excess of vitriol produces chlorohydric acid, which decomposes the sulphated oil, and this is simply undoing what we have previously done. After the washing comes the neutralising, which is only done partially. Soda or ammonia are employed; the latter is to be preferred, although soda is more generally used.

Water is then added so as to make a finished product containing from 45 to 50 per cent. fatty matter; occasionally much less water is added, especially when for export.

The neutralisation is carried out so far that, about from one-fourth to less than one-half of the theoretical, the average composition is—

1·30 to 1·50 per cent. Na_2O.
20·0 to 27·0 per cent. free fatty acids.
25·0 combined acid and glycerides.

In producing high class Turkey Red oils, much more trouble is taken, but the above is the plan usually followed. In summer time, Turkey Red oil occasionally decomposes with separation into fatty matter and water, together with an odour of fermentation. On one occasion I took some of an oil thus decomposed, and placed it on flour paste in a moist warm atmosphere, when the surface was instantly covered with a purple colouration as if a tar dye had been sprinkled on. This is similar to results often found on mildewed cotton, and caused by a variety of fungus not thoroughly studied. It is very important that Turkey Red oil should not be too acid, otherwise it will not bear the addition of a proper amount of tin compounds in the preparing liquors.

Applications.—Turkey Red oil, as its name implies, is used in the initial preparation or mordanting of Turkey Reds, but it is used in the final production of ordinary Alizarin Reds, and in the mordanting of cloth for extract and steam styles in calico printing. The process for producing Turkey Reds may be briefly stated as follows:—The previously well-bleached pieces are passed through a liquid prepared from Turkey Red oil, aluminate of soda, stannous chloride and ammonia, and dried. Then they are passed through a solution of alum once or twice and again dried, and kept in a properly constructed room to age. They are then passed through cow-dung and arsenate of

soda, to fix the mordant and remove any excess, when they are ready for dyeing. After dyeing they are again prepared in Turkey Red oil, steamed with high or low pressure steam, and brightened by soaping, which completes the operation. Turkey Red oil is used in ordinary Alizarin reds only in the final operations of brightening. Thus the manufacture and application of Turkey Red oil is not an unimportant industry which absorbs a large quantity of the castor oil imported.

Constitution.—Turkey Red oil has been the subject of much investigation, but on account of the difficulties in this branch of research, the results contain much of a speculative character. Turkey Red oil may be manufactured from olive, cotton, or castor oil, but the latter alone has the legitimate right of the designation Turkey Red oil. We may therefore concentrate our attention on the product produced by the action of sulphuric acid on castor oil and of olive oil. Such a study divides itself into two parts, viz., action of sulphuric acid on ricinoleic acid and isoricinoleic acid and triricinolein. 2nd. Action of sulphuric acid on oleic acid and triolein, which are those peculiar to castor oil and olive oil respectively. Castor oil contains no oleic acid, whilst olive oil probably contains linoleic acid, although in small quantity.

The hydrolysis of a tryglyceride by an alkali such as alcoholic potash would be represented by the elementary equation—

$$(C_3H_5)F_3 + 3\,H_2O = C_3H_5(HO)_3 + (H_3F_3)O_3$$

but the action of sulphuric acid is not so simple, the products not being simply fatty acids forming the molecule of the triglyceride and glycerol, but they contain sulphur in combination in some form or other; and it is here that the opinion of chemists who have studied the question are divided. The question as to completion of the hydrolysis under the conditions which obtain in the manufacture of Turkey Red oil are shown thus :—

Sulphuric Acid used.	Free Fatty Acid = Sulphoricinoleic Acid.
Per Cent.	Per Cent.
12·5 by weight.	30·4
25·0 „	55·5

The percentage of free acid, and hence the progress of the reaction, is not quite proportional to the acid used. But from the composition of the Turkey Red oil it is possible to tell approximately how much vitriol has been used in its fabrication. A 45 per cent. Turkey Red oil usually contains 25 per cent. free acid, and the matter separated from such an oil by acid and salt solution usually contains—

	Per Cent.
Free fatty acids as sulphoricinoleic	78·5
Glycerides as triricinolein.....	25·3
	103·8

so that after making allowance for free acid existing in the oil, about one-third of vitriol is commonly used, although considerably less than this is occasionally used.

The fatty matter of Turkey Red oil is divided into two classes, viz., those soluble in water and those insoluble in water. Luchti and Suida believe that the soluble part of Turkey Red oil from olive oil consist of glycerol sulphates, one of which is derived from hydroxystearic acid, $C_{18}H_{36}O_3$, and the other from an hydroxyoleic acid—

$$\left.\begin{matrix} C_{18}H_{33}O_3\,C_3H_5OH \\ SO_4 \end{matrix}\right\} = \text{Hydroxyoleic glycerol sulphate.}$$

$$\left.\begin{matrix} C_{18}H_{35}O_3\,C_3H_5OH \\ SO_4 \end{matrix}\right\} = \text{Hydroxystearic glycerol sulphate.}$$

Such a view is, however, untenable, from the fact that oleic acid gives the same product as triolein, in the former case of which no glycerol is present, and also that from Turkey Red oil only the most minute traces of glycerol can be obtained, and that such bodies would be neutral and not acid as is the case. The only two other possible views are those of Müller-Jacobs and of Benedikt. The latter believes that the compounds are not true sulphonic acids, but similar in constitution to the bodies known as sulphuric esters. Müller-Jacobs considers them to be true sulphonic acids.

The following formulæ shows both these views in juxtaposition :—

$C_{17}H_{33}OH$	$C_{17}H_{34}OSO_3H$
SO_3H	$<$
$COOH$	$COOH$
Hydroxystearin sulphonic acid. Müller-Jacobs.	Hydroxystearin sulphate. Benedikt.

Benedikt and Ulzer obtained the true sulphonic acid of a higher homologue of oleic acid synthetically and compared its properties with those of the Turkey Red oil acid. It is a yellow oil miscible with water in all proportions; it is unattacked by caustic alkalis and concentrated chlorhydric acid, whilst by the latter Turkey Red oil acids are decomposed into sulphuric acid and hydroxystearic acid. Benedikt and Ulzer, from this and other considerations, believe their theory correct, viz., that the soluble part of olive Turkey Red oil consists of hydroxystearin sulphate, that of castor Turkey Red oil of recinolein sulphate.

Luchti and Suida have considered the soluble part of olive Turkey Red oil to consist of an acid sulphate of hydroxystearic acid, explaining the decomposition in the following manner :—

$$\underset{\text{Oleic Acid,}}{C_{18}H_{34}O_2} + \underset{\text{Hydric Sulphate.}}{H_2SO_4} = \underset{\text{Hydroxystearin Hydrogen Sulphate.}}{C_{18}H_{35}(OSO_3H)O_2}.$$

$$\underset{\text{Hydroxystearin Hydrogen Sulphate.}}{C_{18}H_{35}(OSO_3H)O_2} + H_2O = \underset{\text{Hydroxystearic Acid.}}{C_{18}H_{35}(OH)O_2} + H_2SO_4.$$

Benedikt and Ulzer have determined the quantity of hydroxy acid in Turkey Red oils of various origin by means of the acetyl process (some doubt has been thrown on the value of the acetyl process by Lewkowitsch, see the Proceedings of Chemical Society, 1890), and compared those with the theoretical values of hydroxystearic acid and ricinoleic acid. They have also determined the iodine values of the acid from olive Turkey Red oil and from castor Turkey Red oil, which results will be considered in the concluding part of this memoir.

The author's experiments on the conjoint fatty matter rom castor Turkey Red oil show—

	Per Cent.
Free fatty acids (calculated as ricinoleic acid)...	78·5
Glycerides calculated as triricinolein).....	25·3
	103·8

which shows that acids of lower molecular weight are present. Olive Turkey Red oil in similar manner from a consideration of the alkali required on the one hand for neutralisation, and on the other for hydrolysis.

	Per Cent.
Free acid calculated to hydroxytearic acid	71·7
Triolein	24·8
	96·5

The regeneration of the primary acid, in the case of castor oil, ricinoleic and isoricinoleic acids, is not so easy as Benedikt supposes. Thus the mean combining weight of Turkey Red oil acids from castor oil after boiling with acid was 321, whilst ricinoleic acid would be 298.

Experiments made in the author's laboratory show that the greater the amount of sulphuric acid used in the fabrication of the Turkey Red oil, the lower the percentage of iodine assimilated, and presumably the less capacity for oxidation. Similarly, increase of hydrolytic agent means raising the melting point of the conjoint acids in the case of olive oil, whilst the reverse is the case with castor oil. Thus the acids from olive Turkey Red oil prepared by half its weight of sulphuric acid have a melting point of 41° C. = 106° F., those of castor Turkey Red oil at about 34° F.

Benedikt and Ulzer, as a result of their experiments, show that the known superiority of Turkey Red oil from castor oil in Turkey Red dyeing is due to it consisting of the acid sulphate of a non-saturated acid, whilst on the other hand olive Turkey Red oil contains derivatives of a saturated acid; also, that on account of the acid prepared from olive Turkey Red oil absorbing no iodine, whilst the castor oil acid takes up 83 per cent., the latter has a greater capacity for oxidation, and hence is more suitable. Another fact must not be lost sight of, and that is emulsions of castor Turkey Red oil are in a much finer state of subdivision and hence in being taken up by the fabric offers a larger surface to oxidation.

Analysis.—The analysis of Turkey Red oil is divided in two parts, one of which it is proposed to deal with in a future paper:—1st. The estimation of the proportion of combined alkalis, free fatty acids, and of total fatty matters. 2nd. The examination of the fatty matters for purity. The latter is the most difficult, and it is intended to devote a special paper to the subject, when a large number of experiments now in progress are finished.

Specific Gravity.—The specific gravity of Turkey Red oil is very variable; it is best taken by means of the Westphal balance. In a 45 per cent. oil the limits may be—Maximum, 1·035; minimum, 1·017.

Estimation of Total Alkali.—5 to 7 grms. of the oil are diluted to about 50 cc., a few drops of methyl orange added, then half normal hydric sulphate till the usual reaction.

In a Turkey Red oil giving a deep milky emulsion with water, the percentage of Na_2O will be from 0·8 to 1 per cent. or even lower, whilst an oil giving only a moderate emulsion or none at all, the percentage of alkali (Na_2O) may be from 1·2 to 1·5.

Estimation of Free Fatty Acids.—The estimation of free fatty or fatty sulphuric acids in a Turkey Red oil neutralised by caustic soda is carried out in the usual manner with a few precautions. It is necessary to use much more alcohol or preferably a mixture of alcohol and ether; also, the temperature of the liquid during titration must be low on account of the great tendency to hydrolysis of the glycerides present in all Turkey Red oils, and the liquid must be rapidly agitated to prevent local action of the alkali. Semi-normal alcoholic potash is used for titration and phenolphthalein as indicator.

The average percentage of free fatty acid present calculated in terms of sulphoricinoleic acid, in a 45 per cent. oil may vary from 22 to 30 per cent.

In a Turkey Red oil, in which ammonia has been used for neutralising, a difficulty is encountered in the fact that the alkali used for titration liberates a quantity of the ammonia which may be lost if the temperature be above 60° F., and when we remember the reaction of ammonia towards phenolphthalein, we shall see that the end reaction is by no means sharp; nevertheless very good results may be got even in the case of ammonia Turkey Red oil.

Estimation of Total Fatty Matters.—The accurate estimation of total fatty matters in Turkey Red oil is a matter of some importance, and one in which considerable difference of opinion exists as to the best method of attaining the object in view. When we consider the constitution of Turkey Red oil it will be evident that the method of analysis used for other fatty bodies such as soap, are of little use without considerable modification. A crude form of test much used by manufacturers is the following:—"20 grms. of sample in a 200 cc. flask, add 20 cc. of water and 20 cc. of strong HCl, boil till the fatty matter floats quite clear on the aqueous liquid, pour into graduated jars, allow to cool, read off number of cc., which multiplied by 5 gives percentage."

It is evident that the preceding test can at most be only roughly approximate, there being errors on both sides, loss due to solubility on the one hand, and on the other the fatty layer retains water, and volume is taken as weight. Much more satisfactory as a factory test is the following:—25 grms. of the sample is weighed out into a flask, the body of which holds about 100 cc., and the neck is graduated into centimetres and tenth of a centimetre. 50 cc. of saturated salt solution added and 10 cc. of concentrated HCl, boil till clear, and add saturated salt solution till rather above the zero graduation, allow to cool, and read off the number of cc. from which the percentage is calculated.

Although the above tests may be suitable as a control in the manufacture of the oil, they are not suitable for purposes of valuation. I have therefore pleasure in submitting the following method as being equal or better than any hitherto published. It relies on the use of an immiscible solvent with subsequent treatment of the extract to remove extraneous matters.

Ten cc. of perfectly saturated salt solution are pipetted into a globular separator of about 100 cc. capacity, and from 5 to 6 grms. of the sample poured directly into the separator. About 0·5 cc. of HCl 1–2 is then added, and the whole thoroughly agitated, after which about 50 cc. of ether is added and again agitated. The ethereal layer is received into a dry flask, and the aqueous layer again agitated with about 25 cc. ether, which is received in the flask with the first extract. The ether is then evaporated and recovered, and the fatty matter in the flask dried by blowing dry air through about 10 minutes.

From 25 to 35 cc. of really absolute alcohol is then added, agitated and allowed to stand a short time, poured through a dry filter, the residue in flask washed two or three times by alcohol, and the filtrate and washings received in a tared flask, the alcohol evaporated and the residue kept on the water-bath about one hour, whilst a current of purified air is continuously passed through the flask. The residue is then weighed and the percentage calculated.

The functions of the alcohol treatment are: it enables the water taken up in all ethereal extractions to evaporate quickly and precipitates the sodium sulphate, leaving the fatty matters in as pure a condition as it is possible to attain.

I have tested a number of the extracts for ash by burning at a very low heat in platinum, and have never found more than 0·3 per cent. ash, and with proper manipulation as low as 0·1 per cent. ash.

Discussion.

Dr. C. O. Weber: Mr. Wilson gave the quantity of sulphuric acid as ranging from 15 to 40 per cent. He thought this depended largely upon the temperature at which the oil was produced, and this should be kept as low as possible. The amount of sulphuric acid used was most important in the manufacture of Turkey Red oils, and the rise of temperature above a certain point produced decomposition not only of the albuminous matters, but also of the ricinoleic acid which was split in the molecule; and if they examined the oils which have been produced above 40°, they would find the products of the decomposition of the ricinoleic acid. To always get a product of the same quality it was desirable to use the same quantities of sulphuric acid; and if under these circumstances the temperature was found to rise above 40°, artificial cooling must be applied. He deprecated the use of brine for washing, because if used for the first washing, where there were large quantities of free sulphuric acid present, there was also large quantities of hydrochloric acid set free, which had a much stronger tendency to decompose ricinoleic acid than even sulphuric acid had. He would rather recommend washing with Glauber salt solution, which was absolutely innocuous. As far as his experience went, the excess of sulphuric acid used in the manufacture of Turkey Red oil made the use of any salt solution unnecessary, at any rate in the first washing. For the second or third washing it might be advisable to use Glauber salt solutions. In his opinion the theoretical side of the question was not far enough advanced to form any reliable judgment, but he did not think that sulphurous ethers were present to any large extent in Turkey Red oils, as in that case they would always be able to regenerate equivalent quantities of sulphuric acid, whereas on analysing Turkey Red oils they could not regenerate sulphuric acid, or very small quantities only. But this referred particularly to oils produced at low temperature; if the oils were produced at temperatures above 40° C. the case was somewhat different.

Dr. Brunner: The decomposition product of ricinoleic acid was in no case valerianic acid, but oenanthylic acid.

Dr. Weber: With regard to the remarks just made, he had seven years ago seen considerable quantities of what was represented to him to be valerianic acid produced from Turkey Red oils at high temperatures.

Dr. J. Grossman said it seemed to him very unlikely that with a mixture of strong sulphuric acid and salt at ordinary temperatures there should be hydrochloric acid set free.

Dr. Weber: That hydrochloric acid was set free was absolutely certain, especially when used in the manner referred to by Mr. Wilson. If sulphuric acid be added to a hot or cold solution of salt, there could not be any doubt that hydrochloric acid was set free, and that would act upon the ricinoleic acid, as he knew from sad experience.

Mr. W. Thomson asked whether there was any distinct relation between the iodine absorption of Turkey Red oil and its capability of being oxidised.

Mr. Wilson, in reply, said that both Glauber and common salt were used largely for washing purposes. If they were not used there was great loss due to solubility of the most valuable parts of the fatty acids. He was aware that occasionally nothing but water was used, except perhaps in the final washing, and this, as he had stated before, was only partly satisfactory. With regard to the production of hydrochloric acid in the first wash by action of the sulphuric acid on the common salt, he understood there was some doubt in their minds. He would say that it was beyond doubt, and on this account he would recommend the use of sulphate of soda in the first wash, if not altogether. In many cases it was best not to use water of too high a temperature to begin with, as he had mentioned in the paper. He had spent several days washing the fatty matters produced by the action of sulphuric acid on castor oil, and had found that to some extent there was a regeneration of the primary fatty acids and sulphuric acid by the action of fairly concentrated acids. As to the remarks made by Mr. Thomson with regard to the relationship between the iodine absorption of fatty acids and their tendency to oxidise, there were some marked exceptions to the usual rule, still in the majority of cases it was no doubt true.

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Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

SESSION 1890-91.

Feb. 3rd (Edinburgh).—Dr. J. B. Readman. "The Manufacture of Phosphorus: Part III."

Mar. 2nd (Glasgow):—

(1.) Dr. E. J. Mills. "Destructive Distillation: Part II."

(2.) Messrs. R. T. Thomson and H. Ballantyne. "On the Revision of Constants Employed in the Analysis of Fats and Oils: Part II."

Meeting held at the Societies' Rooms, 207, Bath Street, Glasgow, on Monday, 5th January 1891.

MR. W. J. CHRYSTAL IN THE CHAIR.

THE EFFECT OF EXPOSURE UNDER CERTAIN CONDITIONS UPON SOME CONSTANTS OF OILS.

BY H. BALLANTYNE.

The object of the following experiments was to ascertain the effect of exposing different oils to the action of light and air, upon the so-called "constants" employed in the analysis of such fatty substances, with a view to determining which constants should be relied upon in examining oils of doubtful age.

As far as can be ascertained by a perusal of the literature on oil-analysis of the last 10 years, no systematic series of experiments has been made for the purpose of examining the effects of exposure upon oils. It is, of course, a well-known fact that long exposure to light and air causes an oil to become rancid and to liberate a quantity of free acid, and it is very generally understood that the rancidity is due to this liberation of free acid. Most oils are known to have their colours bleached by subjection to sunlight, and this fact is utilised to a certain extent in the refining of oils in commerce.

Occasionally one comes across notes of the abnormal figures given on analysis by old samples of particular oils. For instance, Allen (this Journal, 1886, 66), mentions that a sample of porpoise oil, having a specific gravity of 920, after standing for three years showed a gravity of 926, while no great increase of free acid was observed; another portion of the same oil, kept under different conditions, had increased in density to 932. It has also been noticed that the iodine absorption of rancid butter-fat is abnormal, but such peculiarities have occurred where the oil was either in a state of decomposition or was very old. It is hoped that, owing to their systematic nature, the following experiments may prove of value to those interested in oil-analysis.

The oils operated upon were olive, castor (first pressure), rape (colza), cotton seed, arachis (earth-nut), and linseed, these being six of the most important oils used in commerce. Of each of these, six quantities of about $3\frac{1}{4}$ oz. each were exposed in white glass bottles, thus:—

A. Kept in direct sunlight, uncorked, and agitated every morning.

B. Kept in direct sunlight, uncorked, but undisturbed.

C. Kept in direct sunlight in a corked bottle and undisturbed.

D. Kept in the dark, uncorked, and agitated every morning.

E. Kept in the dark, uncorked, but undisturbed.

F. Kept corked and undisturbed in the dark.

Thus quantities A. and D. would show in an exaggerated degree the results of exposure to both light and air, and air only, respectively, while B. and E. would indicate what alterations might be expected in ordinary sample bottles of oil under these circumstances, which had inadvertently been left uncorked.

As it was found that only series A. and C. were affected to any appreciable extent by this treatment, these two sets alone were tested regularly every month, the constants determined being the free acid, potash neutralising power, specific gravity and iodine absorption. The colour and

quality were also noted. At the end of six months the quantities B., D., E., and F. were examined in their density, iodine absorption, potash neutralising power and free acid, and Maumené's temperature test was performed on quantities A., C., D., and F.

In Table I. will be found a note of the alkali-neutralising power of and percentage of free acid in the original samples operated upon; the specific gravity, iodine equivalent and temperature reaction are referred to in their respective tables.

Table I.

	Olive No. 1.	Castor.	Rape.	Cotton Seed.	Arachis.	Linseed.	Olive No. 2.
	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
Potash neutralising power	19·00	18·02	17·53	19·35	19·21	19·09	18·90
Free acid as oleic*	5·19	2·16	2·43	0·27	6·20	0·76	11·28

* The free acid is in all cases calculated to oleic acid for simplicity's sake.

The constants will now be dealt with individually.

1.—*Free Acid.*

There is a very prevalent belief among chemists that the rancidity of oils is due to the liberation of free acid by decomposition, and many references could be given to papers in which such a statement is made. Starting with that supposition, the writer was surprised to find that such was not the case, but that in most instances rancidity sets in and continues for some time without the liberation of any free acid whatever, and in others the development of free acid commences long before rancidity. Thus, it is found that with olive, rape, castor, and arachis oils, no increase of free acid whatever has taken place during the six months, even in the quantities shaken up every morning and allowed to stand in direct sunlight, while rancidity has commenced in the latter quantities. It is therefore unnecessary to mention the figures for free acid obtained every month in these oils, although, of course, it is certain that decomposition and liberation of free acid will take place after a certain prolonged exposure.

On the other hand, cotton seed and linseed oils develop free acid before rancidity sets in. Thus, the cotton seed oil in experiment A. became rancid shortly after the fourth month, whereas the free acid increased regularly from the beginning of the experiment at the rate of 0·08 per cent. per month (that being 30 per cent. of the total free acid), and amounted to 0·77 per cent. at the end of six months. In quantities B. and C. the free acidity rose to 0·45 per cent., while in D., E., and F. there was no increase, owing to the absence of light. Linseed oil affords results analogous to those of cotton-seed oil: the free acid originally was 0·76 per cent., while at the end of half a year it had increased to 1·10, 0·91 and 0·81 per cent. in series A., C., and B. respectively.

2.—*Potash Neutralising Power.*

This was determined regularly once a month, but in no case was it found to be affected.

3.—*Colour.*

The quantities exposed to both sunlight and air (A. and B.) were rapidly bleached, castor, rape, arachis, and linseed becoming only faintly yellow, and cotton seed almost perfectly colourless. Olive oil gradually developed from a strong yellowish brown into bright pale green, and then faded until it became colourless.

The rapidity of the bleaching process seems to vary in different olive oils, as in olive No. 2, mentioned below and in Table I., the colour at the end of five months is only somewhat less yellowish-green than the original oil, whereas at the same period olive No. 1 had become bright green.

Quantities C., kept corked in direct sunlight, were slightly bleached, while the series kept in the dark were not at all affected, thus showing that light and air are both necessary to bleach or alter the colour of an oil.

4. *Specific Gravity.*

It was found that the specific gravities were affected to a very remarkable extent by exposure. Table II. embodies the results of determining every month the specific gravities at 15·5 C. of quantities A. (exposed to direct sunlight, uncorked, and agitated every morning) and C. (exposed to direct sunlight in a corked bottle).

Table II.—Specific Gravities at 15·5 C.

Set.	Name of Oil.	Original.	One Month.	Two Months.	Three Months.	Four Months.	Five Months.	Six Months.
A	Olive.....	916·8	918·7	919·3	920·8	921·5	922·7	924·6
	Castor	967·9	968·1	969·1	970·0	970·0	968·5	968·3
	Rape (colza)	916·8	918·3	917·2	918·5	918·4	920·0	920·7
	Cotton seed	922·5	923·7	924·1	926·1	927·8	930·4	932·0
	Arachis (nut).....	920·9	921·3	922·1	923·3	923·9	925·6	926·7
	Linseed.....	932·5	933·1	933·6	935·3	935·9	937·2	938·5
C	Olive.....	916·8	917·5	917·1	918·1	917·3	917·2	918·5
	Castor	967·9	968·9	968·5			Discontinued.	
	Rape (colza)	916·8	917·1	916·5	917·0	916·7	916·3	917·1
	Cotton seed.....	922·5	923·5	922·6	923·4	923·1	922·9	923·6
	Arachis (nut).....	920·9	920·9	920·8	920·9	920·9	920·9	921·6
	Linseed.....	932·5	932·4	932·6	932·6	932·8	932·6	932·7

In A. we find that olive oil increased in density from 916·8 to 924·6, castor from 967·9 to 968·3, rape from 916·8 to 920·7, cotton seed from 922·5 to 932, arachis from 920·9 to 926·7, and linseed from 932·5 to 938·5 in six months. None of the oils was rancid till the fourth month. Series B., which corresponds with ordinary samples left in sunlight imperfectly corked, showed an increase in specific gravity to 920·3, 968·0, 919·4, 925·9, 924·0 and 936·2 in olive, castor, rape, cotton seed, arachis, and linseed oils respectively. In set C., Table II., we find that some of the densities are affected to a noteworthy extent, but this change is apparently due chiefly, if not wholly, to slightly imperfect corking of the bottles, and the unavoidable admission of fresh air on the occasions when the periodical tests were performed.

Owing to these extraordinary and unexpected results, a large quantity of an entirely different olive oil (containing 11·28 per cent. of free acid as compared with 5·19 per cent. in the first-mentioned specimen) was exposed under the conditions marked A., C., and F., and hitherto has shown results in accordance with those above, having increased in four months from 916·5 to 919·0 sp. gr.

It will be noticed that the increase in density of the oils is by no means regular, month by month. This irregularity is due to a combination of many causes, the most important one being undoubtedly the weather—the temperature and the quantity of sunshine. That the rise in gravity is not due to mere contraction of the oils was proven by exposing quantities of olive oil in tall bottles, and noting the volume of the oil, at the same temperature, before and after exposure; it was not found to have varied.

On examining these figures, one is at once struck by the remarkable fact that the specific gravity is not necessarily a criterion of the purity of an oil, at least as the test is usually applied. For instance, one might obtain for analysis a sample of olive oil of professed purity, which on examination showed a density of 920·8, but was not in the slightest degree rancid, and from its colour and taste *appeared* to be simply a fine quality of olive oil. Could an analyst, in the present state of affairs, conscientiously certify such an oil to be genuine? He would probably believe that the sample was adulterated with some oil which he could not detect, and as our "constants" at present stand, he would be quite correct in taking that view. Yet such a case, and even a more remarkable one, could quite readily exist, as is shown by the above results.

Several other interesting peculiarities have been noted regarding the particular oils. It will be seen from Table II. A. that castor oil was the least affected of any by subjection to light and air, and after having increased in density during the first two months, gradually returned to almost its original gravity. In E. and F. (the quantities kept at rest in the dark, the latter securely corked), the specific gravity has fallen to 967·0. This last peculiarity, the depression of gravity in the series kept in the dark, has also been noticed in the cases of rape, earth-nut, and linseed oils. The following shows the fall in density after six months' treatment:—

—	Original.	D.	E.	F.
Rape	916·8	916·1	916·2	916·0
Arachis	920·9	920·3	919·9	920·0
Linseed.....	932·5	932·4	931·8	931·9

It is a striking fact that linseed oil, kept in the dark, exposed freely to the air, and even shaken up every morning, has not increased in density, but has rather diminished. In Allen's "Commercial Organic Analysis," Vol. II., p. 120, we find the statement that in the absorption by linseed oil of oxygen from the air, "the action of light is not essential," but that "in the dark, the chemical change is induced very slowly, but when once begun, it proceeds very rapidly." The results yielded by the above experiments seem to show that the action of light *is* essential in bringing about the chemical change, as the quantity of oil was small, and had every opportunity for absorbing oxygen.

The only oil which increased in density by exposure to air in the dark was cotton-seed oil, which originally had a specific gravity of 922·5, the figures for the individual experiments being — for D. 923·3 and for E. 923·2. Quantity F. was unaltered.

5. *Iodine Absorption.*

Table III. contains particulars of the iodine absorptions of quantities A. and C., as determined month by month. In series A. no alterations of iodine equivalent beyond the limit of experimental error were observed during the first two months, and so, unfortunately, most of the tests were omitted during the next two months.

Table III.—Iodine Absorptions, per Cent.

Set.	Name of Oil.	Original.	One Month.	Two Months.	Three Months.	Four Months.	Five Months.	Six Months.
A.	Olive	83·16	82·53	82·33	81·59*	..	79·13	78·24
	Castor	83·63	83·90	83·59	..	..	83·63	83·27
	Rape	105·59	105·90	105·90	..	103·45	102·21	102·13
	Cotton seed.....	106·84	107·47	107·16	106·17*	..	102·21	100·12
	Arachis.....	98·67	98·36	98·67	..	96·35*	95·40	93·20
	Linseed.....	173·46	171·78	171·78	..	..	169·07	166·17
C.	Olive	83·16	83·16	82·65	..	..	82·39	82·64
	Castor	83·63	83·90	83·27		Discontinued.		..
	Rape	105·59	106·21	105·90	..	105·02	..	105·27
	Cotton seed.....	106·84	107·78	108·41	106·65	106·90	107·79	106·40
	Arachis.....	98·67	98·67	98·67	..	..	99·12	97·60
	Linseed.....	173·46	173·04	172·65	..	..	..	172·88

[* The three figures marked with an asterisk in the table are obtained from the results given by quantities B. Thus, arachis oil, quantity B, gave a specific gravity of 924·0 and an iodine equivalent of 96·35 per cent. after six months' exposure. This gravity corresponds very closely with that of quantity A. at the fourth month, so that the iodine absorption may fairly be stated in Table III. as 96·35 per cent. Quantity B. of the cotton seed oil gave a density of 925·9 and an iodine equivalent of 106·17 per cent. This corresponds with the gravity of 926·1 given by A at the third month.]

From the figures given it will be seen that for some time the halogen absorption is almost unaffected by the exposure to light and air; then a sudden break seems to occur, probably at the third month, at which the absorption suffers a depression, after which it continues rapidly to fall. This point of change in the iodine number takes place a month

before the oil becomes rancid; in most cases much longer. Of quantities B., under the same conditions as A., only undisturbed, the results corroborate those in the table, but of course the depression has not gone so far. The only oil which has not decreased in iodine absorption is castor oil, which is thus exceptional both in regard to specific gravity and iodine number. It will be observed from the results at C., Table III., and those mentioned below, that in nearly every case both air and light are necessary to cause this change in iodine absorption, just as is the case with the density. There is, however, no numerical correspondence between the changes which take place in the gravity and in the iodine equivalent.

The quantities of the oils kept in the dark have in almost every case shown a very slight increase in iodine number. Rape oil, however, is an exception, and it is the only oil whose iodine equivalent has decreased independently of the action of light. Experiment D., at the end of six months, showed an absorption of 101·17 per cent., and quantity E. absorbed 101·49 per cent. The original oil, kept corked in the dark, was not altered.

6. *Maumené's Temperature Test.*

Archbutt has recorded the fact that when olive oil is exposed to light for some time, the temperature reaction with sulphuric acid is increased to a considerable extent; to an extent, indeed, beyond the limits allowed to genuine olive oils. The figures he gives are:—Rise of temperature in oil kept in dark, 44·5 C., ditto in portion exposed to light, 52·5 C. Unfortunately, no mention is made of whether air was permitted to act on the oil exposed to light, nor of the duration nor circumstances of the exposure. In order to determine these points, and also to ascertain if the results yielded by olive form a general rule as to the behaviour of other oils, the rise of temperature was estimated in quantities A., C., D., and F. of all the oils after six months' exposure. As the results obtained were merely intended for comparison among themselves, ordinary concentrated sulphuric acid was used without any regard to its strength. Otherwise the tests were performed under the conditions mentioned in Allen's "Commercial Organic Analysis," Vol. II., p. 53, the highest temperature reached during the stirring being noted as the rise of temperature.

The results obtained are embodied in Table IV.

Table IV.—Temperature Reactions.

Set.	Olive.	Castor.	Rape.	Cotton seed.	Arachis.	Linseed.
	° C.	° C.	° C.	° C.	° C.	° C.
A.	67	78·5	72·5	100	90	131
C.	47	74·5	63	75·5	77	120
D.	43·5	73	60·5	76·5	73·5	112·5
F.	44	73	61·5	75·5	73·5	113·5

Series F., having been kept corked in the dark, may be assumed to represent the original genuine oils. As was to be expected, in every case has the remarkable increased rise of temperature been noted, but it has also to be observed that, except perhaps in the case of linseed oil, this change is not brought about by sunlight alone, as would be inferred from the foot-note in Allen, Vol. II., p. 99. Neither is it produced by the sole action of air, but by the combined action of both air and sunlight. This latter fact brings the change in temperature reaction on to the same footing as the alterations in colour, density and iodine equivalent. The slightly increased rise of temperature in series C. is in all probability due to the same cause as the similar elevation of specific gravity in the same quantities, namely, the admission of fresh air on the occasions when the oils were examined. It would appear that linseed oil, however, is affected by light alone, although not to such an extent as by the simultaneous action of light and air.

An examination of these temperature reactions in Table IV., in conjunction with the specific gravities in Table II., raises some very important questions. It will be observed that the rise of temperature varies directly as the density—the greater the increase in gravity, the greater the increase in temperature reaction—and therefore if an oil be placed under circumstances favourable to the raising of its specific gravity, it will also be likely to suffer a rise in temperature reaction. Now the temperature test is pretty generally adopted as a standard for the purity of olive oils, as few oils of importance have so low a temperature reaction, the limits permitted (allowing for the variation in results obtained by different methods) being from 39° to 45° C. Taking the case mentioned under "specific gravity" of an olive oil having a density of 920·8, the rise of temperature with sulphuric acid would at least be as high as 55° C., and these two data would in all probability be taken as almost conclusive proof of sophistication of the oil.

In analysing olive oils that have been stored for a long time in order to become acid for use in dyeing, the validity of the temperature reaction and specific gravity as tests becomes a very important matter. For instance, an undoubtedly genuine olive oil for dyeing purposes, containing 9·67 per cent. of free acid, which some time ago had a specific gravity of 915·4, and has lain for a few months in occasional diffused sunlight in a corked bottle containing a large quantity of air, has now a density of 918·6, and gives a rise in temperature of 53° C. The iodine equivalent is low—78·9 per cent., probably having decreased owing to exposure, as in Table III.—and the colour is bright green, the taste and smell being very faintly rancid. Another specimen of Gioja olive oil, which has lain under the same conditions, has a specific gravity of 916·6, iodine absorption 79 per cent., free acid 9·42 per cent. and temperature reaction 49° C. The colour of this sample is deep green, the taste and smell being quite sweet. Evidently in such cases Maumené's test and the specific gravity are not reliable criteria, and even the iodine equivalent may be misleading if the original oil had already a low halogen absorption.

7.—*Special Tests.*

It was found on applying the elaïdin test to olive oil, that the solidification of the mixture did not differ in quantities F. and D., both of which were kept in the dark. Quantity C. also yielded a solid elaidin, although not quite so hard as those given by F. and D. Experiment A., however, which had been subjected to the simultaneous action of light and air, showed no tendency even to thicken, when submitted to the elaidin test.

The efficiency of Bechi's test was impaired to an exceedingly great extent in the quantity of cotton-seed oil exposed to both light and air. Experiment F., by Pattinson's modification of the test, gave a black precipitate and colouration, whereas quantity A. only imparted a light brown colour to the solution.

The conclusions arrived at from these experiments are, that the indications of the specific gravity must not be too readily accepted in cases where they point to the falsification of an oil. Neither should Maumené's test be relied on implicitly, and, indeed, where the gravity of the sample under examination and the rise of temperature are abnormally high, and no clue can be discovered as to the supposed adulteration, these two tests, taken conjointly, should be considered as showing that the oil is an old one, or has been subjected to the conditions mentioned above. Even a very low iodine equivalent should not have much reliance placed upon it, unless the free acid and other tests show the oil to be fresh, and some satisfactory indications of adulteration are obtained. Apparently, however, the iodine absorption is the test which should be most depended upon, as it is the least liable to alteration of all the tests examined (except the potash neutralising power), and it only varies when radical changes have already taken place in density, &c.

Addendum.

The temperature of turbidity in Valenta's test has been lowered by several degrees in quantities A. and B. of all the oils examined.

The following shows the change in the viscosity of rape oil. Quantity B., now exposed for 9 months, was tested along with quantity F.:—

——	F.	B.
Time of flow at 15·5° C., in seconds	56	66
Time of flow at 50° C., in seconds	25·5	26·5

Discussion.

Mr. R. R. Tatlock said that, if he understood aright, the principal feature of the paper was that most seed oils were affected when exposed to air and light, and that the tests upon which they had been taught to rely for the analysis of these oils were no longer trustworthy. Mr. Ballantyne's experiments went to prove that when samples of oils were exposed, the density and specific gravity were much affected, and went on increasing according to exposure. Whether that was due to oxidation or not had not come out clearly, but they might assume for the present that it was so. The iodine equivalent was also affected after some considerable exposure, while the saponification was affected least of all. The days were—and not long ago—when the trustworthy chemical examination of an oil was almost an impossibility. They had then been taught to rely upon certain constants, as they are termed, particularly upon the iodine equivalent, and several others of a similar character, for the examination of these oils; and now Mr. Ballantyne rudely awakened them by saying that these oils may be subject, in keeping, to such alterations as would interfere with the constants. This showed how careful they ought to be before coming to any decision as to the examination of oils. The whole question was beset with difficulties. One question he would like to ask with reference to the nature of the change which took place was, did Mr. Ballantyne observe any increase in the weight of the entire sample operated upon which would point to oxidation of the oil, or whether an oil that had been so changed could be examined with results which would tell whether it was originally of a different character?

Mr. Ballantyne, in reply, said that, as indicated in his paper, there was no increase in the total bulk, but that, from the fact that the specific gravity had increased, he inferred that there was an increase in the total weight. Regarding the other part of the question, he was sorry that his experiments had not gone far enough to enable him to answer it.

Obituary.

WILLIAM LANT CARPENTER, B.A., B.Sc. Lond., F.C.S., Gilchrist Lecturer, Fellow of the Physical Society, Member of the Society of Chemical Industry, and of the Publication Committee of its Journal, &c.

William Lant Carpenter was the eldest son of the late Dr. W. B. Carpenter, C.B., F.R.S. He was born in the year 1841 at Bristol, but was educated in University College School, London, and studied chemistry under Prof. Williamson in University College, London, and also in the Birkbeck Laboratory. He was, in 1859, engaged in the Broad Plain Soap Works, the proprietors of which were Messrs. Ch. Thomas Brothers, where, for nearly 20 years, he was a partner of the firm. At the termination of this partnership in 1881, Mr. Carpenter removed to London, and in 1882 he became connected with the School of Electrical Engineering in Hanover Square. Being engaged as Lecturer by the Gilchrist Trustees, he undertook the duties of this post, and threw into the work all the energy of an earnest and strong nature. For many sessions Mr. Lant Carpenter greatly distinguished himself as a most effective lecturer under the Gilchrist Trust, especially in the North of England and in Scotland. At Bristol he was engaged in philanthropic work under the auspices of Miss Mary Carpenter, his aunt, and during the greater part of his residence in Bristol he took a pronounced part as its secretary in the management of the Boys' Industrial School there. He frequently lectured at the Philosophical Institution in Bristol, was an active member of the Naturalists' Society, and much interested in the foundation of the University College, Bristol, on the Council of which he represented the University of London.

Thus he was led to take an interest in the education question generally, and of late years the working of the Education Acts and the importance of Continuation Schools and Recreative Evening Classes have engaged much of his attention. He was local secretary at the Bristol (1875) meeting of the British Association, and may truly be said to have taken a leading part in all movements for the promotion of science, and especially physical science, in the West of England, where he was well known as a lecturer on such subjects. He was in charge of the chemical and part of the physical investigations of the deep-sea explorations of H.M.S. "Porcupine" of 1869 and 1870, his report on which was printed in the *Proceedings* of the Royal Society. William Lant Carpenter, besides being a member of the Institution of Electrical Engineers, was a Fellow of the Chemical Society and of the Physical Society. During the last ten years of continuous work his health had suffered a severe strain and a holiday became necessary. This was taken in 1889, but, combined with a journey to look after the schools on the Indian reserves in the Dominion of Canada for the New England Company, the journey became a strain instead of a rest, very few nights of his absence from home not being occupied in travel, so as to economise time. His health broke down again early in 1890, and so a voyage was undertaken to Australia and New Zealand, which he had visited in 1880 in order to seek restoration from the results of a similar collapse. Unfortunately no good effects followed from this voyage, though subsequently at Shanklin and Bournemouth some improvement was apparent, and his friends began to entertain hopes of his ultimate recovery. These were, however, doomed never to be fulfilled, and he died on December 23rd, leaving his four children, his brothers, and a wide circle of friends to mourn his loss.

With regard to Mr. Carpenter's publications, his excellent little book, compiled from his Gilchrist lectures, entitled "Energy in Nature," cannot be forgotten or overlooked, but since the once well-known, if not classic work on the Manufacture of Soap, by Morfit, no treatise on the Chemistry and Manufacture of Soap has appeared which can be considered equal to Carpenter's work entitled "Soap, Candles, Lubricants, and Glycerin," published by E. F. and N. Spon in 1885. Mr. Carpenter had also acted as examiner in the subject of Soap Manufacture for several years for the City and Guilds of London Institute. So solicitous was he not only for the condensation of the abstracts of English patents on the subject of Fats, Oils, and Soaps, appearing in the Journal of the Society of Chemical Industry, but that in such condensation adequate information should be given, that for several years, in addition to the heavy load of duty he had already taken on his shoulders, he undertook the abstracting himself of all patents bearing upon his favourite subject, and was always most punctual and prompt in the delivery of the MSS. In this earnest devotion to the part he had voluntarily undertaken to play both as member of Publication Committee and as abstractor, he thus followed closely in the steps of his distinguished and singularly devoted predecessor, Mr. Walter Weldon.

Journal and Patent‡ Literature.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

Non-conductors for Steam Pipes. Eng. and Mining J. 1890, **50**, 650.

In order to show the relative merits of the different substances which are offered for preventing the escape of heat from boilers and steam pipes, or as substitutes for wire lathing and plastering, or for tin plates in the protection of elevator shafts, or of woodwork nailed closely to walls, the following tables are submitted. These tables and extracts are taken from a report made by Prof. Ordway, late of the Massachusetts Institute of Technology. It will be observed that several of the incombustible materials are nearly as efficient as wool, cotton, and feathers, with which they may be compared in the following table. The materials which may be considered wholly free from the danger of being carbonised or ignited by slow contact with pipes or boilers are denoted by a (†). Those which are more or less liable to be carbonised are denoted by a (*).

Ordway's report is as follows:—"Careful experiments have been made with various non-conductors, each used in a mass one inch thick placed on a flat surface of iron kept heated by steam to 310° F. The following table gives the amount of heat transmitted per hour through each kind of non-conductor one inch thick, reckoned in pounds of water heated 10° F., the unit of area being one square foot of covering.

Substance 1 in. thick. Heat applied, 310° F.	Pounds of Water Heated 10° F. per Hour through 1 sq. ft.	Solid Matter in 1 sq. ft. 1 in. thick. Parts in 1,000.	Air included. Parts in 1,000.
*1. Loose wool	8·1	56	944
*2. Live geese feathers	9·6	50	950
*3. Carded cotton	10·4	20	980
*4. Hair felt	10·3	185	815
*5. Loose lamp black	9·8	56	944
*6. Compressed lamp black.	10·6	244	756
*7. Cork charcoal	11·9	53	947
*8. White pine charcoal	13·9	119	881
*9. Anthracite coal powder.	35·7	506	494
†10. Loose calcined magnesia	12·4	23	977
†11. Compressed calcined magnesia	12·6	285	715
†12. Light carbonate of magnesia	13·7	60	940
†13 Compressed carbonate of magnesia	15·4	150	850
†14. Loose fossil meal	14·5	60	940
†15. Crowded fossil meal	15·7	112	888
†16. Ground chalk (Paris white)	20·6	253	747
17. Dry plaster of Paris	30·9	348	652
†18. Fine asbestos	42·0	81	919
†19. Air alone	48·0	0	1,000
†20. Sand	62·1	529	471

"The first column of figures of results, therefore, gives the loss by the measure of pounds of water heated 10°. The second column gives the amount of solid matter in the mass one inch thick. The third column gives the amount of bulk of included or entrapped air."

There are some mixtures of two materials which may be quite safe, although consisting in part of substances which may be carbonised. It must also be considered that a covering for a steam pipe or boiler should have some strength or elasticity, so that when even put on loosely and holding a great deal of entrapped air it may not be converted into a solid condition by the constant jar of the building, then becoming rather a quick conductor. This warning may be applied especially to what is called "slag-wool," which consists of short, very fine threads of a brittle kind of glass. The following table, giving the figures on which the graphical table is based, has been submitted by Ordway, with the following explanation:—

"The substances given in the following table were actually tried as coverings for 2-inch steam pipe, but, for convenience of comparison, the results have been reduced by calculation to the same terms as in the foregoing table:—

Covering.	Pounds of Water Heated 10° F. per Hour by 1 sq. ft.
†21. Best slag wool	13·0
*22. Paper	14·0
*23. Blotting paper wound tight	21·0
*24. Asbestos paper wound tight	21·7
*25. Cork strips bound on	14·6
*26. Straw rope wound spirally	18·0
*27. Loose rice chaff	18·7
†28. Paste of fossil meal with hair	16·7
†29. Paste of fossil meal with asbestos	22·0
†30. Loose bituminous coal ashes	21·0
†31. Loose anthracite coal ashes	27·0
†32. Paste of clay and vegetable fibre	30·9

"Later experiments, not yet published, have given results for still air which differ little from those of Nos. 3, 4, and 6. In fact, the bulk of matter in the best non-conductors is relatively too small to have any specific effect, except to entrap the air and keep it stagnant. These substances keep the air still by virtue of the roughness of their fibres or particles. The asbestos of 18 had smooth fibres, which could not prevent the air from moving about. Later trials with an asbestos of exceedingly fine fibre have made a somewhat better showing, but asbestos is really one of the poorest non-conductors. By reason of its fibrous character, it may be used advantageously to hold together other incombustible substances, but the less the better. Trials were made of two samples of a 'magnesia covering,' consisting of carbonate of magnesia with a small percentage of good asbestos fibre. One transmitted heat which, reduced to the terms of the first of the above tables, would amount to 15 lb., the denser one gave 20 lb. The former contained $\frac{250}{1000}$ of solid matter; the latter $\frac{400}{1000}$.

Charcoal, lamp-black, and anthracite coal are virtually the same substance, and Nos. 5, 6, 7, 8, and 9 show that

‡ Any of these specifications may be obtained by post, by remitting the cost price, *plus* postage, to Mr. H. Reader Lack, Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C. The amount of postage may be calculated as follows:—

If the price does not exceed 8*d.*	½*d.*
Above 8*d.*, and not exceeding 1*s.* 6*d.*	1*d.*
„ 1*s.* 6*d.*, „ „ 2*s.* 4*d.*	1½*d.*
„ 2*s.* 4*d.*, „ „ 3*s.* 4*d.*	2*d.*

non-conducting power is determined far less by the substance itself than by its mechanical texture. In some cases when a greater quantity of a material is crowded into the same thickness the non-conducting virtue is somewhat increased, because the included air is thereby rendered more completely fixed. But if the same quantity is compressed so as to diminish its thickness its efficiency is lessened; for the resistance to the transmission of heat is nearly, though by no means exactly, in proportion to the thickness of the non-conductor. Hence, though a great many layers of paper, as in No. 23, prove to be a tolerably good retainer of heat, one or two layers are of exceedingly little service. Any suitable substance which is used to prevent the escape of steam heat should not be less than an inch thick.

"Any covering should be kept perfectly dry, for not only is water a good carrier of heat, but it was found in trials made, that still water conducts heat about eight times as rapidly as still air."

A Novel Form of Flexible Tubing. T. R. Almond. Eng. and Mining J. 1890, **50**, 651.

The author has made metallic flexible tubing that will convey gases, steam, or liquids under considerable pressure.

When a tube is formed by coiling a wire around a mandrel, the convolutions may be made to press upon each other with considerable force, and the joint formed at the point of contact of the individual convolutions will be tight in proportion to the amount of pressure exerted. If such a tube be bent, the joints will be broken all around the coils except at one point, and therefore, when bent, it is useless for conveying liquids or gases.

Wishing to utilise the peculiar flexibility of spiral spring tubing for the conveyance of gases in cases where a flexible tube is required, the author conceived the idea of interposing a triangular-shaped wire between the coils of a round wire. When a tube so constructed is bent, the convolutions of the triangular coil adjust themselves to the spaces between the round coils, as shown in Fig. 1. The triangular wire is pressed between the coils of the round wire during the process of constructing the tube with sufficient force to spread them apart, so that the contact surfaces are at all times under pressure. The triangular wire serves two purposes: one is to spread the coils apart, so that the pressure will be exerted on the contact surfaces; the other to fill the irregularly-shaped spaces between the coils of round wire, adjusting itself to the changing form of the spaces due to any given flexion. This pressure brings into play the element of friction to such an extent as partly to destroy the flexibility of the tube, which, when bent, will retain the form given to it.

As the primary object was to obtain a flexible tube, trials were made with wire having a more obtuse angle; such is shown in Fig. 2. This gave better results, as a more perfect joint was produced with less tension of the inner coil, and the friction became correspondingly less, the result being a tight tube with sufficient flexibility. Fig. 3 shows the shape of the seats into which the round wires are forced by their tension. The seat for the inner wire is much more obtuse, and on this account the inner wire will not, under a given tension, be forced into such a seat so tightly as in the sharper V in Fig. 3. It will be seen that the degree of flexibility depends upon the amount of tension put upon the inner coil, or the extent to which the convolutions are forced apart. The author has produced a perfectly tight tube with two coils of round wire, in which the outer coil is wound sufficiently tight between the convolutions of the inner coil to spread them apart for the purpose of getting pressure on the joints, substantially the same as with the triangular wire. This makes a very strong tube, but is too bulky for many purposes. Two half-round wires, or even less than half-round, may be used; or the inner wire may be round and the outer half-round, or much less than half-round. The tube will then be less bulky, and, supposing the outer wire to be considerably less than half-round, the convexity of its surface may be such as to give results similar to the obtuse triangular wire shown in Fig. 2. He has made several tubes in which the contact surfaces of the coils are made to coincide with a circle whose centre is the axis of the tube. The joints so formed are practically a series of ball and socket joints; such a tube has smoother outer and inner

Fig. 1.

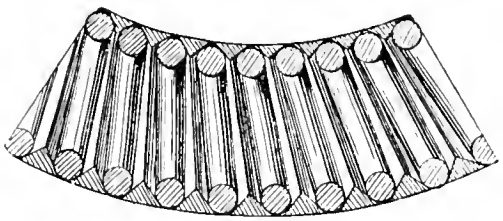


Fig. 3.

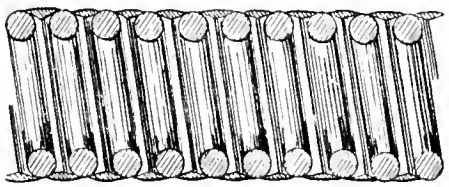
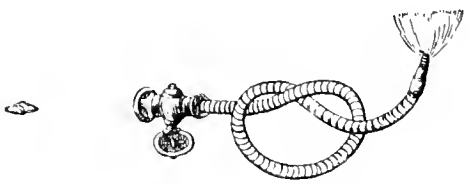


Fig. 2. Fig. 4.



Types of Flexible Tubing.

surfaces than those previously described. A serious objection to such a tube is that the wire changes its shape during the process of coiling, so that the joint surfaces will not make sufficiently complete contact, whereas the forms of wire previously mentioned are of simple construction, and the slight change of form which occurs during the process of coiling will not affect the result. The extent to which this tubing may be bent without leakage is considerable; a piece of $\frac{1}{4}$-in. bore, tied as shown in Fig. 4, has been subjected to a steam pressure of 75 lb. without leakage. The smallest curves of the bent portion corresponded in this case to a circle 2 in. in diameter. The author has not yet made any tube larger than $\frac{5}{16}$-in. bore, but thinks it possible to make them as large as 1-in. bore, and strong enough to stand any ordinary steam pressure. For purposes where pressure is not required, the tube may be made of sheet metal, and may possibly be made as large as 2 in. in diameter.

PATENTS.

Apparatus for the Purification of Lubricating and other Oil. J. Deuss, Gladbach, Germany. Eng. Pat. 13,324, August 23, 1889. 6*d*.

The purpose of this invention is the purification of oil which has been used for lubricating machinery, in order that it may be used again. This is effected by means of a filter which is described and illustrated in the specification.

—C. F. C.

Improved Means or Apparatus for Withdrawing Molten Glass or Molten Metals from Furnaces, and Controlling the Outflow thereof: also applicable for Conveying Liquids or Chemicals of a Liquid Nature from Larger to Smaller Vessels or Receptacles. D. Rylands and J. W. Horner, Barnsley. Eng. Pat. 17,933, November 11, 1889. *8d.*

This invention consists in the combination of a syphon pipe and controlling vessel raised and lowered by any suitable mechanical means, for withdrawing and controlling the outflow of molten glass and molten metal from furnaces with air-ejecting arrangements and firing appliances.

—E. G. C.

An Improved Method of and Means for Purifying the Waste or Impure Matters from Tanneries, Factories, Dyeworks, or similar or other Sources. J. W. Calvert and J. Chaffer, Leeds. Eng. Pat. 18,946, November 26, 1889. *6d.*

The process consists in the precipitation by strong sulphuric acid and filtration of the resulting liquid through a filter bed which is described and claimed. The filtering materials are sawdust, broken stone and broken brick. The liquid is subjected to a preliminary settling in tanks, and the sludge removed for manure.—J. M. H. M.

Improved Apparatus for Filtering Sewage and other Liquids. W. Birch, Manchester. Eng. Pat. 4732, March 26, 1890. *8d.*

See under XVIII. *B., page* 61.

An Improved Method of Drying and Desiccating Sludge, Manure, and other Materials. G. V. Haslam and P. Cornish, London. Eng. Pat. 11,747, July 26, 1890. *6d.*

The material to be dried is fed into a hopper and thence is conveyed by "broken blade" screws through a series of open cylinders which are enclosed or arranged in a suitable furnace. The heat from the fire is conveyed first along under the cylinders and then back over the top surface. It is preferred to serrate the edges of the screw blades to complete the drying and desiccating. The specification is accompanied with suitable drawings.—V. H. V.

II.—FUEL, GAS, AND LIGHT.

On the Lighting of Paris. J. für Gasbeleuchtung, **33**, 551—553.

On the occasion of the international conference of electricians in Paris last spring, M. Hippolyte Fontaine reviewed the various methods of illumination employed since the establishment of the great Paris Gas Co. (*i.e.*, during the last 30 years). The address dealt with the various illuminating agents under the following heads:—

I. *Wax, Tallow, Stearin, &c., in Candles.*—The following table gives the amounts of tallow and stearin products brought into Paris, as calculated from the Customs duties:—

Year.	Tallow.	Wax and Stearin.
	Kilos.	Kilos.
1855	1,260,572	1,288,213
1877	670,500	3,580,671
1889	307,880	4,115,263

In estimating amounts of light produced, the author adopts as the unit the so-called "decimal candle"; this is one-twentieth of the platinum light-unit adopted by the Congress of 1884, and corresponds to about 1/10 Carcel. This decimal candle requires a consumption of 8·5 grms. of wax per hour. 10 grms. would be a fairer estimate (taking an average for wax and tallow, and allowing for waste), and on this basis the following numbers are calculated:—

Year.	Number of Inhabitants.	Candle-hours per Inhabitant per Year.
1855	1,174,346	220
1877	2,044,849	210
1889	2,389,705	190

The use of candles has, therefore, remained fairly steady, but with a slight tendency towards decrease. It should be noticed that 30 years ago the amount of tallow used was equal to that of wax and stearin. The latter have increased in importance, whereas the consumption of tallow has steadily gone down.

II. *Vegetable and Animal Oils.*—These are calculated in the same way, and divided up as follows, according to their uses:—

Year.	For Food.	For Painting, &c.	For Lighting.
	Kilos.	Kilos.	Kilos.
1855	2,466,127	1,174,346	6,894,654
1877	4,293,182	2,044,849	7,871,721
1889	5,018,380	2,389,705	6,180,339

The illuminating power of the "decimal candle" above referred to would correspond to that of a good Carcel lamp burning 4·2 grms. per hour. 5 grms. per hour would be a more correct estimate for ordinary lamps. This gives a total of 1,236,067,800 candle-hours for the year 1889, or 517·2 candle-hours per inhabitant. The table shows that, before the introduction of petroleum, vegetable oils formed the most important artificial source of light. Now, however, their importance is rapidly diminishing.

III. *Petroleum and Petroleum Products.*—Mineral oils were first practically used for lighting in 1865. Since that time the use of petroleum has enormously increased. In a few years the amount of light produced by it has become 10 times as great as that from candles, and five times as great as that from vegetable oils. This is shown by the following table, which is calculated on the basis of 3·8 grms. of petroleum and 6 grms. of petroleum-naphtha per candle per hour (or an average of 4 grms.).

Year.	Petroleum and Naphtha used for Lighting.	Candle-hours per Inhabitant.
	Kilos.	
1872	3,759,556	503·1
1877	5,919,716	722·0
1889	19,084,654	1,995·0

The increased use of petroleum accounts for the smaller consumption of vegetable oils.

IV. *Gas* is the illuminant most commonly and largely used in Paris. Its production is a monopoly in the hands of the *Compagnie Parisienne du Gaz*. The price paid is 0·30 franc per cubic metre for private use, and 0·15 fr. per cubic metre for the town lighting. The company pays a duty of 0·02 fr. for every cubic metre of gas used in Paris, and 200,000 frs. for the use of the streets. It further has to give up to the town one-half of all profits above 10 per cent. (see end of abstract). The production of gas, expressed in

millions of cubic metres, was 40·8 in 1855, 191·2 in 1877, and 312·2 in 1889. In the latter year private consumption accounted for 159·9, and public lighting for 30·1, the rest being used for heating, &c. and outside Paris. The use of gas for heating purposes is rapidly increasing.

The following table is calculated on an average basis of 12·5 litres of gas per candle-hour. (The burners in common use consume about 14 litres per candle-hour. There are better burners, that only consume 5, 4, or even 3 litres, but they are not much used) :—

Year.	Total Candle-hours.	Candle-hours per Inhabitant.
1855	2,781,000,000	2,371
1877	9,768,000,000	4,776
1889	15,200,000,000	6,470

Thus the consumption of gas does not diminish, in spite of the increased use of petroleum and electricity. The year 1889 was, however, an abnormal one. Under ordinary circumstances the last number would have been 6,080 instead of 6,470. In addition to the gas company's supply from the mains, some use is made of compressed gas of high illuminating power. This is made of a sort of boghead coal, and is supplied to the consumer in cylindrical holders, under a pressure of 10 to 12 atmospheres.

V. The *Electric Light* first appeared in Paris in 1873. In 1877 the Jablochkoff candle was introduced, and in that year Paris contained 22 electric light installations, employing 230 H.P. In 1883 the horse-power had risen to 900, giving a light of 360,000 candles. Between steam-engines, gas-engines, and other motors, there was, towards the end of 1889, in actual use a total of 17,400 H.P., supplying current for 6,800 arc lamps and 118,000 incandescent lamps. The total candle-power thus produced is 3,484,800, so that 1 H.P. is equivalent to about 200 candles. Assuming the lights to be run for four hours per day, this gives nearly 57 million candle-hours per year, or 2,130 candle-hours per inhabitant per year. About a third of this light is produced by means of arc lamps, which certainly do not consume more than 1 to 1·5 Watts per candle. Incandescent lamps have also been so much improved that they only require about 4 Watts per candle.

In addition to the above, there are now in construction central stations, having an aggregate of 10,600 H.P., and preparations are already being made for further installations amounting to at least 3,900 H.P. Thus one may expect to have 32,000 H.P. at work in 1891 or 1892. The following table for electric lighting is calculated on the assumption that the lamps have hitherto been run only four hours per day (a number which will certainly be exceeded in future) :—

Year.	Candle-hours per Annum.	Candle-hours per Inhabitant per Annum.
1877	134,220,000	65
1883	525,560,000	230
1889	50,878,080,000	2,130

The above tables show that the total artificial illumination in Paris amounts to 11,300 candle-hours per inhabitant per year, or 30 per day. This is divided as follows: Wax, tallow, and stearin, 1·6 per cent.; vegetable oils, 4·5 per cent.; petroleum, 17·7 per cent.; electricity, 18·9 per cent.; gas, 57·3 per cent. H. Fontaine draws the following general conclusions: (1.) The present illumination in Paris is three times as great as it was 30 years ago. (2.) Vegetable oils, wax, stearin, and tallow only supply 6 per cent. of the total, and this quantity diminishes every year. (3.) The three most important illuminants are gas, electricity, and petroleum. The consumption of gas remains stationary, while that of petroleum is rapidly increasing. Although electricity is the newest competitor, it has already taken the second place.—D. E. J.

The following is taken from the "Electrician," Nov. 14, 1890 :—

The concession granted to the Compagnie Parisienne du Gaz has recently (Nov. 10) been prolonged for a period extending from 1905 to 1930. The company is authorised to exploit any system of lighting and heating, including the electric light and other applications of electricity. The price of gas for lighting purposes is to be reduced from 0·30 fr. to 0·25 fr. per cubic metre (*i.e.*, from 7*s.* 6*d.* to 6*s.* 3*d.* per thousand), and from 0·30 fr. to 0·20 fr. in the case of gas-engines, &c.—D. E. J.

Zirconia as a Substitute for Lime in the Oxyhydrogen Light. W. Koehs. Dingl. Polyt. J. **278**, 235—240.

The high light-emitting power of zirconia has been observed by many experimenters, an historical account of whose labours occupies the first portion of this article. Now that compressed oxygen is cheap, and zirconia a fairly common article of commerce, many applications of a zirconia "lime light" working with ordinary coal gas are feasible. Linnemann has devised a burner which, now it has been improved by Wolz, of Bonn, is well adapted for its purpose. The main points to be considered are: the use of oxygen at sufficient pressure to cause the combustion of the gases as they issue from the burner to take place about 0·5—1·0 cm. above its mouth in order to obtain a conical flame of the highest intensity which shall not overheat the burner itself, a result which is attained by supplying the oxygen at a pressure of about 15 times that of the coal gas. The complete and immediate consumption of the burning gases is so important a condition of success that large burners have not proved economical on account of the failure of the large central stream of oxygen to mix rapidly enough with the coal gas as it issues. This imperfection can be detected by observing the flame through a smoked glass, when the point at which unconsumed oxygen impinges on the incandescent zirconia can be recognised as a black spot. Even under these unfavourable conditions, but little disintegration of the zirconia takes place. The zirconias used by the author are as pure as possible, and made in the form of cylinders 2 × 0·8 cm., and yield a light of 40—50 candle power when heated with 30 litres of oxygen and 30 litres of coal gas per hour.

When a comparison of the light emitted by gas burned under different conditions is made, using an amyl acetate lamp as a standard, it is found that 30 litres of gas per hour simply burnt as it issues from a circular opening give only one candle power. The use of 30 litres of oxygen instead of air, and the introduction of a cylinder of zirconia increases the light therefore some forty-fold without augmenting the heat evolved in the least. The colour of the light is comparable with that of the electric arc.

The zirconia light as thus arranged readily lends itself to spectroscopic, photomicrographic, and medical use.—B. B.

PATENTS.

Improvements in Means for Generating and Utilising Gas or Vapour, and in Apparatus therefor. P. L. Girardet, jun., Constantine, Algeria. Eng. Pat. 16,393, October 17, 1889. 6*d.*

An inverted metallic U-tube has the lower parts of its limbs plugged with cotton wool or asbestos, and immersed in a liquid hydrocarbon. Beneath the bend of the U-tube is placed a cotton-wick burner, supplied from the same reservoir as the U-tube. The heat from the wick-burner volatilises the hydrocarbon drawn up in the U-tube by capillary attraction, and the vapour produced escapes by a small tube inserted in the bend of the U-tube. The vapour, which may be mixed with air or not, according to circumstances, is led to a suitable burner and used for heating or lighting purposes.—H. K. T.

Improvements in Apparatus for the Manufacture of Illuminating Gas. F. J. Jones, St. Albans. Eng. Pat. 19,721, December 7, 1889. 8*d*.

This invention consists in heating coal in a stream of the gases resulting from the action of steam upon red-hot coke, the resulting mixture of gases and vapours being converted into permanent gas by passing them through a superheater. The apparatus consists of a water-gas producer, a series of retorts placed in a vertical or inclined position and a superheater, the whole being enclosed in a chamber heated by gaseous fuel. Sometimes the gas is enriched by injecting petroleum, tar, &c., into the superheater. In this case the superheater should be filled with coke, and should admit of the latter being changed from time to time to prevent choking by deposited carbon.—H. K. T.

An Improved Apparatus for Charging Inclined Gas Retorts. F. Morris, Brentford. Eng. Pat. 19,763, December 9, 1889. 6*d*.

This invention consists in separating retorts charged on the Y or λ plan into two separate retorts, each retort being closed by its own lid so that when one is being charged there is no danger from flame owing to the gas produced in the other.—H. K. T.

Improvements in the Method for Producing Intense Light by Magnesium or by other Glowing Materials. J. W. C. C. Schirm, Berlin, Germany. Eng. Pat. 11,784, July 28, 1890. 8*d*.

This is an apparatus consisting of a Bunsen burner, the inlet tube of which is fitted with a funnel-shaped vessel containing powdered magnesium, aluminium, or other substance capable of giving a glowing light. The powder as it falls through the aperture of the vessel into the pipe is carried along by the stream of coal-gas, and burns with an intense white light at the mouth of the burner. When an intermittent light is required an elastic ball is attached to the gas tube and becomes filled with gas. On violently compressing the ball the gas is delivered by means of a specially arranged valve to the burner, carrying with it a quantity of metallic powder previously introduced into the tube. An arrangement in which benzene vapour is used is also described.—H. K. T.

Improvements in Incandescent Gas Burners. C. S. Upton, New York, U.S.A. Eng. Pat. 15,463, September 30, 1890. 8*d*.

This invention consists of various forms of burner of the incandescent type in which a cap or thimble of platinum wire or other suitable material is raised to a white heat in a Bunsen flame. The burner consists of a metal chamber variously perforated so as to cause the issuing flame to impinge upon the refractory material. Air is conveyed to the lower part of the burner by means of tubes which also form supports for a shade and reflector.—H. K. T.

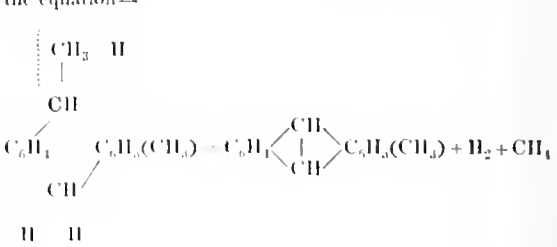
III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

The Cinnamenes (Styrol Compounds) of the Benzene Hydrocarbons and their Conversion into Anthracene and Methylated Anthracenes. G. Kraemer, A. Spilker, and P. Eberhardt. Ber. **23**, 3269—3276.

The cinnamene (styrol) employed in this research was prepared from synthetical cinnamic acid, as its isolation from crude xylene was considered too difficult. For this purpose, 1 kilo. of cinnamic acid was subjected to a very slow process of distillation, occupying between four and five hours for its completion. 360 grms. of crude cinnamene were obtained, and this, after purification by fractional distillation under reduced pressure and redistillation under the ordinary pressure, gave 320 grms. of pure cinnamene. Commercially pure xylene mixed with 5 per cent. of this product gave the same compound as that obtained from crude xylene. According to the formula previously given (Ber. **15**, 3170), the substances formed by the above process of condensation are α-γ-substitution products of propane. In order to explain their conversion into anthracene derivatives it is necessary to assume the removal of a carbon atom from the middle of the molecule, the latter splitting up into two parts and then re-uniting. It is, however, hardly probable that so complicated a reaction would be accompanied by such high yields as are invariably obtained when these anthracene derivatives are formed. Pinner and Liebermann have recently illustrated the condensation in the following manner:—

$$C_6H_5.CH:CH_2 + H_2SO_4 + CH_3.C_6H_4.CH_3 = C_6H_5.CH(CH_3).CH_2.C_6H_4(CH_3).$$

α-β-propane derivatives being formed. In accordance with this view the production of anthracene is easily explained by the equation—



and as the authors consider this reaction feasible and highly probable, they have no hesitation in regarding the compounds described in the paper as α-β-derivatives.

Methods are given in detail for the preparation of *Metaxylene cinnamene* or α-β-*phenylmetatoluylpropane*—

$$C_6H_5.CH(CH_3).CH_2.C_6H_4.CH_3;$$

Toluene cinnamene or α-β-*diphenylpropane*—
$C_6H_5.CH(CH_3).CH_2.C_6H_5$, and *Pseudocumene cinnamene* or α-β-*phenylxylylpropane*—

$$C_6H_5.CH(CH_3).CH_2.C_6H_3(CH_3)_2$$

with descriptions of properties of these compounds.

Several unsuccessful attempts were made to combine benzene with cinnamene, a result which seems to show that the condensation cannot take place without the presence of a side chain (methyl group) which effects the combination.

The properties of the hydrocarbon obtained from cinnamene and toluene are consonant with the reactions of the α-β-diphenylpropane prepared by Silva (Compt. Rend. **89**, 606) by the action of propylene dichloride on benzene, which boils at 277°—279°, and of the α-γ-derivative described by Graebe (Ber. **7**, 1627) and von Claus and Mereklin (Ber. **18**, 2938) which boils at 290°—300°. Graebe's compound was prepared from dibenzylketone by reduction and the diphenylpropane of von Claus and Mereklin by the action of trichlorhydrin on benzene in the presence of aluminium chloride.

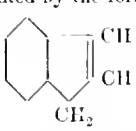
The hydrocarbons $C_{15}H_{16}$ and $C_{16}H_{18}$ described by Weiler and Fischer (Ber. **7**, 1181) are isomeric but not identical with the compounds obtained by the authors. These bodies also yield methylanthracene when their vapours are passed through red-hot tubes.—D. B.

On Indene and Cinnamene (Styrol) in Coal Tar. G. Kraemer and A. Spilker. Ber **23**, 3276—3283.

In a previous communication on the presence of coumarone in coal tar (this Journal, 1890, 275) the authors expressed the opinion that besides this hydrocarbon there are bodies similarly constituted in the fractions of high boiling point

obtained from light tar oils. The isolation of coumarone was effected by means of bromine, but the authors have since found that by forming the picrate the separation is performed with greater ease. The process is described in detail in a German patent (No. 53,792) which the authors have recently secured, and it is here only mentioned by way of addition that the melting point of the picrate is 102°—103°.

Indene is obtained by saturating the fraction of the light tar oils boiling between 176° and 182° with picric acid at an elevated temperature. On cooling, the picrate crystallises out. It contains some coumarone and all the naphthalene originally present in the tar oil, and is purified by distillation with steam. The distillate is then again treated with picric acid in a solution of toluene. The resulting picrate forms golden yellow needles melting at 98°. It decomposes gradually on exposure to the air and is readily and completely split up by steam. 10 kilos. of the tar fraction gave 2 kilos. of indene. This is a colourless oil boiling at 177°—178°; under 757 mm. pressure it has a specific gravity of 1·040 at 15°, and its formula is C_9H_8. The vapour density determination by V. Meyer's method gave 123 and 119 (theory = 116). It is resinified by concentrated sulphuric acid with formation of para-indene. In order to determine it constitution indene was subjected to the action of oxidising agents. Chromic acid and potassium permanganate gave unsatisfactory results; nitric acid, however, yielded an acid which proved to be orthophthalic acid. Hence, out of nine carbon atoms six are united in the form of a benzene ring to which simultaneously two other carbon atoms are attached in the ortho position, so that the constitution is represented by the formula—



Indene is, therefore, the fundamental hydrocarbon of hydrindene, indole, and indigo respectively. It combines with bromine, forming a dibromide, $C_9H_8Br_2$, which crystallises in colourless prisms melting at 43°—45°, and dissolves in organic solvents. Water decomposes it into the hydroxybromide, C_9H_9BrO, with separation of hydrogen bromide. This product forms long white needles melting at 130°—131°, and may also be obtained by saturating the original tar fraction with bromine in the cold, distilling the mixture with steam and extracting the bromide from the black resinous residue by means of water.

On reduction with sodium in an alcoholic solution indene is converted into hydrindene, C_9H_{10}. The latter has a specific gravity of 0·957 at 15°, and boils at 173·5°—174·5°.

Although the presence of cinnamene in coal tar has been observed by Berthelot and others, the authors have recently isolated this hydrocarbon from the fraction boiling between 140° and 150°. The best results were obtained by the separation process with bromine owing to the fact that the picrate is very unstable and dissolves too readily in the light tar oil to admit of its crystallisation therefrom.

The discovery of indene fills up a gap in the list of substances found in coal tar to which reference has been made in the authors' paper on coumarone. Indene stands midway between fluorene and another product of dry distillation, which the authors are hopeful of finding in the lowest boiling fractions of the tar oils, or possibly in coal gas itself, thus—

$C_2H_2—C_2H_2$	$C_6H_4—C_2H_2$	$C_6H_4—C_6H_4$
CH_2	CH_2	CH_2
?	Indene.	Fluorene.

In conclusion it is stated that it is the presence of indene more than that of coumarone which causes the colouration obtained with various tar products on treatment with concentrated sulphuric acid; the red colour, for instance, which impure naphthalene gives with sulphuric acid is due to the presence of indene, and doubtlessly also the colour which phenol produces.—D. B.

Turbidity in Mineral Oils. A. Veith. Dingl. Polyt. J. 277, 567—571.

MANY apparently well-refined samples of mineral oil, though at first quite clear and bright and neutral to the usual reagents, lose their limpidity after a while and become turbid and of a bad colour. Such oils burn badly and cause trouble both to the manufacturer and consumer.

The cause of these phenomena can only be made clear by a consideration of the nature and method of refining of the crude petroleum. Besides the hydrocarbons of the paraffin, paraffene, olefine, and naphthene series that constitute the bulk of the oil, certain less saturated organic substances are present. These, together with decomposition products, containing oxygen which form during the distillation of the crude material, render the process of purification as usually carried out necessary. The treatment with vitriol commonly adopted removes a portion of the more easily attackable hydrocarbons as sulphonic acids, and oxidises another portion of the impurities, a reaction indicated by the evolution of sulphur dioxide during the treatment. After separating the sulphuric acid laden with impurities, the remaining small quantity is removed by washing with caustic soda. The expenditure of these chemicals is cut down to the lowest limit by the manufacturer, whose interest here runs counter to that of the consumer, with the result that the cheaper kinds of oil are sometimes put on the market imperfectly refined. The turbidity already referred to makes its appearance in a highly characteristic manner. If one portion of the oil be exposed to sunlight in an open vessel no notable change occurs; another portion kept in cask becomes increasingly turbid. On exposing this turbid portion to light and air again it becomes perfectly clear again. When such a sample of mineral oil is treated with sulphuric acid of sp. gr. 1·5 it remains colourless, the acid becoming a light rose colour; on shaking with caustic soda of sp. gr. 1·2 it becomes dirty yellow or straw yellow in shade. The precise cause of the formation of the turbidity is not easy to ascertain. It was at first ascribed to the size used to make the casks tight, but it was proved that well-cleaned casks had the same effect. Shaking with water did not suffice to clarify the oil, but caustic soda was perfectly effective. Full elucidation of the question failed for want of opportunity, but it appeared probable that the turbidity might be due to the presence of sulphonates. On shaking the oil with magnesia which was afterwards dried and ignited, the presence of sulphuric acid was recognised by the ordinary tests. The existence of sulphonic acids was further proved by shaking out with caustic soda and precipitating the neutralised lye with barium chloride; the precipitate on ignition evolved combustible gases and left a residue of barium carbonate and sulphate.

Engler states (*Erdöl von Baku*) that mineral oil is treated in many Russian refineries direct with concentrated lye immediately after the acid in order to prevent the occurrence of this objectionable turbidity. Experimenting in this direction, a portion of the distillate before further refining was treated with caustic soda of sp. gr. 1·2, whereby the presence of organic acids which could not have resulted from any sulphonating action was proved. The same oil showed a greater proportion of organic acids after treatment with vitriol.

The sole practical means of preventing the turbidity or reducing it to a minimum is the use of caustic soda. The distillate from the refining still is treated with about 1 per cent. of caustic soda sp. gr. 1·3, and mixed intimately therewith. When separation from the tarry soda solution has taken place after some hours' standing, the oil is treated with sulphuric acid, thoroughly washed and again treated with a small quantity of strong lye. If a portion of the oil after allowing separation to take place be proved to suffer no further change on shaking with caustic soda sp. gr. 1·2, the bulk may be run off and well washed. Complete separation of the lye is necessary to prevent decomposition of the soda salts, formed by the action of the lye on the impurities of the oil by subsequent dilution.—B. B.

On the Condensation of Acetylene by the Silent Electric Discharge. M. Berthelot. Bull. Soc. Chim. (3), **4**, 1890, 480—481.

Acetylene that has been condensed by the silent electric discharge forms a highly oxidisable product which in a few weeks absorbs more than a quarter of its weight of oxygen, a fact that has also been observed by Schutzenberger. The substance has the appearance of yellowish and resinous pellicles which undergo gradual and spontaneous change with the deposition of carbonaceous matter. When subjected to dry distillation the substance undergoes a sudden decomposition, leaving a considerable residue of carbon and liberating a very large quantity of water mixed with acetic acid and acetonous liquids, analogous to those from sugar and tartaric acid. Neither benzene nor furfurol is formed. Heated with soda-lime only acetone is formed. These observations show that the condensation of acetylene effected by the electric effluvium differs altogether from the condensation effected by heat, which at a temperature of from 400° to 500° C. chiefly results in the formation of benzene.

—H. S. P.

Asphaltum. Eng. and Mining J. 1891, **51**, 13.

Asphaltum is found in the United States in California, Utah, Colorado, Wyoming, and at several places in the Southern States, but the only useful sources, at present, are the two States first named. In Utah hard varieties of the mineral are found, in several widely-separated localities, in veins quite free from foreign substances, and of considerable size.

In 1888, 700 tons of asphaltum were shipped from Utah to St. Louis, and used for making varnish. Its value there was 35,000 dols. About 100 tons of ordinary asphaltum were produced in the territory the same year. In California, the product of liquid asphaltum, known as brea, from Los Angeles and Ventura counties, was estimated at 4,600,000 galls. This substance is of a glossy black colour, impervious to water, and particularly adapted for coating iron. It is used chiefly in the manufacture of paint and varnish, and the demand for it is increasing.

In 1888 the mining of sandstone or loose sand cemented by asphaltum became an important industry in California. The material mined is heated until soft, and in that condition laid as a pavement, for which purpose it is produced in large quantities, and eagerly sought. Of this material, in 1888, 13,000 tons were produced, valued at 5 dols. per ton, the total value of asphaltum produced in the United States in 1888 being 331,500 dols. In the year preceding, the production was 4,000 tons, valued at 16,000 dols.

Asphaltum Production, Imports and Exports, in the United States.

Year.	Production.		Imports.*		Exports.*	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Tons.	Dols.	Tons	Dols.	Tons.	Dols.
1887	4,000	16,000	27,553	100,697	203	3,606
1888	53,800	331,500	40,673	113,854	..	..
1889	..	..	43,174	89,211	..	..
1890	..	..	78,301	130,555	258	3,965

* Fiscal years ending 30th June.

By far the most important deposits of asphaltum in California are those of Ventura county, which were discovered in 1888. This material differs from the substance found elsewhere in California in its large proportion of fixed carbon, and in that respect compares favourably with the well-known asphaltum of Val de Travers and Trinidad. The composition of the Ventura asphalt is compared with that of other asphalts in the following table:—

Locality.	Fixed Carbon.	Volatile Carbon.	Residue.
Val de Travers.....	11·50	..	88·50
Ventura Co., Cal.....	24·40	..	75·60
Mendocino Co., Cal.....	1·70	11·60	86·70
Santa Cruz Co., Cal	2·58	18·16	79·26
Ditto ditto	1·90	13·54	84·56
Ditto ditto	7·36	46·20	46·24
Santa Barbara Co., Cal...	1·30	14·10	84·60
Ditto ditto ...	8·00	42·30	49·70
Los Angeles Co. (Brea)...	14·40	71·40	14·20

The composition of the Trinidad asphalt is extremely variable; the residue ranges from 30 to 60 per cent., and the bitumen (fixed and volatile) from 40 to 70 per cent.

The asphaltum of Ventura county, now being mined by the Ventura Asphalt Company, is stated to be an unusually hard and tough material. It begins to soften at 212° F.; becomes waxy at 248°; begins to volatilise at 347°; but does not melt until 383°. Its tensile strength is from 600 to 700 lb. per square inch; and when mixed with 60 per cent. of sand, is from 821 to 825 lb. It is impervious to water, and unaffected by salt water or the atmosphere.

The principal use for asphaltum is in paving roads and in the construction of sea walls and other masonary work. Large quantities also are used in protecting wharf piles and timbers and the bottoms of boats.

Asphaltum can be produced, it is said, in large quantities from the Ventura mines; it is sold there on board cars at 9 dols. per ton.

The asphaltum used in the United States hitherto has been imported chiefly from Trinidad. With the large deposits now known in Utah and California, however, it is probable that the needs of many parts of the country will be supplied from domestic sources, and that the industry will grow rapidly.

IV.—COLOURING MATTERS AND DYES.

o-Methylbenzidine. R. Hirsch. Ber. **23**, 3222—3226.

Molecular weights of nitrobenzene and orthonitrotoluene dissolved in about five times the weight of alcohol, are reduced after addition of 10 per cent. of caustic soda with an excess of zinc dust. After boiling for several hours the colour of the solution and of the precipitate is grey or light yellow. The author thinks it however advisable to use an excess of *o*-nitrotoluene, about 4 parts to 1 part of nitrobenzene, thus avoiding the formation of benzidine, which can only be separated from methylbenzidine with great difficulty. The alcohol is distilled off after addition of water and the residue is carefully neutralised with hydrochloric acid after cooling, until all zinc oxide is dissolved. As soon as a filtered sample becomes cloudy on addition of sodium acetate the addition of hydrochloric acid is discontinued, and the zinc salt is separated by filtration from the insoluble hydrazobenzene and its homologues. They are then dissolved in hydrochloric acid, filtered, the excess of free acid neutralised and the bases precipitated as sulphates by means of sodium sulphate. The sulphates are converted into the free bases by sodium carbonate and the separation of the bases from each other effected by their different solubility in water.

Boiling water dissolves 1·05 *per cent. of benzidine,* 0·33 *per cent. of tolidine.*

Boiling water dissolves of mixtures of the two bases 1·1—1·3 per cent., but never so much of tolidine, as if the pure base had been used.

Water of 20° C. dissolves 0·04 per cent. of benzidine, 0·014 per cent. of tolidine.

When the mixture of the bases, obtained in the experiment described above, was boiled repeatedly with 50 times its weight of water, the quantity of the dissolved bases decreased and the remainder after the third boiling consisted of pure *o*-tolidine. The first solution contained after cooling 0·15 per cent., that is four times the quantity of benzidine soluble in water. The extractions by boiling of the base thus obtained were continued until the cold solution contained no more dissolved in it than could be found in a saturated benzidine solution. The united solutions were then precipitated by very careful addition of dilute sulphuric acid (an excess of acid has to be avoided as methylbenzidine-sulphate is more soluble in it than in water), the sulphate is reconverted into the base and the free base again boiled five times with 20 times the amount of water. The crystallisations from the two first solutions were pure *o*-methylbenzidine. It forms plates melting at 115° C.

The author prepared the acetyl- and benzylidene compounds by the action of acetic anhydride and benzaldehyde on the three bases. The following table shows their properties :—

	Benzidine.	Methyl-benzidine.	Tolidine.
Diacetyl compound melts at.	317° C.	310° C.	306° C.
Diacetyl compound is soluble in.....	12 parts of glacial acetic acid.	6 parts.	6 parts.
Benzylidene compound melts at.....	227° C.	217° C.	149° C.
Benzylidene compound crystallises from alcohol.....	In cloudy flakes.	In yellow plates.	In long needles.

—A. L.

The Indigo Synthesis from Anilido-acetic Acid. A. Biedermann and R. Lepetit. Ber. 23, 3288—3291.

One molecule of aniline, well mixed with one molecule of monochloroacetic acid, is quickly heated with 3—4 times the quantity of caustic soda, until the mixture appears yellow and finally orange after fusing. The source of heat is removed, and the product of the reaction cooled. After dissolving it and passing air through the solution indigo is precipitated. The yield was not more than 2½ per cent. Care has to be taken to avoid too excessive heat and to prevent access of air.

The reaction is explained by the equations :—

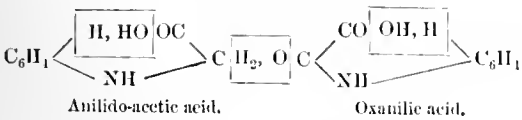
$$C_6H_5.NH_2 + ClCH_2.COOH + KOH = KCl + H_2O + C_6H_5.NH.CH_2.CO_2H$$

$$2\,(C_6H_5.NH.CH_2.CO_2H) = C_{16}H_{12}O_2N_2 + H_2 + 2\,H_2O.$$

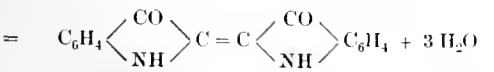
On using anilido-acetic acid the same results were obtained.

To prevent the evolution of free hydrogen, which always means a reduction of the yield, the employment of a mixture of equal molecules of oxanilic acid and anilido-acetic acid was tried, but with no better result. The yield was really slightly lessened.

The idea to be realised by this experiment may be explained by the following equation :—



Anilido-acetic acid. Oxanilic acid.



Indigo blue.

—A. L.

Synthesis of Indigo and Allied Dyestuffs. K. Heumann. Ber. 23, 3431—3435.

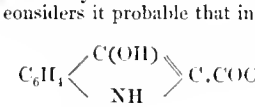
In the synthesis of indigo from phenylglycocine, previously described by the author (this Journal, 1890, 1121), it seemed probable that isomers of pseudo-indoxyl were produced by the substitution in the benzene nucleus of hydrogen atoms in the meta- and para-positions to the nitrogen atom. To ensure the sole production of ortho-compounds, the author, in a further synthesis, sets out with anthranilic acid. By acting on this body with chloracetic acid, phenylglycine-*o*-carboxylic acid—

$$C_6H_4(COOH)(NH.CH_2.COOH)$$

was obtained. After recrystallisation from water, this compound appears as a yellow granular mass, melting with decomposition at about 200° ; it dissolves with difficulty in cold water ; exhibits a blue fluorescence in alcoholic solution. The ordinary methods of preparation of ketones were tried with a view to obtaining the CO group of this acid in the necessary position for the production of pseudo-indoxyl and indigo, that is, between the phenyl- and methyl-residues. A portion of the acid was, with this object, mixed with a slight excess of milk of lime, evaporated to dryness, and heated ; the mass became coloured yellow or red, and the inner surface of the glass vessel, in which the experiment was made, became covered towards the top with a blue deposit of indigo. Towards the end of the reaction a brown oil distilled, which, when treated with lime, was found to generate indigo. When the same experiment was made in a retort from which the air was excluded by a current of hydrogen, no formation of indigo was observable ; a turbid yellow-green aqueous distillate, on which a brown oil floated, was received. On exposure to air this distillate became coloured a pale green-blue ; on addition of a few drops of caustic soda solution, blue flocks quickly separated, and the liquid became covered with a bronze-coloured pellicle. The yield of indigo was, however, unsatisfactory, most of the oil being resinified. Assuming that the distillate contained indoxyl, barium hydrate was tried instead of calcium hydrate, with a view of retaining the same. The mixture of phenylglycine-*o*-carboxylic acid with a slight excess of baryta was evaporated to dryness and carefully heated, the mass, without any decomposition taking place, being coloured deep yellow. When the intensity of colour increased no more, the reaction was interrupted. On mixing the product with water, a blue precipitate of indigo was quickly formed on the surface of the liquid ; the separation of indigo was hastened by a current of air. The precipitate was collected, freed from baryta by treatment with hydrochloric acid, and washed with water and afterwards with alcohol.

The use of baryta not being satisfactory for the reason that the mass was unequally heated through remaining unfused, alkalis were tried and found to give the best results. One part of phenylglycine-*o*-carboxylic acid was heated with 3 parts of potassium hydrate and 1 of water ; towards 200° the mass commenced to colour yellow, changing afterwards to a rich orange. The heating was continued as long as the mass deepened in colour. After cooling, the product was dissolved in about 200 parts of water and oxidised by a current of air or by addition of acidulated ferric chloride, and the separated indigo was washed, first with water, next with dilute acid, and then with alcohol, and finally dried.

The author considers it probable that indoxylic acid—



is first formed in the above reaction, and that this body further decomposes into indoxyl and carbon dioxide.

The syuthesis of indigo from phenylglycine-*o*-carboxylic acid is, with the use of potash, effected at a temperature 60° to 80° lower than that required with phenylglycine.

The process has been patented.—E. B.

On some Derivatives of Benzidine-m-Monosulphonic Acid. A. Zehra. Ber. **23**, 3459—3464.

The author describes some derivatives of the benzidine-*m*-monosulphonic acid.

Sodium Salt of Diacetylbenzidine-m-monosulphonic Acid—

$$C_6H_3NH(COCH_3)\,(SO_3Na)\,(4)\,(3)$$
$$|$$
$$C_6H_4NH(COCH_3)$$

was obtained by heating the dry sodium salt with about the same quantity of acetic anhydride. It forms colourless needles, with difficulty soluble in cold water, easily soluble in hot water.

m-Dinitrodiacetylbenzidine-m-monosulphonic Acid—

$$C_6H_2NH(COCH_3)(NO_2)(SO_3H)\,(4)\,(5)\,(3)$$
$$|$$
$$C_6H_3NH(COCH_3)(NO_2)\,(4)\,(5)$$

was obtained by adding the theoretical quantity of nitric acid to a solution of one part of the sodium salt of the diacetyl compound in five parts of sulphuric acid. The temperature of the mixture ought to be kept below 5° C. The orange-coloured product is soluble in water and alcohol. On heating it with dilute sulphuric acid (1 : 2) on the water-bath—

m-Dinitrobenzidine monosulphonic Acid—

$$C_6H_2NH_2(NO_2)(SO_3H)\,(4)\,(5)\,(3)$$
$$|$$
$$C_6H_3NH_2(NO_2)(4)\,(5)$$

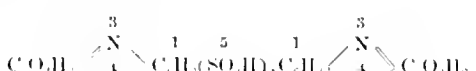
was formed, with difficulty soluble in hot or cold water, easily in dilute mineral acids. By nitrous acid it is converted into a diazo compound, which forms a nearly insoluble blue-black with β-naphthol, a reddish violet with β-naphtholdisulphonic acid R, and a violet-black with β-naphtholdisulphonic acid G.

On reduction of the nitro compound with stannous chloride and hydrochloric acid—

m-Diamidobenzidine-m-monosulphonic Acid—

$$C_6H_2(NH_2)(NH_2)(SO_3H)\,(4)\,(3)\,(5)$$
$$|$$
$$C_6H_3(NH_2)(NH_2)\,(4)\,(3)$$

is obtained, forming a very stable hydrochloric acid salt. Ferric chloride produces a dark colouration, a black precipitate being formed at the same time; picric acid forms a picrate. By the action of the sodium salt of croconic acid an azine of the formula—



is formed, which gives an additional proof that the two amido groups are in ortho position to each other.—A. L.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

The Theory of Dyeing. O. N. Witt. Färber-Zeitung, **2**, 1—6.

Excluding the process of colouring textile fibres by the application of solid pigments by means of adhesive substances, such as glue or albumen, dyeing processes are classified as adjective when the intervention of a mordant is necessary, or substantive when no such assistance is required. This classification is wanting in precision, and is unsatisfactory. Still more unsatisfactory, however, is the extension of the above classification to colouring matters, for it is well known that the necessity for the employment or non-employment of a mordant depends more on the nature of the fibre to be dyed than on that of the colouring matter used, most dyestuffs being substantive towards some fibres and adjective towards others.

The nature of substantive dyeing is doubtless simpler than that of adjective dyeing, yet it is not understood. The exponents of the theory of dyeing have ranged themselves into two sets, one set advocating a mechanical theory, the other a chemical one. In addition to these, there is a small group who content themselves with comparing the action of textile fibres in absorbing colouring matters to the absorbent action of animal charcoal. As, however, nothing is known regarding the nature of this property possessed by charcoal, the analogy is of no service in increasing our knowledge of the nature of dyeing.

The adherents of the mechanical theory assume that the molecules of colouring matter leave the dye-bath and deposit themselves in between the molecules of the fibre, without entering into chemical union with the same. Against this view, it may be urged that nothing has as yet been adduced to support such an unusual hypothetical migration of molecules, it being impossible, in the whole field of natural science, to find any analogy to it. But the strongest objection consists in the fact that only certain dyestuffs possess the power of dyeing substantively, and these, again, behave differently with different fibres.

The chemical theory supposes that, in cases of substantive dyeing, a chemical combination between fibre and colouring matter takes place. This supposition is doubtlessly correct in certain rare instances. Thus, the researches of E. Knecht have shown that a combination in definite proportions takes place between the wool fibre and colouring matters of the class of nitrophenols. These colouring matters are, however, such as one would expect from observed indications, to chemically combine with the fibre mentioned; in the majority, and most important, of cases, no such definite combination can be shown to exist. This defect has been partially remedied by the above-named chemist, who has propounded a theory, to some extent supported by experimental proofs, to the effect that many of the cases of so-called substantive dyeing are, in the case of the wool fibre, really cases of adjective dyeing, the dyestuff combining with the languinic acid, which is slowly formed on boiling that fibre with water, and which, therefore, acts as a mordant, being itself contained in the wool fibre in a state of "solid solution." Although this hypothesis goes far to explain the character of certain cases of wool-dyeing, it affords no elucidation of the nature of the substantive dyeing of cotton and silk, both of which fibres are unaltered by prolonged boiling with water, silk, indeed, being dyed to some degree even from a cold bath.

A critical objection to the chemical theory is supplied by the behaviour of certain dyed colouring matters. Take, for example, silk dyed with Magenta. Such dyed silk has to be treated with moderately strong soap solution before it yields up any colour. It might be inferred from this that the Magenta-silk compound was of fair stability. To one's astonishment, however, on dipping the compound into absolute alcohol, the dye is almost instantaneously detached from the silk. This effect is the more striking as it is well known that no chemical affinity exists between alcohol and Magenta. Alcohol is a solvent for Magenta, nothing more. Let it be supposed, however, that these two bodies do combine and that the affinity of alcohol for Magenta is greater than that of silk for the same. The following simple experiment shows this supposition to be wrong:—On the addition of water to the alcoholic solution of magenta, the dye returns to the silk, the strength of the alcohol determining whether the dye remains in solution or attaches itself to the silk. Of such reactions as these, no explanation is given by the chemical theory of dyeing.

Relations between fibre, dyestuff and dye-bath, similar to those obtaining in the experiment just described, are found to exist in all cases of incomplete exhaustion of the dye-bath; a portion of the dye is absorbed by the

fibre, the rest remains in solution. On removing the dyed material and introducing a fresh undyed portion, further absorption of dye is effected, but this may be repeated many times without the dye being completely withdrawn from the bath. The fibre, according to the chemical theory of dyeing, precipitates the dyestuff. Strange it is then that a large excess of the precipitant does not remove the last traces of dye, for there is no resemblance between this incomplete action and the ordinary case of incomplete precipitation so frequently observed in chemical reactions; in the latter the solubility of the precipitate causes the precipitation to be imperfect, but the above precipitate, that is, the assumed compound of fibre and dyestuff, is quite insoluble.

These and other considerations led the author to inquire whether there were not some other way of accounting for the phenomena of dyeing, which should be free from the objections mentioned, and induced him to look upon them as actions of solution. In order, however, to include the dyeing process as an act of solution, it becomes necessary to extend the theory of solution to the interaction of solids on solids.

To show that there is nothing irrational about such a view, the author quotes as examples precious stones and coloured glass, in which the colouring ingredients are in a state of solid solution in the mass of the same. That these solutions were once liquid is of no moment as regards the theory of dyeing. The process of substantive dyeing and, as is shown below, numerous cases of adjective dyeing, may then be considered as actions of solution. Facts in support of this theory may be plenteously adduced. According to the mechanical theory of dyeing there is in a substantively-dyed fibre a juxtaposition of fibre- and dye-molecules; the dyed fibre should, consequently, exhibit the colour of the dry dyestuff. But it does not. Fibres dyed, for example, with Magenta or Methyl violet, are red or violet and not bronzy-green. Fibres dyed aniline blue do not show the coppery-red hue characteristic of the dry dyestuff. On the other hand, there is an undoubted instance of mechanical dyeing in the case of indigo, and in dark shades of this colour the bronzy hue of dry indigo is readily seen. Again, shellac-varnish coloured with Magenta or Methyl violet is red or violet, but on evaporation, the alcohol, which is the common solvent of the resin and dye, is driven off, and the residue, although its constituents are in molecular juxtaposition, is bronzy, because the dyestuff is insoluble in the resin. A further proof is afforded by the consideration of the behaviour of a fluorescent dye, such as Rhodamine. Rhodamine in alcoholic solution shows a powerful fluorescence. If, however, it be evaporated in a thin layer on a glass plate, the residue is devoid of fluorescence. Similarly shellac-varnish tinted with Rhodamine fluoresces, and on evaporation, so long as traces of alcohol remain in the residual mixture, the fluorescence is visible, but on completely expelling the alcohol the fluorescence disappears. Now, silk which has been dyed with Rhodamine fluoresces. Evidently the dye is in a state of solution, precisely as it is when dissolved in alcohol or water.

The fact that all dyestuffs are not substantive is due to their different solubilities in the fibre-substances. This does not imply that adjective dyestuffs are insoluble in the fibres. As a matter of fact, all dyestuffs which are soluble in water are more or less soluble in the three typical fibre-prineiples, fibroïn, keratin, and cellulose. If this were not so, a strand of cotton which had been dipped in a solution of Magenta, for example, should, on washing, readily part with the last traces of absorbed colour, as glass-wool does, when treated in the same manner.

This theory is not, however, concerned with the solubility or insolubility of dyestuffs in textile fabrics, but with the relative solubility of the same in textile fibres and in water. On the basis of this explanation, substantive dyes may be defined as such as are more soluble in the fibre prineiples than in water, and are, in consequence, extracted by the former from their solution in the latter. The operation of substantive dyeing is thus analogous to the extraction of substances from aqueous solution by means of insoluble solvents. The extraction of Magenta from its aqueous solution by silk may be compared to that of resorcinol from the same liquid by means of ether. On agitating with ether an aqueous solution of resorcinol, the resorcinol leaves the water and passes into the finely-divided globules of ether, being more soluble in that liquid than in water. So it is with the magenta and silk, the dye is more soluble in silk than in water. The requisite fine state of division is here presented in the form of the silk fibre. Moreover, the fibre, being a colloid, is osmotic and permits the dye solution to penetrate through its molecular interstices. If, however, the solvent power of the dye-bath be increased by the addition of alcohol, or, what amounts to the same thing, that of the fibre decreased by the application of tannin matters, which, although possessing chemical affinity for the basic dye, nullify the solvent capacity of the silk, dyeing does not take place, the Magenta remaining in the dye-bath. With this conception of the nature of the process of dyeing, the object and necessity for the constant movement in the dye-bath of the material to be dyed are readily understood, as is also the necessity for the proper proportioning of the volume of dye-liquor to the amount of material to be dyed.

The effect of immersing cotton in a solution of Magenta may be compared to that of agitating an aqueous solution of resorcinol with benzene; resorcinol is soluble in benzene, but more soluble in water, and is therefore not extracted from water by benzene.

Again, the imperfect extraction of resorcinol from its aqueous solution by amyl alcohol is analogous to a case of incomplete exhaustion of a dye-bath.

From the above it would appear that the chemical nature of a textile fibre, in cases of substantive dyeing, is only of moment as affecting the solvent capacity of the same. Thus, fibroin dyes better than other fibres on account of its superior solvent power; keratin, again, has for most dyes a greater solvent power than cellulose; the solvent power of cellulose is, indeed, so little that there are only a few dyes which it is capable of extracting from water, and with some of these, for example, the stilbene dyes, it is found advantageous to decrease the solubility in water of the dye by an addition of common salt. It will now be understood how it is that the thick-walled linen fibre is so much more difficult to dye than thin-walled cotton, the latter presenting much greater surface than the former, and consequently being better adapted for extraction purposes.

Finally, the fact that Congo red, for example, dyes a scarlet colour on cotton, whilst its aqueous solution is yellow, and that numerous other dyestuffs dissolve in textile fibres with a colour different from that which they possess when in aqueous solution, finds numerous analogies in extraction processes; thus, the colourless isonitrolic acid dissolves in benzene with a blue colour; iodine, which is brown in aqueous solution, imparts a purple colour to chloroform, &c.

Turning now to cases of adjective dyeing, it will be seen that with them, too, dyeing is an action of solution. The solution, however, takes place, in the first instance, between the fibre and mordant. Once dissolved by the fibre, the function of the mordant is to precipitate and fix the dyestuff which comes into contact with it. An analogous instance of solution is easily found. As mentioned above, benzene is incapable of extracting resorcinol from its aqueous solution, but if benzoyl chloride or acetic anhydride be added to the benzene, the resorcinol is readily removed from the water, being at the same time converted into a corresponding ester. The benzoyl chloride and acetic anhydride here play the rôle of mordants.—E. B.

Import of Cotton Goods Containing Arsenical Dyes into Norway. Board of Trade J. January 1891, 33.

Her Majesty's Consul General at Christiania, in a report to the Foreign Office, dated the 20th December, with respect to the regulations affecting the importation into

Norway of cotton goods in the preparation of which arsenical dyes are used, says:—

"It appears from the report of the Christiania Sanitary Commission for 1889, that the textile goods of which the sale was prohibited in that year, on the ground of their containing arsenical matter in excess of maximum permitted under the Rules of the Commission, consisted, as in 1888, almost exclusively of British cotton prints.

"Out of 496 samples of textiles tested by the Commission last year, 55, or 11 per cent. (against 24 per cent. in 1888), were condemned in accordance with those rules.

"The principal colours were blue and white (22 samples), brown and white (eight), black and white (five), red and yellow (four), brown and yellow, blue and yellow, yellow and red (severally three samples), and the remainder (one sample of each) blue and black, blue and brown, blue, black and red, red, yellow and green, and red and white.

"I am informed that the test is more severe at Christiania than in most cities on the Continent.

"This will account for the growing preference given in this country to German, French, and Swedish cotton prints and dyed woollens.

"Indeed, it seems to be believed in Norway that the danger of using textiles coloured excessively with arsenical dyes is not fully recognised in Great Britain, whereas medical men in this country strongly insist on the existence of that danger, especially in the case of children and of persons in weak health.

"Arsenically-dyed bedclothes (blankets, &c.) are more particularly avoided under medical advice.

"Several British manufacturers of cotton prints, aware of this prejudice, now guarantee that their goods are 'free from arsenic'; but a more general care in selection of patterns suitable to this market should evidently be exercised."

PATENTS.

Improvements in Injection Tubes, Skewers, or Spindles employed in Machines for Dyeing or otherwise Treating Yarn in Cop or other Compact Form. A. Graemiger, E. A. Leigh, and S. Mason, jun., Manchester. Eng. Pat. 17,747, November 7, 1889. 6*d*.

The object of this invention is the formation of a better joint between the open end of the hollow, perforated injection-spindles, employed in cop dyeing machines, and the cop-carrier or its nipple, thus ensuring a better result in the treatment of the cops, &c. This is effected by making the open ends of the spindles taper off slightly towards their extremities, the spindles then being fixed in the conical nipples, which, for this purpose, must taper inwards, instead of *vice versâ* as hitherto; or the spindles constructed in this manner may be fixed directly in conical holes in the cop-carrier.—E. B.

Dyeing and Printing Animal and Vegetable Fibres with Dinaphthyldiquinhydrone, or with Beta-Naphthoquinone or Tetra-Oxydinaphthyl. B. Willcox, London. From The Farbenfabriken vormals. F. Bayer and Co., Elberfeld, Germany. Eng. Pat. 18,073, November 12, 1889. 4*d*.

Dinaphthyldiquinhydrone is effectually fixed on vegetable and animal fibres by the aid of metallic oxide mordants, shades being obtained with the chrome mordant similar to those obtained with anthragallol, and fast to light and soap. β-naphthoquinone, or the tetrahydroxydinaphthyl obtained by reducing dinaphthyldiquinhydrone, may be used instead of dinaphthyldiquinhydrone, being converted into the last-named compound during the course of the dyeing or printing operations.

Two claims are made: first, the employment for dyeing or printing purposes of the above-mentioned colouring matters; second, the use of the chrome mordant in fixing the same.—E. B.

Improvements in Machines for Dyeing, Bleaching, or otherwise Treating Fibres in a Raw, Spun, or Intermediate State of Manufacture. A. Graemiger, Manchester. Eng. Pat. 18,115, November 13, 1889. 8*d*.

The material to be dyed, &c., is placed on a perforated disc or between two perforated discs or plates forming the piston of a pump, which works in a closed cylindrical liquor vessel containing inlet and outlet pipes, or in an open cylindrical vessel containing suitable arrangements for preventing the outflow of liquor on the downstroke of the piston. The dyeing, &c., is effected by the liquor being drawn or forced through the material on actuating the piston. For details of construction, arrangement of valves, &c., the original specification must be consulted.

—E. B.

Improvements in Apparatus employed in Dyeing Velvets, Plushes, and other Fabrics in the Piece, and in the Drying of Fabrics generally. B. J. B. Mills, London. From J. Valansot, sen., Lyons, France. Eng. Pat. 19,196, November 29, 1889. 8*d*.

The subject of this invention is an apparatus for holding or carrying cloth whilst undergoing the operations of dyeing, washing, drying, &c. It enables the cloth when once wound on the framework of the apparatus to pass successively through all the operations mentioned without being detached from the apparatus. The apparatus is constructed of two discs placed at suitable distance apart on a central shaft. Each disc carries a number of radiating arms in which there are grooves for the reception of rods, which are fixed parallel to the central shaft and kept in their places by hooks or catches. The rods are formed of wood or of copper tubing with wooden cores, and, to prevent the cloth which is being treated from slipping, are wrapped with cloth or thread. Instead of rods, there may be used cords, belting, &c. attached to the arms in separate strips, or composed of one entire length, which is fixed to the centre and outer extremity respectively of the apparatus, and passed over hooks on the radiating arms and tightly stretched.

To fill the apparatus with cloth, it is necessary to place it horizontally on two supports, and after fastening one end of the piece to the innermost rod, to wind the cloth spirally over the succeeding rods, which are placed in position one by one as the winding progresses, the other end of the cloth being fastened to the outermost rod. The apparatus may be fixed so as to rotate either vertically or horizontally.

—E. B.

Improved Apparatus for Dyeing and otherwise Treating Textile Fabrics. C. Corron, St. Etienne, France. Eng. Pat. 19,863, December 10, 1889. 8*d*.

A dye-bath is fitted with three draw rollers working under the surface of the liquor, and with a pair of oscillating squeezing rollers mounted on levers above the bath. The squeezing rollers serve to lay the cloth in folds in a second bath contained inside the main dye-bath. One bath may be used for mordanting, washing, or brightening, whilst the other is used for dyeing, or "two colours or shades may be dyed at the same time." In connexion with this double bath, claims are made for a roller with right- and left-handed screw-threads for stretching in width the cloth under treatment; for a compressing roller for fulling the fabric; an arrangement of steam pipes with "graduated perforations to aid in stretching the fabric in width;" and "the combination of the wheels and chains for driving the rollers and the cranks for working the oscillating lever."—E. B.

Improvements in Producing Azo-Colours on Cotton or other Vegetable Fibre. R. Holliday, Huddersfield. Eng. Pat. 20,064, December 13, 1889. 4*d*.

The improvements relate to the process of producing azo colours on materials composed of vegetable fibres (Eng. Pats. 2757 of 1880; 1638 of 1881; and 2946 of 1882), and consist in combining in one operation the oiling of the fibre

and its impregnation with the phenol used. This is effected by mixing the oil—which, by preference, is such as is employed in alizarin-dyeing—with sufficient fixed alkali to develop the colour on subsequent treatment with the solution of diazo, diazo-azo, or tetrazo compound.—E. B.

Improved Mordant for Black Dyeing. W. Marriott, Huddersfield. Eng. Pat. 11,580, July 24, 1890. 4*d*.

A MIXTURE of "copperas, bluestone, and crystallised soda" is placed in an iron pan and gently heated until the carbonic acid of the soda has been expelled, when oxalic acid is added and the whole thoroughly mixed. The resultant mass, when dried and ground into powder, is employed along with logwood in the single-bath method to produce a fast black on woollen goods.—E. B.

Improvements in Apparatus for Dyeing Yarn. J. F. Peck, Providence, Rhode Island, U.S.A. Eng. Pat. 13,184, August 24, 1890. 8*d*.

A CYLINDRICAL cop-spindle holder is provided in its interior with a valve by means of which the passage of the dye-liquor through the cops is controlled, so that, while a large number of cops are immersed in the dye-liquor, only a few at a time are acted upon by the suction pump, a uniform shade of colour being in this way produced on all the cops. Claims are also made for improvements in a device employed for moving the spindle-carriers from one vat to another; in the employment of a moveable hose-pipe connected with the suction pump; and in several other mechanical arrangements which it is impossible to properly describe without reference to the drawings accompanying the original specification.—E. B.

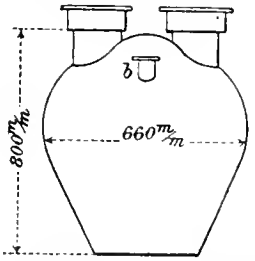
Improvements in Dyeing, Bleaching, Washing, or otherwise Treating Cops of Yarn or the like, and Apparatus therefor. W. P. Thompson, Liverpool. From F. Kornfeld, Prague, Austria. Eng. Pat. 14,897, September 20, 1890. 6*d*.

HOLDERS of special construction are employed for receiving the cops, &c. to be dyed. Obstacle-plates or flanges project from the sides of the holders, and are inserted between the coils of thread after the cops have been placed in position. The purpose of the obstacle-plates is to produce a better penetration of the cops, &c. with the liquors "or gases" employed. The holders are cylindrical in the middle and terminate in conical caps with flanges projecting over the sides of the middle piece; they are placed in vertical rows over tubes connected with a liquor-vessel, their tops projecting into a similar liquor-vessel placed above, and the dye-liquor, &c. is pumped through the cops from one vessel to the other.—E. B.

VII.—ACIDS, ALKALIS, AND SALTS.

On Guttmann's Improvements in the Manufacture of Nitric Acid. H. Anderseh. Zeits. f. angew. Chem. 1890, 619.

GUTTMANN states (Zeits. f. angew. Chem. 1890, 507; this Journal, 1890, 862) that with his battery the distillation of nitric acid can be conducted as hot as may be desired, and that a great evil of the retorts is that through foaming the contents may easily be carried over into the delivery pipes. The author considers it a very doubtful advantage to be able to work as hot as may be desired, as the nitric acid is easily decomposed by a too elevated temperature; and, further, that when the charge is properly adjusted to the size of the retorts, the contents are never carried over into the discharge pipes. Guttmann's system of cooling in pipes will no doubt operate more quickly, but a weak point is the number of joints which have to be made. Under the old system, for the complete condensation of the acid from a charge of 3—3·5 hectokilos. of saltpetre in one retort, four



THE MANUFACTURE OF NITRIC ACID.

bottles of the size shewn in the figure are necessary in winter, and five in summer.—W. M.

The Alkali Manufacture in Russia.

THE Russian Chemical Society has just recently received a communication, with a sample of the first output of Russian bleaching powder, from P. K. Ushkoff, of Elabouga, in the province of Viatka, who has just started manufacturing bleaching powder on a large scale from native products. This is considered a very important step in the growth of Russian chemical industry, as the whole of the bleaching powder hitherto required for home industries had been imported from abroad (about 10,000 tons per annum).

The same manufacturer has nearly completed his arrangements for manufacturing soda ash and caustic soda by the Leblanc process.—N. W. T.

PATENT.

The Production of Sulphate of Ammonia (SO_4NH_4O) from the Nitrogen of Marshy Moors or Meadow Land Moors, and Apparatus therefor. W. L. Wise, London. From H. Grouven, Leipzig, Germany. Eng. Pat. 1136, March 21, 1878. (Second Edition.) 1*s*. 3*d*.

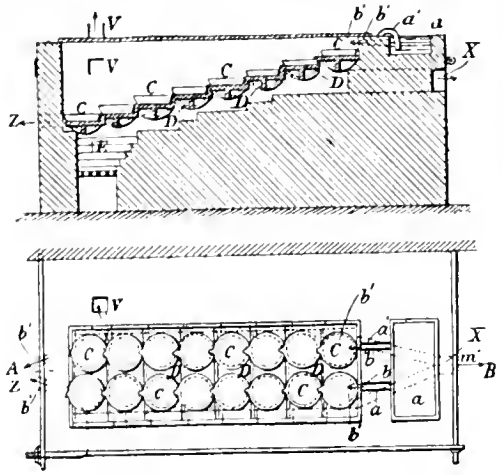
ACCORDING to the patentee, "marshy or meadow land moors contain up to 3·8 per cent. of nitrogen." The method of obtaining this nitrogen (or 98 per cent. of it) is based on the results of investigation, "that the intrinsic nitrogen value of the moor is for the greater part contained in its proteine of plants, and does not, as has hitherto generally been assumed, exist in ammonia salts." The process is divided into the following main operations:—

"(1.) Preparation of the excavated moor or bog for further treatment." "(2.) The conversion of the moor or bog to ashes, steam, gas, and vapours, the air being excluded, and under the influence of certain degrees of heat." "(3.) The decomposition of steam in the presence of the gases and vapours by means of the adoption of a peculiar contact mass and at certain degrees of heat for the formation of carbonate of ammonia in gaseous form." "(4.) The condensation of a part of the carbonate of ammonia gas formed." "(5.) The conversion of the non-condensed carbonate of ammonia gas to sulphates of ammonia by the use of a peculiar chalk gypsum (sulphate of lime) in form of marbles or very small balls at certain degrees of heat." "(6.) The conversion of the condensed carbonate of ammonia to sulphate of ammonia." "(7.) The filtration and the evaporation of the solution of sulphate of ammonia and the production of the dry sulphate of ammonia." For details of the apparatus, &c., the specification must be consulted.

—O. H.

Improvements in Furnaces for Concentrating Sulphuric Acid. C. Négrier, Paris, France. Eng. Pat. 14,022, September 6, 1890 (Internat. Conv. April 26, 1890). 6*d*.

The acid runs from the reservoir *a* by means of the syphons *a'* upon the slab *b*, and thence by the tubes *b'* into the concentrating dishes C. The dishes are placed in pairs,



The Concentration of Sulphuric Acid.

each successive pair lying below its predecessor. They are made of porcelain, whilst the shelves D are of iron and are pierced with holes to allow of the more ready escape of the acid in case of fracture of the dishes. Each dish rests upon asbestos tissue and is surrounded with sand to the level of the upper rim. The fire is situated at E, whence, as the acid becomes more and more concentrated in its passage downwards, it meets with gases of increasing temperature. It issues finally very highly concentrated at Z. The vapours evolved from the dishes are aspirated off through a leaden tuyere V. The furnace gases leave at X, and their heat may be utilised in a similar apparatus for a preliminary concentration of the acid.—S. G. R.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

PATENTS.

Improved Means of Manufacturing Hollow Glass-ware and Glass Tubes by Machinery. D. Rylands, Barnsley. Eng. Pat. 17,468, November 4, 1889. 11*d*.

The inventor describes mechanical arrangements for ensuring the molten glass being level or nearly level with the plunger after it has come sufficiently in contact with the top molten metal to form the mouth or top of the hollow glass-ware; also for securing a smooth rim and top; for passing the outer mould along fixed bars, in combination with a stationary and blowing plunger and an inner pressing mould; and for the manufacture of glass tubes.—E. G. C.

Improved Means or Apparatus for withdrawing Molten Glass or Molten Metals from Furnaces and Controlling the Outflow thereof, also applicable for Conveying Liquids or Chemicals of a Liquid Nature from Larger to Smaller Vessels or Receptacles. D. Rylands and J. W. Horner, Barnsley. Eng. Pat. 17,932, November 11, 1889. 8*d*.

See under I., *page* 36.

Improvements in the Manufacture of Glass Tubes, Sheet Glass, and other Glass Ware. D. Rylands, Barnsley. Eng. Pat. 19,734, December 9, 1889. 8*d*.

An oscillating or swinging motion is imparted to the tube mould, which is of a special construction, described in detail in the specification.—E. G. C.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

Methods of Preserving Timber at the Vienna Exhibition. R. Rittmeyer. Dingl. Polyt. J. **278**, 221—234.

One of the latest methods of impregnating timber with a preservative agent is that devised by Pfister. The apparatus necessary is portable, and is intended to be taken to the spot where the trees to be treated are felled, so that impregnation can be carried out there. The entire trunk is not saturated, but only an inner cylinder of wood as large as may be available. A plate of suitable size provided with a cutting edge is forced into the squared end of the stem and held in position by chains attached to hooks driven into the trunk and tightened by a screw. It is kept central while being fixed by a stake passing through the aperture which afterwards serves for the attachment of the pipe conveying the preservative fluid. Two men can thus prepare a tree in three or four minutes. Any cracks, longitudinal or transverse, are stopped up before the plate is put on to prevent unequal diffusing of the preservative liquid or its too easy exudation. A precaution that should be observed consists in felling no more trees than can be treated the same day, as impregnation is effected through a freshly-cut surface more readily than through one that has been long exposed. The liquid used is a solution of zinc chloride of a specific gravity of 1·008 for timber that is to be used under cover and 1·010 for that which will be exposed to the weather. Stronger solutions raise the cost of preservation without corresponding advantage, the expulsion of the substances instrumental in setting up putrefactive change being as complete with a weak as with a strong solution. In a process of this nature in which a portable apparatus is used, some consideration must be had to the relative advantages of taking it to the timber and the reverse plan, as the water necessary to dilute the strong solution of zinc chloride sent with it may be not available or unsuitable if found near the trees to be treated. A water containing calcium carbonate must be neutralised with hydrochloric acid before being used, as it would otherwise precipitate a portion of the zinc. The solution having been prepared and the plate fixed, the pump is set in action and the preservative fluid forced in, displacing the sap naturally present in the tree. As the latter exudes from the free end of the stem it has a specific gravity varying with the kind of wood, its age and situation, sometimes reaching 1·0045. As the process continues practically pure water passes out for a while, and then the specific gravity of the expelled liquid rises again until it reaches that of the fresh preservative, showing saturation to be complete. By starting with a liquor about 50 per cent. stronger than that mentioned above as of the usual concentration, and diluting it to the proper extent by the weaker liquid first expressed from the tree after the expulsion of the sap, considerable economy, more particularly in the quantity of water used, which is sometimes a very desirable consummation, results.

On the average 360 litres of solution are necessary for 1 cub. m. of beech.

Pfister states the cost as ranging from 4*d*. to 6¼*d*. per cubic metre, according to the extent to which the partially exhausted liquor is utilised, the specific gravity being in all cases 1·010.

The timber should be allowed to remain some time after impregnation before being worked in order to permit the full formation of insoluble compounds with the preservative.

Zinc chloride is used in preference to other salts on account of its cheapness, but for special purposes various liquids may be employed. Thus the wood may be coloured red throughout by dilute sulphuric acid, the depth of colour increasing with the concentration. Mahogany red is obtained by using dilute nitric acid, while weak iodine solution gives a brown shade. Greyish black and black are produced by injecting ferric chloride followed by tannin. The wood may be rendered non-inflammable by impregnating it with an aqueous solution of alum, to which a concentrated solution of zinc chloride in the proportion of 10—25 litres per hectolitre has been added. In estimating the economy of carrying on the process in the forest itself it must not be forgotten that either the impregnated timber must be worked up on the spot, or a greater freight be encountered; for example, the increase in weight, due to impregnation, of a freshly-cut sleeper 2·5 m. × 25 cm. × 15 cm. amounts to as much as 12—30 kilos.

The chief disadvantage of the process lies in the fact that the impregnation is somewhat irregular, as the following table of analyses of the two ends of sundry sleepers demonstrates.

Percentage of Zinc Chloride.

Thick End of Log.	Thin End of Log.
1·12	0·27
1·21	0·59
1·09	0·80

The older Boucherie process, in which the timber is impregnated by a moderate pressure due to a head of liquid in the containing vessel (about 10 m.), though slow, gives a considerably more even distribution of the preservative.

The sleepers used on the Hungarian State railway are treated with zinc chloride solution forced in by steam pressure (Dingl. Polyt. J. **271**, 230). Using a solution of sp. gr. 1·015 at 17° C., a fairly complete impregnation is obtained though the distribution is still somewhat irregular; thus a sleeper containing 1·222 per cent. of zinc chloride at the end had only 0·364 in the middle. Extensive experiments have been made to test the efficacy of the process. In those cases where rapid decay was observed it was satisfactorily traced to imperfect saturation, which may be due to the wood being already attacked by fungoid growths, such wood being difficult to impregnate, or to imperfection in the execution of the process. A travelling plant of this description has been devised for railway work.—B. B.

On the Use of Decomposed Granite Sand as a Natural Cement in Japan. J. Takayama. Dingl. Polyt. J. **278**, 275—286.

In some provinces of Japan a sand consisting of decomposed granite is found and is used as a cement in admixture with slaked lime. The author gives analyses of samples of the sand from different localities which show that it contains a finely divided clayey material which, in combination with slaked lime, has the property of hardening. Numerous experiments are detailed to show which is the best proportion in which to mix the sand and lime and showing the influence of fresh water, sea water, and the action of frost upon the cement so formed. The cement is not so strong as Portland cement, but may be substituted for it in many cases on account of its cheapness. Fresh water has no action on it, but it is soon destroyed by the action of salt water.

—H. S. P.

Asphaltum. Eng. and Mining J. 1891, **51**, 43.
See under III., *page* 40.

X.—METALLURGY.

The Basic Process as applied to Copper Smelting. P. C. Gilchrist.
See pages 4—13.

On the Darby Process of Recarburising Iron. A Paper read at the International Congress of Iron and Steel Manufacturers at Pittsburg, U.S.A., October 1890.

In experiments for the production of steel the chief point in the solution of the problem is always the introduction into or the removal from the iron of a determinate quantity of carbon. In producing steel containing a desired percentage of carbon by the Bessemer process, two methods present themselves. By the one, the process is stopped when the bath possesses the desired contents of carbon; by the other the bath is completely decarburised, and then the wished-for carbon added in the form of ferro-manganese, spiegeleisen, &c. In Germany the latter method only came into use and was retained when the Thomas-Gilchrist process for the production of steel low in phosphorus from highly phosphoric iron in the basic converter came successfully into use, the more so, as from the nature of the process, before dephosphorisation takes place, complete decarburisation is necessary. But, while by the old acid process the carburisation was readily effected by the simple addition of spielgeleisen, &c., the Thomas-Gilchrist process brought with it new difficulties owing to the interference of the oxides always present in the basic process, and the phosphoric acid of the slag. Although methods of manipulation were resorted to with success for overcoming these difficulties, still the production of low phosphorus steel high in carbon could not be accomplished so readily as not to make the introduction of another simple method of carburising desirable. The circumstances are similar as regards the basic and acid open-hearth processes. Many methods of introducing carbon were tried in many quarters and all of them were based on the known fact of the great affinity between carbon and iron at high heats. It was sought to reduce and carburise the bath of steel by the introduction of carburetted gases, by the addition of tar, petroleum, &c., as well as many mixtures of these substances with solid bodies such as burnt dolomite. None of these attempts led to a practical working result until Darby, the managing director of the Brymbo Steel Works, succeeded in solving the problem. Having remarked an increase of carbon which took place in welding two pieces of steel in a coal fire, he brought fluid steel into intimate contact with solid carbon, the result being a rapid absorption of the carbon by the steel. On this experiment he founded his patent process by which fluid steel can be carburised by filtration through pieces of carbon in the form of graphite or wood charcoal, &c. (this Journal, 1889, 546 and 549; 1890, 1134). He employed for this purpose a cylinder of sheet iron lined with refractory material and open at the top and closed at the bottom by a plate pierced by numerous holes. This cylinder was filled with the carbonaceous material and inserted either between two steel ladles, or between the Siemens furnace and a steel ladle, and the fluid steel was allowed to flow through it. It was soon found that the absorption of the carbon was so rapid that the long time required for filtration by this method was unnecessary. Darby therefore substituted for the cylinder a pot lined with refractory material, with a bottom perforated by numerous holes. The carbon was not placed in this, but above it was placed a receptacle containing the roughly broken carbonaceous material. This receptacle had a side valve by the opening of which the carbon was allowed to fall faster or slower into the pot where it mixed with the steel which became carburised and flowed out through the perforated bottom.

The loss of carbon (graphite) by this method by burning is from 15—to 20 per cent.; with coke the loss is greater. Darby's experiments extended only to the carburising of open-hearth steel, and he succeeded in making excellent steel from phosphoric raw material containing any wished-for percentage of carbon to upwards of 0·9 per cent.,

containing only traces of other bodies and distinguished by its toughness. It has been worked up into chisels, knives, wires, &c. with the best results. The steel rolled very well, although only small additions of ferro-manganese or ferro-silicon were made.

In order to extend the system to the Bessemer process, Darby entered into an arrangement with the Phœnix Company of Laar, near Ruhrort-on-the-Rhine. When tried with the basic Bessemer process, although the steel was readily carburised it would not roll, the ingots falling to pieces in the rolls. This was found to be due to the oxidation caused by the streaming of the metal during four minutes through the 60 small holes of the perforated bottom of the carburising pot, and it was sought to prevent the oxidation by substituting one hole of suitable diameter for the 60 small holes. An improvement resulted, but the steel did not yet roll sufficiently well. Finally, the observation that the finely-ground coke is immediately absorbed on first contact with the metal, led to the adoption of the plan of allowing the carbonaceous material to be added direct to the stream of molten metal flowing from the converter before it reached the casting ladle, whilst the slag was retained in the converter until the carburisation was complete, by means of a suitable plate or block of refractory material held at the mouth of the converter whilst the metal was being poured. A table showing some of the results obtained is given in the original paper. During the month of June, at the Phœnix Works, 70 per cent. of the steel-rail charges and also a number of charges for hard and welding Thomas steel were produced in this way. The same addition of ferro-manganese is required as in the Thomas process, but no spiegel is needed. The advantages are enumerated as follows:—1. In the basic Bessemer (Thomas) process:—the carburising takes place in the almost complete absence of the slag, rich in oxides and phosphoric acid, consequently it proceeds with certainty, is accompanied by no important rephosphorisation, and is practicable for any desired percentage without simultaneously increasing the manganese. By the omission of spiegeleisen a considerable economy is effected. 2. In the Bessemer (acid) process:—the carburisation takes place up to the highest grade of hardness with far greater safety than by the help of spiegel and without the increase of manganese consequent upon the use of spiegel. Here also a considerable economy is effected due to the saving in spiegel. 3. In the open-hearth process:—for the acid and basic open-hearth processes the advantages are nearly identical with those for the Bessemer and Thomas processes; the very considerable cost of the ferro-manganese and ferro-silicon being wholly or for the most part avoided. In combination with the basic open-hearth process a steel can be made for many industrial purposes that can compete successfully with crucible steel.

By the addition of, at the outside, 0·04 per cent. of aluminium to the bath a steel has been produced absolutely free from porosities and eminently fit to be used for railway tyres.—H. S. P.

Quicksilver Mines and Reduction Works. Eng. and Mining J. 1890, **50**, 265—266.

This paper is a statistical abstract of the eleventh census of the United States Geological Survey on the production of quicksilver. Only two States produce any quantity of this material—California and Oregon. The former yielded in 1889, 26,464 flasks, each containing 76½ lb., and the latter produced only about 20 flasks, the total yield in 1888 being 33,250 flasks. At present there are only 14 mines with 36 furnaces in work, while there are 6 mines with 7 furnaces closed on account of litigation, low prices or want of funds, but which anticipate resuming when the price of quicksilver rises. The yield in California was obtained from 93,000 tons of ore, at a cost of 881,401 dollars, of which 71 per cent. was paid for wages, 25 per cent. for supplies, and 4 per cent. for other expenses. The cost per flask for production ranged from 65 to 21 dollars with an average of 33 dollars, while the market price fluctuated from 50 to 40 with an average of 45 dollars. The highest percentage of quicksilver in the ore was returned for a lot of 200 tons at 2·295, the lowest at 0·286, and the average yield for all the ore roasted was 1·088 per cent.

It appears from the statistics that during the last 10 years the United States production has gradually fallen from about 60,000 to 26,000 flasks, and while the Almaden mine has kept up a steady yield the Italian mines have increased from 3,400 to 10,000 flasks, and the Austrian mines from about 10,000 to over 15,000 flasks. The grand total production for 1889 of 101,236 flasks is about 8,000 below the average for the 10 years. The paper contains a table of the yield, price and approximate value of the quicksilver from Californian mines for each year from 1850 to 1889, and also a statement of the estimated value of each and all the mines and works there at the present time.—A. W.

International Standards for the Analyses of Iron and Steel. Extracts from the Work of the American Committee. J. W. Langley. Eng. and Mining J. 1890, **50**, 455.

See under XXIII., *page* 67.

A New Method for Precipitating and Collecting the Gold in Chlorination. L. D. Godshall. Eng. and Mining J. 1890, **50**, 620.

Some time ago, C. H. Aaron in one of his writings mentioned a new precipitant for gold, with which the writer has experimented for over a year. It is precipitated sulphide of copper. This is, undoubtedly, far superior to anything hitherto in use, but it requires certain precautions.

In view of the difficulties always met with in the perfect separation of the gold and copper, the writer made further experiments in order to ascertain if other metallic sulphides might not answer the purpose of the copper sulphide, and found both on the experimental and the commercial scale that precipitated iron sulphide acted similarly to the copper sulphide in every way, and presented far less difficulty in the subsequent separation of the gold and iron; the use of the latter is therefore recommended by the writer as being preferable in every way to copper sulphide. Not content with this discovery, a number of experiments were made with precipitated lead sulphide, and this was found to be equally effective with the two sulphides already mentioned. Reduction of the gold is in this case extremely simple. The only possible objection that can be made to iron sulphide as compared to copper sulphide is that the former oxidises a little more readily than the latter, also that, in barrel chlorination, there is always present in the gold solution more or less free acid; small as the quantity generally is, when the liquid is heated, the acid has a slight solvent action on the iron sulphide, while it does not affect the copper sulphide. These properties make it necessary to replace the iron sulphide a little more frequently than the copper sulphide, but this disadvantage is very slight when compared with the difference in cost and trouble in the reduction of the copper sulphide. The reactions produced by these three sulphides are similar to that produced by H_2S. They are—

$$3\,CuS + 2\,AuCl_3 = Au_2S_3 + 3\,CuCl_2$$
$$3\,FeS + 2\,AuCl_3 = Au_2S_3 + 3\,FeCl_2$$
$$3\,PbS + 2\,AuCl_3 = Au_2S_3 + 3\,PbCl_2$$

It will be seen by the above reactions that, as the gold is precipitated, the precipitant is being gradually, according to the amount of gold present, converted into a soluble chloride and dissolved, consequently it must be renewed from time to time.

The precipitate containing the gold should not be taken out too frequently, as this will simply cause needless work in the reduction and separation. Whenever the sulphide seems nearly exhausted the filter need not be cleaned out, but simply more freshly precipitated sulphide added to it. The strong canvas used for protecting the fine filtering muslin or linen should be replaced at times by a new piece, as the action of the free acid may and will in time render the fibres rotten and weak, and liable to tear, thereby causing a loss of the gold.

PATENT.

Improvements in the Tempering, Annealing, or Treating of Castings or Forgings of Copper, Nickel, Cobalt, and Aluminium, and of Alloys of these Metals with each other or with Manganese, Cast or Wrought Iron or Steel. A. Evrard, Paris, France. Eng. Pat. 17,890, November 9, 1889. 4*d*.

A BATH of molten lead, zinc, or other fusible metal or alloy is used for tempering metals instead of water, saline solutions, fatty substances, &c., the advantages being that the bath has a high conductivity, does not evolve gaseous substances, and can be easily maintained at a given mean temperature. The use of this bath for large forgings and for armour plates in which the percentage of carbon exceeds 0·45 per cent. has already been patented by the author (Eng. Pat. 10,823 of 1886). The present patent refers to its application to copper, nickel, cobalt, aluminium, &c., and to alloys of these metals with manganese, cast and wrought iron and steel. The resistance of these alloys to shock and to penetration by projectiles is considerably increased by immersion when hot in metallic baths.—H. K. T.

ERRATUM.

In December number 1890, page 1133, column 2, paragraph 4; for the date given, viz., 1833, read 1883.

XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

The Heroult Process of Smelting Aluminium Alloys. F. P. Dewey. Washington Meeting of the American Institute of Mining Engineers. Ironmonger, 1890, 377—378.

THE Heroult process consists in electrolysing a mass of molten alumina (Al_2O_3), and at the same time alloying the separated aluminium with a heavy metal, the heat necessary for the fusion of both the alumina and the alloying metal being supplied by the direct passage through the molten mass of an electric current of high ampèrage and low voltage. The process has been in active operation at Neuhausen, in Switzerland, for about two years. It is also in active operation in Froges, in Southern France. Both these locations were selected for this purpose on account of the presence of large and desirable water powers. The apparatus consists of a carbon containing vessel, which may be a single crucible for small operations, or may be built up of slabs or blocks of carbon for large and industrial operations. When built up of slabs or blocks, the whole is surrounded by an iron casing. In the earlier crucibles this iron casing was cast around the carbon, in order to secure close electrical contact. This, however, has been found unnecessary; and for the later crucibles the casings consist of plates bolted together, while pulverised carbon is packed between the carbon blocks and the iron. Electrical conductors are united direct to this iron casing, and the current passes from this through the carbon lining to the interior of the crucible. By this arrangement the crucible forms a part of the electric circuit, and in the earlier stages of the process is the cathode. When, however, the metal within the crucible melts, the melted metal serves as the cathode during the running of the process. A single carbon rod may serve for the positive electrode or anode in small operations. For large and industrial operations it was formerly necessary to build up compound anodes of slabs of carbon, as then it was impossible to get large single slabs. These small slabs were held together by dowels, either of carbon or of the heavy metal of the alloy, and clamped together at the top. By recent work at Froges, it has, however, been possible to manufacture single pieces of carbon of any desired size to serve as anodes. From these very much better results are obtained than from the built-up anodes. One of the great difficulties with the latter is that, even with the utmost care in their preparation, and testing the plates before use, they will crack during the operation, and the pieces, falling down, are apt to cause short circuits. Moreover, when a plate cracks it becomes necessary to interrupt the operation and remove the broken piece. On account of the high heat in the furnace this is a disagreeable operation. With all the large anodes, whether built up or solid, metallic side-plates are used. These are clamped tightly upon the anode and extend a short distance into the furnace when new. They serve to protect the heated portion of the anode outside the furnace from oxidation, and they conduct a portion of the current, and thereby lessen the outside heating. As the process goes on and the anode is consumed and lowered into the furnace, these plates gradually melt, and furnish heavy metal to the alloy. As the plates melt away the clamps are raised from time to time. The anode is suspended from a crane provided with means for its ready adjustment within the crucible. In starting the process in a cold crucible, a suitable amount, say, of copper, is placed upon the bottom of the crucible, and the current is then allowed to pass. This soon fuses the copper, which forms a bath of molten metal, and thereupon becomes the cathode. Alumina is now added, and the anode is slightly raised. In the intense heat thus produced the alumina melts and forms a layer above the melted copper and becomes an electrolyte. The current passes through it and it is decomposed, the aluminium separates at the cathode of molten copper, and alloys with it, while the oxygen goes to the anode and combines with the carbon. It will thus be seen that the process is electrolytic in its operation. In the ordinary operation of the process the distance between the electrodes is maintained at about 3 mm. At a suitable point in the circuit is placed a large ampère-meter, by watching which the workman can judge as to the distance between the electrodes, and raise or lower the anode as required. Alumina and copper are added from time to time as the operation of the process requires, and the reduction is continued until the crucible is full of metal, when it is tapped into a casting-ladle, and the current stopped. A considerable portion of melted alumina always flows out of the crucible after the alloy, and this is returned to the crucible during the next run. As soon as the crucible is empty the tap-hole is stopped and the proper amount of copper added, which is melted by the residual heat of the crucible. The current is again turned on, alumina added, and the operation of reduction resumed. From 10 to 15 minutes are required for this work.

As soon as the metal in the ladle has cooled sufficiently it is cast in iron moulds. This cycle of operations is repeated so as to constitute a continuous process. Nothing but copper and alumina are charged into the furnace. As the copper and aluminium are withdrawn in the form of an alloy and the oxygen passes off as gas, there is no slag or refuse of any kind arising from the operation. As the anode is consumed in the process it is gradually lowered, and when reduced to a stump replaced by a new one. This is usually done at tapping-time, and takes from 20 to 30 minutes. With the built-up anodes formerly used, it was necessary to heat up the anodes gradually, and generally an hour was consumed; but with the new block-anodes the current can be turned on at once. The reading of the ampère-meter is an excellent guide at all times as to what is going on within the crucible. When everything is moving along smoothly and properly there is simply a slight oscillation of the needle. Sudden or wide variations indicate some irregularity in the operation. In irregular work the position of the anode with reference to the cathode and the melted alumina is clearly shown. If the current pass between the melted alumina and the anode by an arc, if the anode dip into the alumina, but not far enough, or if too far, each condition will be shown by the position of the needle upon the circle; while if by any means the anode comes within arc-distance of the melted metal at the bottom of the crucible, the fact will be unmistakably indicated upon the ampère-meter by a sudden increase in the number of ampères generated. This last

condition is also clearly shown by a number of other circumstances. When copper alloys are made there will be a copious volatilisation of the metal, and the flame at the charging-opening will be strongly tinged by it.

The proportion to be observed between the alumina and copper added varies under different circumstances. It is designed to produce at one operation an alloy containing a high percentage of aluminium. Alloys as high as 73 per cent. of aluminium have been produced; but under certain circumstances it is more economical to run from 35 to 40 per cent., and again at times it is more desirable to produce a 25 per cent. alloy. All things being considered, the 25 per cent. alloy is probably the most economical to produce, and may be taken as the standard. With proper care, and barring accidents, the grade of metal produced can be held with much uniformity. The maximum variations need not exceed 1 per cent. of aluminium. The percentage of aluminium that can be introduced into the alloy by this process is governed by the question of specific gravity. Since the specific gravity of alumina is 3·7 to 4·1, and the specific gravity of aluminium only 2·6, the limit in the percentage of aluminium is reached when the product becomes light enough to float upon the melted alumina. Practical work has shown that when the copper alloy reaches about 65 per cent. of aluminium, it begins to rise and cause trouble by short-circuiting between the sides of the crucible and the anode. When 73 per cent. aluminium is reached, there is so much short-circuiting from this cause that the process must stop. The loss of material varies with the percentage of aluminium introduced into the alloys. In making a 20 per cent. bronze, the loss of copper is from 5 to 6 per cent., but in making a 30 per cent. bronze, it may rise to 10 per cent. Owing to the high temperature and the rapid evolution of gas at the anode, there is considerable loss in alumina carried off mechanically by the gases, which may amount to 30 per cent., but with suitable means for recovering the solid material in the fume this has been greatly reduced at the Froges Works. When the process is in smooth working condition, the flame and smoke are alike light coloured. When, however, a short-circuit occurs, the flame becomes tinged with copper and is very much darkened.

Other metals besides copper can be used to alloy with the reduced aluminium, the only limitation being that they shall not be volatile at the temperature of the operation. The rich alloys produced in the furnace are very hard and brittle. They are not fit for any direct application. To prepare the useful alloys, these rich products are diluted to the proper degree by the appropriate metal for each case. While this process is more particularly designed for the reduction of aluminium, yet it is also adapted to the reduction of other refractory metals. Silicon copper has been thus prepared upon an extensive scale. Since the current required is different from that used for any other purpose, in that it must be of large quantity and of low intensity, the dynamo has to be specially built for this purpose. Machines for such abnormal current have never before been called for, and when the output is compared with the low speed at which they run, they may well be classed with the largest dynamos which have ever been built.

The construction of these gigantic machines was undertaken by the Oerlikon Machine Works, Zurich, Switzerland, and C. E. L. Brown's construction of the armature, in which the winding is passed through holes in the core, is particularly adapted to this application. The field of the dynamo is of the multipolar type, having six poles. It is made in one casting, in order to avoid all joints, and weighs 10,000 kilos. The exciting of the field-magnets is effected by a separate machine. The armature is of the usual Brown type, with embedded wires, but contains two distinct circuits, each having its own commutator. The winding consists on the outside of round copper bars, and on the inside of flat copper plates, placed in grooves planed out of the wood lining, so that the plates are firmly held, and at the same time insulated. There are six sets of brushes, making in all 72. Although cross-connections between the equi-potential coils are not absolutely necessary, yet they have been provided. Copper bars conduct the electric current from the machines to the furnace. The two machines originally built for the works at Neuhausen were connected direct to a Jonval turbine. They were designed to give a current of 6,000 ampères at 20 volts, when running at 180 revolutions. It was found in practice, however, that they could be worked up to 30 volts. The present plant at Neuhausen consists of two 600 horse-power machines running on vertical shafts, and one 300 horse-power machine.

The process has been in operation at Boonton, New Jersey, for a short time. The installation here consists of a Victor 32½-inch turbine-wheel, supplied with water through a 6½-foot flume, with a fall of 28 feet. This, at 220 revolutions, is designed to give 220 horse-power. Coupled direct with the turbine is a Brown dynamo of 150 E.H.P., which furnishes a current of 3,500 ampères at 33 volts. A small 15-horse power exciting dynamo is used with the large machine. There are two furnaces, one 43 in. square on the outside, built up of carbon plates, giving a crucible of 9 in. by 16 in. and 19 in. deep, and a smaller one for experiments. This crucible has a capacity of 200 lb. of contained aluminium in 24 hours, after making due allowance for stoppages at casting, changing anodes, and for minor repairs to the crucible. The anode first used consisted of 10 plates, 6 × 12 × 40 in., bound together at the top by a specially designed clamp, to which the electric conductors are attached. Upon the outside of the anode were placed plates of copper clamped at the lower ends firmly against the carbon plates. At present the solid block anodes are used exclusively. In preparing the crucibles for work a layer of alumina is spread over the top, and upon this slabs of carbon are placed to form the cover, leaving just sufficient opening in the centre to permit the easy movement of the anode. Upon the front an opening is left through which the materials are charged. The grout of alumina serves to insulate the cover from the body of the crucible. The current is brought to the crucible through four large copper bars, no particular care being taken to insulate them, since a small loss in ampères will not much affect the working of the process. For raw materials the purest artificial alumina and Lake copper are used in the regular running of the furnace. Of these, about 25 lb. of alumina and 30 lb. of copper are charged at intervals every hour. Two or three castings are made during the 24 hours. Early in March a test-run was made to determine the general efficiency of the plant. This run lasted 12¼ days. During that time 10,000 lb. of bronze, averaging 22·1 per cent. aluminium were produced. The total loss on the copper was only 6·4 per cent. Each casting of this run has been analysed, showing a metal of remarkable purity. The following are representative analyses by F. M. Simonds:—

Rich Aluminium Bronze.

Run.	Al.	Cu.	Si.	Fe.
23	28·41	71·16	0·11	0·33
30	26·35	73·25	0·11	0·29
36	24·83	74·80	0·11	0·26
37	26·06	72·95	0·12	0·26
49	19·65	80·15	0·14	0·07
51	21·95	74·80	0·12	0·33

A considerable portion of the impurity consists of iron introduced from the tools used at tapping. The tap-hole is usually very hard, but by an improved method of tapping it is hoped to reduce the percentage of iron in the product. One of the chief objects in setting up this small plant was to determine the applicability of a number of American raw materials for this process; and a considerable portion of the time is occupied in this work of testing. The following series of tests, made by Tetmeyer, of Zurich, on metals produced at the Swiss works, shows the general character

of the merchantable alloys prepared from the produet of this process :—

——	Ultimate Stress.	Extension.
	Kilos. per Sq. Mm.	Per Cent.
Aluminium bronze :—		
A	34·6	25·4
B	38·4	27·4
C	45·0	14·5
D	45·7	35·0
E	51·0	35·0
F	53·3	20·5
G	57·4	14·5
H	61·0	7·8
Aluminium brass	48·1	20·7

(See also this Journal, 1889, 900; and 1888, 441.)

PATENTS.

Improvements in the Manufacture of Plates for Use in Secondary Batteries or Electrical Accumulators. A. Reekenzaun, London. Eng. Pat. 18,755, November 22, 1889. 6*d*.

The inventor causes streams of sparks or an are to play between the lead plate to be treated and another conductor, in the presence of air, oxygen, and other gases. The surface becomes oxidised or otherwise acted npon so that the active material of the accumulator is readily produced thereon. In a partieular ease 2 ampères at 40 volts are said to have given good results. *Continuous* sheets, ribbons, or wire are treated by preference, which are then cut up to the required shapes.—E. T.

Improvements in Elements for Voltaic Batteries. D. G. Fitzgerald and A. H. Hough, London. Eng. Pat. 20,856, December 28, 1889. 6*d*.

The improvements relate to methods of applying the "lithanode" (Eng. Pats. 4671 of 1885 and 16,608 of 1886, also this Journal, 1887, 146 and 558) material to the metallic supports. To prevent local action, the lithanode must be very dense, and this condition may be brought about by pressure and by the use of a *weak* solution of ammonium sulphate. As this retards formation, the patentees add ready-formed peroxide to the lithanode material in various ways, to render the process of formation more easy. They also prefer to coat the plates, especially the grey one, with peroxide electrolytically before applying the lithanode mixture.—E. T.

An Improvement in Filaments for Incandescent Electric Lamps. R. Langhans, Berlin, Germany. Eng. Pat. 3082, February 26, 1890. 4*d*.

The filaments, whether of metal or carbon, are coated, as in Eng. Pat. 2438 of 1888, with silicon or boron, which may, however, be obtained in other ways than those described in that patent. Such materials as silicon-tetramethyl, &c., which in a liquid or gaseous form are capable of being decomposed by heat, may be used, the proeess being analogous to that of "flashing" as ordinarily understood. Solid silicon or boron compounds may be used, if dissolved in a suitable liquid. The boron and silicon coatings possess very high electric conductivity and are very little acted on by oxygen; very high evacuation is not therefore necessary.—E. T.

Improvements in the Process of and Means for the Manufacture of Cellulose with the Aid of the Electric Current. C. Kellner, Vienna, Austria. Eng. Pat. 5420, April 9, 1890. 8*d*.

See under XIX., *page* 62.

Improvements in and Relating to Electric Batteries. H. H. Lake, London. From the Crosby Electric Company, New York, U.S.A. Eng. Pat. 15,482, September 30, 1890. 6*d*.

A cylinder of zinc fits tightly in a jar of pasteboard, wood fibre, or other material, coated with shellac on the outside and paraffin and ozokerite on the inside. A carbon rod is placed in the centre of the jar, the bottom of the latter being covered with a pad of felt or other absorbent material, damped with dilute sulphuric acid or other excitant. The space between the carbon and zinc is filled up with sawdust, or such packing material, mixed with sal-ammoniac or other dry excitant.—E. T.

XII.—FATS, OILS, AND SOAP MANUFACTURE.

Turkey-Red Oil. J. A. Wilson.

See pages 26—28.

The Effect of Exposure under certain Conditions upon some Constants of Oils. H. Ballantyne.

See pages 29—32.

Report on Animal Products, &c. Report of the Central Laboratory of the Italian Customs Department, 1886—1889, 441—465.

Butter is taxed according as it is fresh or salt, the former paying 12·50 lire, the latter 17·50 lire per quintal. In a recent decree (March 31st, 1890) it was laid down that margarin and oleomargarin made up as butter should be assessed as fresh butter, but that these substances in the crude state should be classified with fats of all sorts.

As regards fats, those of beef and mutton, and vegetable fats extracted from any exotic plants, are free of duty. Lard pays 10 lire per quintal; pressed beef and mutton fats, sold commercially under the name of stearin, pay 12·50 lire, while fatty acids, liquid, at ordinary temperatures, and composed principally of oleic acid, are free, but if solid pay 8 lire. According to the decree mentioned above, distinction is drawn between fatty acids which solidify up to 40°, those solidifying between 40° and 48° classified as chemical products not specified, and those solidifying above 48° classified as stearic acid. The Department is thus frequently called upon to decide between lard and beef or mutton fat, and in the case of a fatty acid, whether it is oleic acid or a commercial stearin.

In the course of remarks, attention is drawn to the adulteration of lard, or beef and mutton fats, with cotton oil, which is carried on to a large extent in America.

Lanolin, used extensively in the preparation of pomades and cosmetics, may be distinguished by the following special characteristics :—(1) It should not lose more than 80 per cent. when heated to 100°; (2), it should not yield ammoniacal fumes when heated with a 3 per cent. soda solution; (3), it should contain only small quantities of free fatty acid.

For the determination of the melting point of commercial stearin in the Custom house, an apparatus recommended consists of a test tube containing the substance to be examined, in which is immersed a thermometer, the whole being enclosed in a flask filled with water at 100°. In a table the values are given for the acidity number, the iodine number, and the oleic acid calculated therefrom, as also the melting points of various samples of stearin. Controversies arise, firstly, as to whether a fatty substance is to be regarded as a fat or as fatty acid; to decide this in the Custom house the following method is recommended, based upon the regulation which permits of the presence of 25 per cent. of free fatty acids in a rancid fat :—The fatty substance is melted until it is free from air bubbles, and then passed into a glass receptacle (consisting of a bulb with a drawn out extremity) up to a certain mark, and to it is added a known

volume of caustic potash of known strength with a few drops of phenolphthalein. Secondly, as to whether a fatty substance is to be regarded as a beef or mutton fat or as lard. The Department remark that a determination of the iodine number is not sufficient, as hitherto supposed, but a microscopical examination is also necessary. Other questions also arise which are more readily decided. Special investigations are being conducted in the Laboratory on the properties of the oil of Illipé (*Bassia longifolia*). A table is given of samples sent, but fraudulent declarations are apparently not frequent.

Honey and Waxes.—Animal waxes are taxed according to their degree of purification and at a higher rate than vegetable waxes, such as those of carnauba, palm and Japan, &c., which are referred to stearic acid. Mixtures of animal with the vegetable waxes or with stearic acid, spermaceti, &c. are assessed as animal waxes.

When the Department is called upon to decide as to whether any sample of wax is of animal or vegetable origin, or is a mixture, the following determinations are made :—The specific gravity, melting and solidifying points, as also the saponification and acidity numbers. In the latter purpose the methods proposed by Hübl (Benedikt, Analyse der Fette, 286) are adopted, an especial stress being laid upon the ratio between the numbers obtained. An adulteration of resin is readily recognised either by its solubility in alcohol or by the addition of sulphuric acid, when an intense reddish-brown colouration is produced.

Honey of every sort is subject to a duty of 10 lire per quintal, but "rose honey" and all kinds of confectionery containing honey, are classified as "sweetmeats and conserves with sugar."

The table of analytical results of samples sent to the Laboratory do not point to the perpetration of any particular fraud.—V. H. V.

The Composition of Bees-wax. A. and P. Buisine. Bull. Soc. Chim. 1890, **3**, 867—873.

The authors have determined the iodine absorption of pure, dry, washed bees-wax, and find that 100 parts of the wax absorb 8·3—11 parts of iodine, corresponding to 9—12 per cent. of oleic acid. They confirm the results obtained by Hübl and Hebner for the total, free and combined acids. They estimate the alcohols present in the wax by fusing it at 250° with potassium hydrate and potash lime, and measuring the hydrogen evolved. In the residue from this fusion they determine the hydrocarbons by extracting them with suitable solvents.—H. S. P.

The Bleaching of Bees-wax and the Composition of White Wax. A. and P. Buisine. Bull. Soc. Chim. 1890, **4**, 465—470.

Bees-wax is most commonly bleached by simple exposure to air. For this purpose it is run into thin layers which are exposed to the air in full daylight. The colouring matter in this way undergoes total oxidation, and, according to circumstances, the wax is completely decolourised in from 10 to 30 days. When thus exposed to air the colour does not gradually and uniformly fade from it, but white spots make their appearance and rapidly spread.

To bleach wax in this manner the action of air and light is necessary; under the direct rays of the sun the bleaching is most rapid. Yellow wax put into a flask through which air circulates, but kept in the dark, does not bleach at all, even if the air is replaced by pure oxygen or by ozone; but under the influence of light the decolourisation is very rapid, especially in ozonised oxygen. Moreover, it is not the heat of the sun that produces this effect, because at a temperature of 60° and in the dark it has been found that ozone does not attack the colouring matter of the wax.

Wax becomes bleached by the sun (but very much more slowly) even in a vacuum or in the presence of inert gases, such as carbon dioxide and nitrogen.

The method adopted by the authors in the examination of bees-wax has already been described by them in a previous paper (see preceding abstract).

The accompanying table made from the analysis of a series of samples of yellow waxes bleached by air shows the limits between which the determinations varied. The results obtained for pure unbleached yellow wax are given for comparison :—

	Melting Point.	Free Acids equivalent to Mgrms. of KOH per 1 Grm. of Wax.	Total Acids equivalent to Mgrms. of KOH per 1 Grm. of Wax.	Iodine absorbed by 100 Parts of Wax.	Volume of Hydrogen at 0° and 760 mm. from 1 Grm. of Wax.	Hydrocarbons from 100 Parts of Wax.
					Cc.	
Pure yellow wax	63—64	19—21	91—95	10—11	53·5—55	13—14
Pure air-bleached wax.....	63·5—64	20—21	93—100	6—7	54 —55	11—12

It is seen that the two points in which bleached wax differs appreciably from yellow wax are the diminution of the quantity of hydrocarbons, and its lower iodine absorption. From this it is evident that in bleaching by air, besides the destruction of the colouring matter which undergoes a total oxidation, the non saturated compounds of the wax (the acids of the oleic series and the non-saturated hydrocarbons) fix oxygen forming saturated compounds not capable of absorbing iodine.

In practice pure wax is never bleached; the bleachers always add from 3—5 per cent. of tallow. For this there are several reasons, the chief of which is that pure air-bleached wax is too brittle; besides, a small quantity of tallow makes it bleach quicker, and, further, it is the only way of obtaining a perfectly white product. The addition of this amount of tallow is a recognised thing and is not considered an adulteration.

The following table shows the comparative analyses of pure yellow waxes and air-bleached waxes containing from 3—5 per cent. of tallow :—

	Melting Point.	Free Acids equivalent to Mgrms. of KOH per 1 Grm. of Wax.	Total Acids equivalent to Mgrms. of KOH per 1 Grm. of Wax.	Iodine absorbed by 100 Parts of Wax.	Volume of Hydrogen at 0° and 760 mm. from 1 Grm. of Wax.	Hydrocarbons from 100 Parts of Wax.
					Cc.	
Pure yellow waxes	63—64	19—21	91—95	10—11	53·5—55	13—14
Air-bleached waxes with 3—5 per cent. of tallow added ...	63·5—64	21—23	105—115	6—7	53·5—57	11—12

The air-bleached waxes containing from 3—5 per cent. of tallow differ from pure yellow waxes in their contents of acids, their iodine absorption, and the proportion of hydrocarbons. The free acids are somewhat increased; the total acids are notably increased. The iodine absorption is much lower than that of yellow waxes, showing that the oleic acid of

the wax disappears at the same time as that of the added tallow. The volume of hydrogen yielded by the action of potash-lime on the wax is increased to only a small extent in consequence of the formation of a small quantity of oxyoleic acid. The behaviour of tallow alone on exposure to air is shown below:—

—	Melting Point.	Free Acids equivalent to Mgrms. of KOH per 1 Grm. of Tallow.	Total Acids equivalent to Mgrms. of KOH per 1 Grm. of Tallow.	Iodine absorbed by 100 Parts of Tallow.	Volume of Hydrogen at 0° and 760 mm. from 1 Grm. of Tallow.
	°				Cc.
Fresh tallow	47·5	2·75	202	36·01	52·5
Fresh tallow exposed to the air for 40 days in a thin layer	48·5	4·86	213	27·68	60·4

The results obtained from white waxes of commerce ought always to be within the limits indicated above when the tallow has not been added in an excessive proportion.

These analyses show the influence that tallow has upon the bleaching of the wax; its action depends upon the oleic acid it contains, which, being easily oxidised, facilitates by its oxidation the combustion of the colouring matter, and the more non-saturated compounds there are present, susceptible of fixing oxygen, the more rapid is the bleaching. Spirits of turpentine added in small quantity to the wax has the same effect as tallow.

Other methods of decolourising raw wax may be employed, as, for example: melting the wax in the presence of animal charcoal and filtering; or certain oxidising reagents may be used, such as potassium permanganate, potassium bichromate in an acid solution, or hydrogen peroxide.

Reducing agents, such as sulphurous acid and sulphites, do not act upon the colouring matter of bees-wax. Chlorine cannot be used as it combines with the wax similarly to iodine, and alters its properties completely.

The following table shows the composition of wax bleached by different methods. It will be seen from it that wax decolourised by potassium permanganate, by potassium bichromate, &c., varies greatly; the proportion of acids that the products contain after treatment depends upon how far the oxidation has been carried.

The results given in this paper enable one to judge whether a sample of commercial white wax is pure, and, to a certain point, to decide by what process it has been bleached.

—	Melting Point.	Free Acids equivalent to Mgrms. of KOH per 1 Grm. of Wax.	Total Acids equivalent to Mgrms. of KOH per 1 Grm. of Wax.	Iodine absorbed by 100 Parts of Wax.	Volume of Hydrogen at 0° and 760 mm. from 1 Grm. of Wax.	Hydrocarbons from 100 parts of Wax.
	°				Cc.	
Pure yellow wax	63·5	20·17	93·40	10·87	53·0	13·54
Air-bleached wax with 5 per cent. of spirit of turpentine added	63·5	20·2	100·4	6·78	54·9	12·39
Wax bleached by hydrogen dioxide	63·5	19·87	98·42	6·26	56·1	12·53
Pure yellow wax	63·0	20·40	95·06	11·23	54·5	14·30
Wax decolourised by animal charcoal	63·0	19·71	93·20	11·36	53·6	13·30
Wax decolourised by permanganate	63·7	22·63	103·29	2·64	53·6	13·30
	63·5	21·96	99·25	5·80	55·5	13·34
Wax decolourised by bichromate	63·2	21·86	98·90	7·24	54·0	13·24
	64·0	23·43	107·72	1·08	53·6	11·77

—H. S. P.

Contributions to the Chemistry of Fat. A. Thum. Zeits. f. angew. Chem. 1890, 482.

See under XXIII., *page* 70.

PATENTS.

A New or Improved Process for Producing Hard Potash and Similar Soap from Solid or Liquid Fats. H. Enrich, Frankfort-on-the-Main, Germany. Eng. Pat. 11,292, July 13, 1889. 4*d*.

The process consists in gradually adding concentrated solutions of alkalis to the fatty or oleaginous material while the latter is heated to a temperature of from 110°—130° C. The whole of the fat and the whole of the lye undergo saponification, and no elimination of secondary lye or glycerin is said to take place.—O. H.

Apparatus for the Purification of Lubricating and other Oils. J. Deuss, Gladbach, Germany. Eng. Pat. 13,324, August 23, 1889. 6*d*.

See under I., *page* 35.

Improvements in Soap. W. G. Little, Bexley. Eng. Pat. 14,914, September 21, 1889. 4*d*.

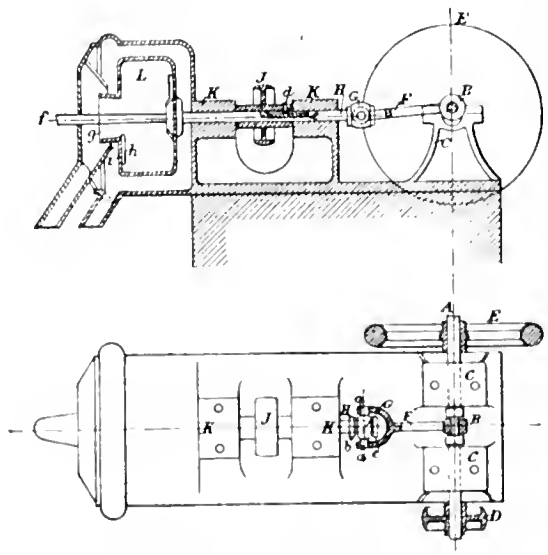
The patentee incorporates soap, when in the form of paste, with sawdust, ground wood, or wood pulp.—C. F. C.

Improvements in Disinfectants and Antiseptics, and in Disinfectant and Antiseptic Soaps. M. Hargreaves, Preston. Eng. Pat. 18,460, November 19, 1889. *4d.*

See under XVIII. *C*, *page* 61.

Improvements in the Separation of Fats from Emulsions. C. D. Hellstrom, Stockholm, Sweden. Eng. Pat. 9062, June 11, 1890. *6d.*

"In an emulsion the particles of fat are in the form of spheres of very different sizes; for example, in milk, the largest are of about 20 times greater volume than the smallest. Each sphere of fat is surrounded with a zone of the surrounding liquid. The zone lessens the flotation of the spheres of fat in proportion to the size of the latter, so that the small spheres no longer possess any flotation; these cannot be separated by centrifugal action alone, except when the larger spheres draw them in a manner with them. The path of the larger spheres through the mass under the influence of centrifugal action will be an unbroken line. When, however, the mass also receives a motion parallel to the axis, the larger spheres which possess flotation will on account of their small density receive a relative motion in an axial direction. If the axial motion continually changes its direction the larger spheres will travel in a zigzag course about the line, which, in the absence of axial movement, would have been the path. The larger spheres so travelling will continually collide with the smaller spheres of fat, which on account of the surrounding zones do not take part in the relative motion. The separation of the fat is rendered more complete by this method. As the axial movement in the mass gives rise to pressure, the particles will coalesce and the enlargement of the at first small particles of fat takes place fairly quickly throughout the mass. On the surface this enlargement of the spheres of fat is hastened by the movements originated by the axial motion. In centrifugal action the surface places itself normally to the resultant of the centrifugal force and gravitation; if there be also axial motions the surface tends to place itself normally to the resultant of all three; as, however, the axial motion is variable both as regards amount and direction, the particles on the surface have a wavy motion. This takes place quite symmetrically round the axis, so that a section which is placed perpendicular to the axis will be alternately extended and compressed, and by this means the particles of fat will be made to unite. By each union of two spheres a portion of the liquid which envelopes the spheres will be liberated; the fat, therefore, is more thoroughly freed from liquid than by centrifugal action alone.



The Separation of Fats from Emulsions.

"When the temperature of the emulsion is such that the fat is cool, the transition to a firmer state of aggregation is hastened by the repeated variations of pressure; if, for example, milk is treated at a temperature under 23° C. in this way, butter is produced. With continuous inflow and outflow the process is made continuous."

The axial movements may be produced by various arrangements. The annexed drawing gives an example. A is a shaft in bearings C C, driven by means of the pulley D. F is a connecting rod connected at one end with the crank H on the shaft A, and at the other end by means of the pins *a* with the sleeve G on the axle H of the centrifugal machine. *b* and *c* are collars on the axle of the centrifugal machine, by means of which the axle receives movement from the connecting rod. The axle H of the centrifugal machine is set in rotation by means of the pulley J. *d* is a pin in the boss of the pulley J, which pin enters a slot *e* in the axis of the centrifugal machine. Thus the axle H can rotate independently of the axial movement. K K are bearings for the axis of the centrifugal machine. L is the basket of the centrifugal machine, *f* the pipe admitting the emulsion, *g* the outlet for the separated fat. The liquid passes away at the periphery by the pipe *h* and the hole *i*.

—C. F. C.

Improvements in the Manufacture of Compressed Cakes of Soap. P. H. Newton, London. From the Cheesebrough Manufacturing Company, Brooklyn, U.S.A. Eng. Pat. 9614, June 20, 1890. *6d.*

Tablets of soap produced by the present method of compression are wanting in homogeneity. The soap is cut into blocks of a length less than that of the cakes into which they are converted, and transferred to the die. The first action of the dies in their closing movement is to displace a portion of the soap to fill the end of the dies, and in displacement the soap is so broken up that the subsequent continued compression fails to make it uniform in density with those portions which undergo compression without displacement. According to the present invention the bars of soap are cut and compressed at one operation, whereby the cakes produced are said to be perfectly homogeneous.

—C. F. C.

XIII.—PAINTS, PIGMENTS, VARNISHES, AND RESINS.

The Painting of Iron. Eng. and Mining J. 1890, **50**, 648.

To prevent paint on iron from scaling off in large flakes, the iron surfaces should be washed before any paint is used, and then brushed with hot linseed oil. When the objects are small and bear being warmed, they may be heated, until the linseed oil, with which they are brought in contact, begins to fume, then all the surfaces are carefully brushed with the oil and allowed to cool. They are now ready to take the paint. When the objects are too large, and a warming not to be recommended, the linseed oil must be put on very hot. The thin liquid oil is said to enter into all the pores, remove all moisture and adheres so firmly to the iron that frost, rain, or air cannot effect a separation. To iron surfaces oiled in this manner the paint adheres well. This proceeding is also to be recommended for wood which is exposed to the open air.

XIV.—TANNING, LEATHER, GLUE, AND SIZE.

Tanning Woods. S. S. Arnaudon. Monit. Scient. 1890, **34**, 915—921.

In this paper the author treats of the tanning woods obtained from plants belonging to the natural order *Anacardiaceæ*.

Astronium or Urundey.—The plants belonging to this genus reach a considerable size—up to 30 metres in height and 1·5—2 metres in diameter. They occur in Central America, particularly in Paraguay. Several species are known, such as *Astronium juglandifolium*, *A. urundeipao*, *A. fraxinifolium*, and others. They are known locally by such names as *urundey-mi*, *urundey-para*, *urundey-pita*, *urundey-herro*, and *urundey-nero*.

Wood of urundey-mi.—The wood of this species is more yellow, and lighter in weight than that of any of the others. A 5 per cent. decoction is brownish-red in colour and deposits a precipitate on cooling. On treating the decoction with various reagents the following results were obtained. Dilute sulphuric and hydrochloric acids gave an orange precipitate. Oxalic acid, the same, mixed with calcium oxalate. Potash and ammonia merely darkened the colour of the extract. Alum gave an orange yellow precipitate. With lime a large orange-brown precipitate was obtained. Aluminium acetate and stannic chloride gave orange precipitates. Acetate of lead yielded a brown precipitate, turning violet after a time. Sulphate of iron gave a black precipitate. Potassium bichromate turned the colour of the decoction to a maroon shade. Sulphate of quinine and gelatin gave voluminous flocculent brown precipitates. The tanning power of the wood was tested by digesting 5 sq. cm. of hide with 5 grms. of the ground wood and 250 cc. of water for several days. The hide was found to be completely tanned and very little coloured. An extract of the wood acted equally well, but the hide was more coloured by it. In order to estimate the tinctorial power of the wood, various materials were soaked in a decoction of it, exposed to the air and then passed through a bath of potassium bichromate or sulphate of iron. The materials were dyed deep orange-red and black respectively. When sulphate of copper was employed, a dark brown colour was obtained. All the colours were unaltered by sunlight.

Urundey-herro.—The wood of this species is heavier and darker than the preceding. Under a magnifier it appears to consist of gummy layers, incrusted with a brown colouring matter. The decoction is darker than that from *urundey-mi*, and is slightly fluorescent. In other respects it resembles the latter.

Black urundey.—This wood is heavier and darker than the others and yields a larger extract to water. The extract is brownish-red in colour and rapidly tans hide.

Urundey bark.—A decoction of the bark is orange-yellow in colour, and throws down a precipitate on cooling. The extract tans hide more effectually than a decoction of the wood, but the resulting leather is darker in colour. In combination with potassium bichromate, or a salt of iron it may be employed to dye hides and fabrics orange-red or black.

Wood and Leaves of the Molle.—Various plants occurring in Central America bear this name. Those of use in tanning are the *molle a curtir* (*Duvaua latifolia*), the *molle ispito* (*Duvaua precox*), the aguaribay (*Schinus molle*), the *molle dulce* or *beber* (*Lithrea gillesi*), and the *molle de Castilla* (*Schinus terebenthifolium*). These plants are all comparatively small, being from 1 to 1·5 metres in height. The leaves, bark, and wood of most of them contain tannin.

Schinopsis Lorentzii Gris, or *Red Quebracho.*—The common Spanish name *quebracho* or *quebracha* signifies "break hatchet," in reference to the great hardness of the wood. The quebracho tree grows to a considerable size. The bark is thick and red and possesses tanning properties. A gum, resembling gum kino, oozes from the bark, and is also disseminated between the fibres of the wood. The tree abounds in South America, particularly in the sub-tropical regions. The wood has a specific gravity of 1·260, and in contact with cold water imparts a bright orange colour to the latter. With boiling water a dark orange decoction is obtained which deposits on cooling a reddish-orange sediment consisting almost entirely of tannin. The freshly cut wood is bright orange in colour, but on exposure it darkens to a reddish shade. The following reagents give precipitates with a decoction of the wood:—Dilute sulphuric and hydrochloric acids, a bright orange, the liquid above the precipitate being clear. Alum added to an alkaline decoction throws down an orange-red lake. Aluminium acetate, a yellowish precipitate. Stannous chloride, an orange-yellow, and stannic chloride, a darker precipitate. A small quantity of an iron salt gives a blue-black precipitate, whilst an excess of iron salt produces a grey one. Potassium bichromate throws down a voluminous reddish-brown precipitate, copper salts give a greenish precipitate. Acetate of lead throws down a bright precipitate, and in the supernatant liquid basic acetate of lead produces a further precipitate. Aluminium sulphate gives a greyish precipitate.

Quebracho wood contains about 18 per cent of tannin. If the ground wood be exposed to the air for several months, the percentage of tannin diminishes, which appears to be due to a sort of resinification setting in. The extract, concentrated to 30° B., contains 50—56 per cent. of tannin; the dry extract contains over 60 per cent. To tan 100 kilos. of fresh hides, 150 kilos. of wood costing 22·50 francs, are required.

The same quantity of bark was used to tan eight dozen sheep's hides. The time required was 28 days. Instead of 150 kilos. of the wood, 60 kilos. of extract at 30° B. might be employed, costing 31 francs. But as one-third of the tannin is left in the extract, the net cost would be 20·60 francs. In replacing the quebracho wood by sumac, a bale of the latter, costing 20 francs, would be required. The leather produced by means of quebracho wood is, however, greatly superior. It has more body, and is stronger, although the colour is somewhat darker than when sumac is used. Quebracho wood also contains a yellow dye-stuff. Hides and fabrics may be dyed a bright yellow, using as mordant a double salt of tin and ammonia, mixed with potassium bitartrate. Wool and leather have a much greater affinity for the colouring matter than silk or cotton. In conjunction with potassium bichromate, quebracho wood dyes stuffs a fine brown, or a splendid black is obtained by substituting a mixture of ferrous chloride and pyrolignite for the bichromate.

Sumacs.—The leaves of sumac and fustic are already used in tanning. The woods of the following species of *Rhus* contain tannin:—*R. typhina* (Virginian sumac), *R. glabra*, *R. rhodanthemum*, *R. cotinus*, *R. elegans*, *R. oxyacanthoides*, in appreciable amount. *R. semialata* contains a little less. Probably the following species of *Rhus* also contain tannin:—*R. Tahitense*, *R. atra*, *R. thunbergii*, *R. tomentosa*, *R. lucida*, *R. succedanea*, *R. serratum*, *R. pentaphilla*, *R. japonica*, *R. radicans*, *R. toxicodendron*, *R. viminalis*, &c.—H. T. P.

Report on Gallic and Tannic Acids. Report of the Central Laboratory of the Italian Customs Department, 1886—1889, 293—301.

Under this category are classed powders for tanning, extracts from various barks, tannin, and the like. Gallic and tannic acids are classified as pure and impure, and subject in the first case to a duty of 10 lire per quintal, but in the second are free. It is further laid down that certain extracts or pastes of dye-woods and other colouring matters which may contain a proportion of tannic acid are not to be included in this class. The authors remark that pure tannic acid in the exact sense of the word does not occur in commerce; the so called pure acid contains a greater or less proportion of impurity, which is not, however, injurious for practical purposes. The Department were called upon to decide as to whether a certain extract was to be considered a "tanning extract" or colouring matter, in the

first case being exempt, in the second subject to a duty of 12·50 lire per quintal.

Of the methods proposed for the analysis of tannins, preference is given to those of Lowenthal, modified by Schröder, and of Hammer, improved by Simand. (This Journal, 1888, 528.)

Analyses are given of samples sent to the laboratory; one case, declared as impure tannin, was found to contain 60·59 per cent. of tannin, and was therefore assessed as commercially pure, while two others denominated impure gallic acid were infusions of tannic acid.—V. H. V.

XV.—MANURES, Etc.

PATENT.

The Production of Sulphate of Ammonia (SO_4NH_4O) from the Nitrogen of Marshy Moors or Meadow Land Moors, and Apparatus therefor. W. L. Wise, London. From H. Grouven, Leipzig, Germany. Eng. Pat. 1136, March 21, 1878. (Second Edition.) 1*s.* 3*d.*

See under VII., *page* 45.

XVI.—SUGAR, STARCH, GUM, Etc.

α- and β-Amyrins. Their Ethers and Bromine Derivatives. A. Vesterberg. Ber. **23**, 3186—3190.

The α- and β-amyrins employed in this research were prepared from "Manilla gum-elemi," which was estimated to contain 20—25 per cent. of total amyrins. Of this quantity about two-thirds to three-fourths was α-, and the remainder β-amyrin. As the result of his experiments the author adopts the formula $C_{30}H_{49}.OH$ for the amyrins. α- and β-amyrin are very much alike, both forming long, silky, flexible needles, fairly soluble in benzene, ether, glacial acetic acid, and hot alcohol, difficultly soluble in cold alcohol and petroleum spirit. α- and β-amyrin require for solution 21·36 and 26·14 parts of absolute alcohol respectively. α-amyrin melts at 181—181·5° C., β-amyrin at 193—194° C. They are both dextro-rotatory.

Dissolved in benzene—

α-amyrin	$(\alpha)_D$	= + 91·59°
β-amyrin	$(\alpha)_D$	= + 99·81

The amyrins are most probably secondary alcohols. By the action of phosphorus penta-chloride they are converted into dextro-rotatory *amyrilenes*, $C_{30}H_{48}$. Phosphorus pentoxide converts α-amyrin into *lævo-α-amyrilene*, which is isomeric with the above. The amyrin acetates are readily soluble in chloroform and are both dextro-rotatory.

α-amyrin acetate forms large tables, melting point, 221° C.

$$(\alpha)_D = + 77.$$

β amyrin acetate forms long prismatic crystals, melting point, 236° C. $(\alpha)_D = + 78·6$.

By oxidation with chromic acid they yield *oxyamyrin acetates*, $C_{30}H_{47}O.C_2H_3O_2$.

Bromo-α-amyrin, $C_{30}H_{48}Br.OH$. Melting point, 177—178° C. $(\alpha)_D = + 72·8$. Fairly soluble in ether and benzene.

Bromo-α-amyrin acetate, $C_{30}H_{48}Br.C_2H_3O_2$. Separates from benzene in hexagonal plates or flat prisms containing benzene. Melting point, about 268° C.

Bromo-β-amyrin was not obtained in the crystalline state. Its solution solidified on cooling to a colourless jelly. Melting point, about 182—186° C.

Bromo-β-amyrin acetate forms prismatic crystals, melting at 238° C. Fairly soluble in petroleum spirit. The corresponding α compound is almost insoluble in petroleum spirit. This difference in solubility may be utilised to separate α- and β-amyrin. For this purpose the mixture of the acetates is brominated, and the resulting compound is simply boiled with petroleum spirit.—H. T. P.

Studies on Starch. K. Zulkowski. Ber. **23**, 3295—3297.

The author, referring to Scheibler and Mittelmeier's paper bearing the above title (this Journal 1890, 1140—1141), points out that his own researches on starch have not been mentioned by them in their historical account of the chemistry of starch. The results obtained by the author are briefly as follows:—Starch is dissolved by hot glycerol, being converted into soluble starch, which by further heating is completely broken down. The author obtained not only erythro- and achroo-dextrins, but a series of bodies increasingly soluble in alcohol. One of them, indeed, was soluble in a mixture of absolute alcohol and ether, from which solution it could be precipitated by barium hydrate.

These various bodies were separated by means of their different solubilities, &c.; but it was found exceedingly difficult to remove the last traces of glycerol from the various products, possibly owing to the formation of glycerides.—H. T. P.

Saccharine Bodies in Fungi. E. Bourquelot. Compt. Rend. **111**, 578—580.

The author has previously pointed out that in order to estimate the saccharine matter in a fungus at a given period of its growth it is necessary to arrest the life of the cryptogam at that period. Further, he has proved in the cases of *Lactarius piperatus* and *Boletus aurantiacus* that the vegetative processes continue for some hours after gathering, as is evidenced by the conversion of trehalose into mannite. In the present paper the author gives the results of analyses of various fungi at different periods of their existence. After pointing out the difficulty of distinguishing in certain species young from old fungi, the author defines the adult age as that at which the heads open out and the spores form and commence to fall down. In the case of all the experiments made by the author the fungus was treated with boiling water immediately after gathering.

As the results of experiments on 13 different species, 12 species were found to contain only trehalose in the young state. At a more advanced age these species contained either mannite only or else both mannite and trehalose at the same time.

In the single case of *Amanita mappa* mannite only was found in the young state of the plant. Finally, in two species, *Boletus aurantiacus* and *Hyphaloma fasciculare*, after desiccation at a low temperature the trehalose was found to be replaced by mannite. The author is inclined to believe there is some connexion between these sugar changes and the formation of the spores. In some cases there is further complication from the fact that the amount of glucose is increased, or even in certain instances that glucose is actually produced.—A. J. K.

Report on Sugars. Report of the Central Laboratory of the Italian Customs Department, 1886—1889, 130—192.

Cane Sugar.—A description is at first given of the various types of sugars and saccharin substances imported into the kingdom. For a long time past the Custom house tariff divided imported sugars into two classes, namely, those of a whiter colour than that of the type 20 of the Dutch scale, which were regarded as refined, and those of a darker shade, considered as impure sugars. This distinction was further confirmed by a reciprocal treaty with Austria-Hungary in 1878. But the protection which the State intended to grant to native refinery became the object of considerable fraud, as sugars, imported as crude sugars, were coloured with a little lamp-black or molasses, or more rarely aniline-yellow, sophistications practised under the very eyes of the Custom house officials, who were powerless in the matter. The

Department was therefore called upon to determine if it were possible to maintain the distinction between the two classes, adopting some criterion other than colour. At the outset it was shown that samples of the same standard according to the Dutch system contained most variable proportions of sugar, and that there was no relation between colour and percentage or rotatory power. A large number of analyses of samples from various countries and importers are given in confirmation of this view; analyses are also given of samples of crude sugars in relation to the drawback. The results are discussed with especial reference to the various proposals made by different refining firms to the Commission of inquiry into the revision of the tariff. The conclusions drawn from the discussion are (1) that the systems of classification by colour is most unjust and unreliable; (2) that the greater part of the sugar imported in the first half of the year 1887 had a polarisation value greater than 95 (French scale); (3) that samples of a less value were colonial sugars, intended for the more needy classes, and formed a small fraction of the total importation; (4) that the objections raised by Signor Depretis in the report of 1887 against the saccharimeter system are ill-founded, especially as other governments, viz., those of France, Holland, and the United States have adopted the system.

Other Sugars.—Milk sugar is referred to the first class, but grape sugar and maltose to the second; sugars from fruits and invert sugar are included under the head of grape sugar. The Department fear that attempts will be made to introduce invert sugar as starch syrup.

The Drawback.—In 1886 the Government conceded to the sugar refiners a drawback upon the import duty of crude sugars to be refined in the country and subsequently exported. Certain questions arose as to the interpretation of the regulations, especially with regard to the meaning of the word "richness" as the effective quantity of saccharose, or the quantity which could be obtained from a crude sugar, and secondly, whether the loss of $1\frac{1}{2}$ per cent. on purification was to be calculated on the crude product or on the yield. The Department decided that the concession might be made in terms of the crude sugar, and interpreted the word "richness" to mean the theoretical yield, which is obtained by subtracting from the polarisation value double the weight of the salts and the amount of reducing sugar, but without deducting the loss on refining. The methods adopted for the analysis of crude sugar as practised in the Central Laboratory and in the Provincial Laboratory of Genoa are given in full, as also those for the determination of raffinose in beetroot sugar. As regards the latter the method based upon its conversion into mucic acid is not accurate within 0·29 per cent., but by the polariscope the value may be determined by means of the following formula, $R = \frac{A - Z}{1{\cdot}57}$, in which R is the percentage of raffinose, A the polarisation value, and Z the percentage of saccharose determined by Clerget's inversion formula.

It appears, however, that a large joint stock company were dissatisfied with the regulations of the drawback, and the matter was again referred to the authors of the report. It was then decided that "the yield from a crude sugar after refining shall be calculated by subtracting from the polarisation value three times the weight of sulphated ash, and twice the weight of the glucose when equal to or less than 2 per cent., but if more, then once the weight only. From the number thus obtained, which represents the theoretical yield, the $1\frac{1}{2}$ per cent. loss shall be deducted, and on this number the tax shall be paid, no account being taken of decimals less than 0·5." Finally the regulations proposed by the Sugar Bounty Convention held in London in 1888 are given in full.

Glucose.—The tariff distinguishes between solid glucose which pays 66 lire per quintal, and liquid glucose, paying 50 lire; starch syrup pays 40 lire. By a law, February 12, 1888, glucose, which had not been subjected previously to a manufacture tax, pays 30 lire. The methods adopted for the analysis are described.

The process used for the detection of saccharin proposed by Girard are given fully, and it is pointed out that they are sufficiently delicate to prevent any chance of sophistication. Another method proposed, which gives satisfactory results, is as follows:—An ethereal or petroleum extract is evaporated after addition of a certain quantity of nitric acid to dryness in a water-bath; a small fragment of caustic potash added, and the mass moistened with two or three drops of water. A colouration is produced varying from blue to reddish purple.

The tariff report refers to the category of starch syrup extracts of malt and barley, which have been neither concentrated nor dried; but if dried so as to resemble burnt syrups they are classed under sweetmeats. A sample declared as liquid glucose was found to be a concentrated malt extract, while another labelled as "Malz extract Gesundheits bier" was referred to as medicinal drugs not specified.—V. H. V.

XVII.—BREWING, WINES, SPIRITS, Etc.

The Treatment and Storage of Beer. A. Hartley. Trans. Institute of Brewing, **4**, 3.—51.

Cask Selection.—Whether the casks are previously examined by the coopers or not, they should always be passed by the best available man in the cellar prior to racking. In large breweries there must, of course, be several passers-in, and it is never advisable to allow one man to pass very many casks at a time. The sense of smell becomes deadened, and, from sheer inability, he will be sure to pass many that he would have rejected at an earlier period of his work.

A very prevalent trouble during the warmer months is the tendency to acidity or sharpness. These sharp casks are fatal to the stability even of quick-running beers, such casks should be soaked in a hot solution of salt and soda. After emptying and rinsing, they should be well treated with sulphurous acid, with the object of destroying the acid ferments in the pores of the timber. After rinsing with sulphurous acid, the casks should be left some few hours tightly corked and bunged; they can then be steamed out ready for use. Cask sharpness is often intensified by allowing the empties to lie about exposed to the heat of the sun, when the film of residual beer is very prone to acidification, owing to the influence of air and high temperature combined.

Racking.—This is done either direct from the primary fermenting vessel, or from the dropping-square, or from the settling- or racking-back. If cleansing in a secondary vessel be deemed advisable, it can be best accomplished in the dropping-square, which retains its natural covering of yeast. The transference of finished beer from vessel to vessel is most prejudicial, owing to the oxidation to which it is exposed. But upon the dropping system the beer is in more or less active fermentation when the change takes place, and it is at any rate supersaturated with gas which reduces the absorption of air. Racking-backs are in many plants essential as a means of collecting the contents of several primary fermenting vessels. They are most convenient for blending purposes. It is hardly necessary to remark that the beer should be led into these backs at the bottom, so that fobbing and consequent oxidation may be as much as possible prevented. From whatever class of vessel the casks are filled, it is important to avoid absorption of air. Racking with the ordinary hose or stocking is most objectionable, on account of the fobbing which occurs by reason of the delivery end floating on the surface of the rising beer. To obviate this, it is a good plan to attach a tinned metal thimble to the end of the hose, of sufficient weight to keep it in position close to the bottom of the cask, the length of the hose being adjusted with this object.

Cask Hops.—They have four principal influences, which are exerted upon the flavour and aroma of the beer, and upon its stability, condition, and clarification. They affect condition in two ways. They undoubtedly carry with them

into the beer certain ferment organisms, which must to some extent influence the secondary fermentation. It is probable that in this respect their influence is not always a desirable one, and that some of those unpleasant flavours that are noticeable in dry-hopped beers might be traced to these organisms. It would be a great improvement if the hops could be washed, or in some way sterilised before they are used. But the cask hops have another and very direct effect upon secondary fermentation, which is due to the increased agitation of the beer whenever the casks are moved. The influence of motion on fermentation is an accepted fact, and is probably chiefly due to the bringing of fresh volumes of wort or beer into direct contact with the yeast cells, and to the dispersing of the exhausted media, and retarding products of fermentation which surround them.

With regard to the influence of cask hops upon clarification, this is rather a mechanical than a chemical one. There are many who hold closely to the idea that clarification depends upon the hop tannic acid. The author maintains that the action of finings is independent of this body. The influence of the hops is of chief importance in promoting the spontaneous brightness of the beer. They afford a large amount of surface attraction whereby the semi-soluble and floating particles in the beer are removed from suspension. In the author's opinion they help to keep the coagulated gelatin in a compact mass, and so prevent it from breaking up into lumps which so often constitutes a trouble with running beers that are not dry-hopped.

Secondary Fermentation and Condition.—The secondary or cask fermentation is of the highest importance in the production of our best qualities of ales. The aim of the brewer now is to accelerate the cask fermentation as much as possible, and to bring his ales into ripe condition with the least possible delay. Healthy cask fermentation is now known to depend upon the action of secondary yeasts, of which there are several types and mixtures, giving rise to different characteristics and flavours. During the slow and prolonged fermentation in cask, the palate of the beer is greatly modified by the products of the secondary yeasts, and the formation of various ethers which give that peculiar vinous character to stored beers. Secondary fermentation is also of the utmost importance in regard to the clarifying capacity of beers. It is often found that beers which are more or less dull after fining when fresh, readily become brilliant after a few weeks' storage in cask. Apart from flavour and brilliancy, cask fermentation is essential to that briskness or gassiness usually expressed by the term condition, and which is due principally to the action of secondary and bottom ferments upon the malto-dextrin in the beer. These ferments have the power, not possessed by the primary types, of breaking down the malto-dextrin into maltose, which is then fermented. Consequently in natural cask fermentation malto-dextrin plays a principal part. This body not only imparts fulness and head, but also, by its gradual decomposition, promotes the steady evolution of gas, causing the beers to retain their life on tap.

The addition of syrup or priming has two principal effects —namely, the imparting of a lusciousness to running beers, and the accelerating of those cask changes upon which the flavour and briskness of stored beers depends. It is often dangerous to employ priming in running ales during summer, especially if they are insufficiently clean, as the primary yeast cells are rendered too active, and unhealthy cask fret is promoted. In winter, quick running beers are usually much improved by priming, if the yeast is in healthy condition. If there is a preponderance of unsuitable ferments, it is unwise to stimulate their action, and when beers are a little out of health priming has usually to be dropped. The two principal objects may be attained by two different classes of syrup. Lusciousness by a solution of invert sugar, which also acts as a stimulant to condition; and rapid condition or briskness, where sweetness is an objection, by glucose priming.

The action of the secondary yeasts in breaking down the malto-dextrin, in beer, may be supplemented by the employment of a cold water extract of malt. So powerful is the diastase thus obtained that half a pound of grist has a distinct influence on 100 barrels of beer. This quantity should be steeped in two pints of water for some six hours and then strained. The diastase liquor is afterwards added to the racking-back, and well roused in. If there is no racking-back, and no opportunity of adding it to a large bulk of beer, it can be mixed with several gallons of beer, and the correct proportion added to each cask. With a sufficiency of malto-dextrin in his worts, the brewer thus has a further means of determining the condition of his beers. If intended for lengthy storage he will wait for the gradual degradation of the body by the cask ferments. If he requires rapid condition he will employ cold malt extract at racking. The practice of adding malt-flour as a priming to stouts is a very old one, but its true significance has only been recently discovered. It acts similarly to the cold water extract of malt, but the latter is decidedly preferable, especially for ales, owing to the absence of husky particles.

Beers that are hopped should always be well rolled every day for about a week before they are topped up and shived down, so that the hops may be thoroughly soaked, and the maximum of absorption attained. After shiving, they should again be rolled, daily if possible, for at least a week before they are stacked away.

Cleansing in Trade Casks.—By cleansing is meant the elimination of the residual primary yeast before the casks are shived or bunged. The beers are racked a day or two earlier than is customary on the ordinary system, and the temperature should not be cut down quite so low. They are racked into cask with a little life left in them, so that the primary yeast may work out as much as possible through the bung hole. The casks need slight topping up once or twice a day for a day or so, and it is remarkable what an improvement this slight amount of cleansing makes in the flavour and eventual brilliancy of beers so treated. This system also gives very good results with pale ales, with which cleanness is so highly important. If these ales are thus worked it becomes necessary to postpone the introduction of the hops until the process of cleansing is finished. This may be several days. A little ale has to be syphoned out to make room for them, and it is more convenient to wet them first. After the addition of the hops, the casks should be bunged and rolled occasionally for a few days longer before they are topped up and shived. In breweries where it is difficult to attain satisfactory cleanness at racking, this system is recommended, as it is undoubtedly prejudicial for the beers to be closed down with any large percentage of primary yeast remaining in suspension.

Preparation for Bottling.—Preliminary cleanness is very important in the case of beers intended for bottling. Unless sufficient brightness at racking has been secured, the process just referred to is very beneficial. Indeed, it may be improved upon by bunging down and rolling the casks well every day prior to being topped up. The agitation of rolling enhances the assimilative capacity of the yeast, and the elimination of those bodies that cause undue yeast growth in bottle. In the production of beers for bottling it is most important that there should be a minimum of matter that either comes out of solution during the bottle fermentation or stimulates unnecessary yeast reproduction. This essential cleanness can only be satisfactorily accomplished by the aid of sound and vigorous secondary fermentation in cask. After shiving, beers for this purpose should be rolled with more than ordinary assiduity, with a view of obtaining, if possible, spontaneous clarification, the very best proof of natural cleanness. But it often happens that beers which are comparatively clean and have passed through their secondary fermentation, will not drop sufficiently brilliant for bottling in the time required. Recourse must then be had to fining. But it is a mistake to suppose that beers are fit for bottling simply because they go bright with finings, unless they have undergone cask fermentation. New beers are certain to throw a heavy deposit, and are very likely to be cloudy in bottle. There is a somewhat popular idea that beers should be flattened before they are bottled. The excess of gas must be let off through porous pegs, but the greatest care should be taken to exclude any air, which is fatal to brilliancy. If fining has to be resorted to, the smallest efficient quantity should be added, and the casks should be allowed to settle for at least a week.

Temperature.—For pale ales and stock beers a moderate one of about 55° F., when it can be maintained, is the most satisfactory. Temperature has a decided influence upon the flavours developed during cask fermentation, in the same way as during primary fermentation. Cellars that receive running beers may be somewhat warmer than those used for stock and pale ales; but it is not advisable to allow the temperature to much exceed that which may be expected in the cellars of the consumer, for in winter there is danger of chilling, after fining, which causes lack of brilliancy. This effect of temperature reduction is the result of bodies, that are only just soluble at higher temperatures, coming out of solution. The cleaner the beers the less likely this trouble. The heat of the beers at racking ought, as a rule, to be a few degrees lower than the likely temperature of the store. Stock beers may well be several degrees below, as the rise in heat will cause expansion, and so prevent ingress of air through crevices in the casks.

Fining and Sampling.—The use of old beer for this purpose is unsound both in theory in practice. The main point to be observed in the manufacture of white finings is sufficiently lengthy steeping. Good finings cannot be made in a hurry. The glass should be steeped for at least a month before it is passed through the finest sieve. It is a good plan to put the steep through a coarse sieve as soon as the glass is soft enough, as further softening is much hastened. If a little water is added daily, and the mixture is kept well roused up, it is usually ready for coarse sieving in about a fortnight. In regard to quantities and proportions, much of course depends on the quality of the glass, which may be very variable. With good Penang leaf a gallon and a half of sulphurous acid, and one pound of tartaric acid may be used for every seven pounds of glass. These quantities should make two barrels of white finings with the daily additions of water made up to a definite strength. This can be tested by the viscosity tester, the time occupied by a definite volume of finings in passing through a small hole giving the comparison required. A definite working standard can thus be easily fixed.

Colour.—The question of colour is in many breweries a troublesome one. Standard sample bottles are very useful, and may be made with orange aniline dye and caramel mixed. These bottles must be made up with half methylated spirits to prevent settlement and loss of colour.

Yeast-Pressing.—Where there is a good proportion of stout and porter, there is no trouble in working off pressings at a good profit. It is most important that yeast should not be allowed to get stale, and in some smaller breweries this is the tendency. The most satisfactory plan is, of course, to press every day, and certainly it should not be done less often than twice a week. In summer, if pressings have to be kept some few days before blending, salicylic acid is the best thing to use as a preservative. Sulphites give an unpleasant flavour and smell.

Waste.—Waste is a most unsatisfactory thing to deal with. When, however, there is a demand for aged beers, there is not any trouble in getting rid of it at a good profit; but in many breweries it is impossible to dispose of the entire waste of a public trade by blending, without prejudicing the character of the beer. It often pays best to allow so much per barrel, and to refuse to receive the waste. When they can be worked up, it is usual to vat them, and if this is done, the more hops that are added to the vat the better.

Returns.—The working up of returns also requires great attention. There are four different kinds: acid, flat, turbid, and casky. The working off of flat returns is the easiest of all. They can be added direct to running beers. Casky returns are practically impossible to deal with, and are best turned down the drain. Some forms of turbidity are very difficult to overcome. They are improved very often by intermixture with acid ones, but when much is returned on this account, it is not wise to blend sours with them, as the acidity may increase, and so enhance the difficulty of blending with mild-flavoured ales. Hopping, as suggested in the case of waste, is the best treatment, combined with rolling when the quantity is not sufficient for vatting. Time usually brings brightness, and until this has been tried they should not be worked off. Acid returns need very careful working off. They may, of course, be neutralised, but this treatment requires considerable skill, and is not, in my opinion, very satisfactory. They may be heavily treated with salicylic acid, to prevent them from becoming worse. The returns of each day should be regularly tasted and sorted, and the casks should be marked for special treatment according to the complaint: if sour, for soaking, if casky, for the cooper. All little lots should be turned into odd-and-end casks, no ullages should be left on hand, and everything should be done to release as many of the trade casks as possible. If the quantity is large enough to employ a vat, the returns should be pumped over at the earliest opportunity. Everything that is fit to use up at once should be immediately blended off. Acid and turbid returns must remain in cask or vat until practically bright. By daily supervision of the returns, it is possible to greatly facilitate working up, and to avoid a great deal of unnecessary trouble and loss.

Preservatives.—With good malts, sound mashing systems, and thorough cleanliness, preservatives are seldom required, but with doubtful materials, the judicious employment of antiseptics is advantageous. If, however, they are added in excess, much more harm than good accrues, on account of their retarding influence on cask condition, which is so important in regard to stability. The basis of most preservatives is some sulphite, or mixture of sulphites and salicylic acid. Salicylic acid is very useful in many cases, especially for running beers brewed from low-class materials. But for ales that are required to come into early condition, it is not satisfactory. There is an impression that the antiseptic power of the sulphites depends upon their affinity for oxygen, and that they owe their action to the absorption of oxygen existing in the beer. But the change from the sulphite to the sulphate is practically a very slow process, and there is a large excess of oxygen in the beer that cannot be attracted by the small amount of preservative employed; their antiseptic action must, therefore, be due to some more direct influence upon the organism. The sulphates and chlorides present in brewing liquors are, of course, very important natural preservatives, and the additions that are often made to the liquor are very useful, both directly and indirectly, in promoting the stability of the finished beers. But of all preservatives, cleanliness is the best, and without it stability and character are unattainable.

Cleanliness.—In regard to the cleanliness of racking-rooms and cellars, much depends on their construction. Cement, concrete, or granolithic flooring, and glazed tile walls are, of course, the nearest to perfection. The surfaces of these departments ought all to be constructed so as to admit of thorough washing with a hose. Plain brick walls and old timber should be repeatedly washed with a mixture of freshly-burned lime and chloride of lime, the latter at the rate of about one-sixth. For the flushing out of drains, chloride of lime is very useful. It is a good plan to mix some with cold water in an old cask at the rate of about four pounds per barrel. Add one piot of sulphuric acid, previously diluted in a wooden bucket with cold water. Allow the cask to remain for some few hours tightly bunged, and then empty down the drain. All wooden vessels, such as troughs and shoots, should be frequently scalded out, and occasionally painted over with sulphite of lime. Beer mains should have steam connexions, and they should be steamed out every time they are used. India-rubber hoses are somewhat difficult to keep clean. They must be flushed with cold liquor after use, and then hung up to dry. It is a bad plan to coil them up when damp. Hot liquor cannot be used for hoses without doing harm, and this is a great disadvantage. They may occasionally be charged with a weak solution of permanganate of potash without injury. All racking-stockings should be scalded out every night, and hung up to dry, and a strict rule should be made of having all filling and topping-up cans, and buckets, well washed every evening, and set in a rack to drain. For the cleansing of wooden vessels, such as vats and racking-backs, powdered pumice-stone, laid on wet upon the brush, as suggested by Aldous, is very useful. Slate vessels can also be cleaned with it. For vessels of either material an occasional coating of sulphite of lime is beneficial.—J. H.

PATENTS.

Improvements in the Manufacture of Degerminated, Flaked, Boiled, and Torrefied Maize to be used for Brewing and Distilling Purposes, and also as a Prepared and Cooked Food, and in Apparatus employed therein. J. White, Belfast. Eng. Pat. 17,434, November 2, 1889. 8*d*.

The maize is first thoroughly cleaned in the usual way. The smaller grains, amounting to one-third of the entire bulk, are sifted out and the remaining larger grains then thoroughly moistened in order to toughen the germs and make them more readily detachable from the "grits" or starchy parts of the grains. The damp maize containing about 25 per cent. of water is passed between a roller, making about 500 revolutions per minute, and a fixed segment, the curvature of which is the same as that of the roller. The roller may have a diameter of 20—30 inches. The fixed segment and roller are provided with concave under-cut flutes or grooves, the edges of the flutes pointing upwards and downwards respectively. The flutes of the roll have a lead of about 1 inches. The distance between the edges of adjoining flutes is about one-sixth of an inch in the case of the roll, and about one-eighth of an inch in the case of the segment. By means of this apparatus the maize is degerminated more thoroughly, and less fine meal is produced; whilst a greater proportion of husk is left on the "grits," thus leading to better drainage in the mash-tun. The mixture of grits and germs is freed from flour by sifting, the germs being subsequently removed by treatment in any suitable washer. The degerminated grits are cooked by boiling or any other known means, a suitable yeast-food being added at this stage. The grits are then partially dried and passed between rolls under great pressure, the rolls revolving at the relative speeds of four and five respectively. By this means the flakes are made thinner and larger. Finally the flakes are torrefied, when they are fit for use.

—H. T. P.

Apparatus for Use in Rectifying Spirits and other Matters. B. Hoff and J. Frommel, Galicia, Austria. Eng. Pat. 20,434, December 19, 1889. 8*d*.

The apparatus consists of a series of columns, each divided into a number of compartments by dome-shaped partitions, communication between the various chambers being made by a short pipe or hole in each dome. The top of each column is connected by a pipe to the base of the next column in series. The lower part of each chamber is joined to a tube which carries off the condensed matters into a common main, or otherwise. In some or all of the chambers of each column there is a stack of condensing blocks placed on a perforated false bottom. These blocks are made of some smooth non-porous substance, and may be of spheroidal, cylindrical, polygonal, wedge-shaped, or other suitable pattern. They are pierced in various directions, the perforations being either straight or curved, the object being to increase the area of the condensing surface as much as possible without impairing its smoothness. This apparatus is said to require no artificial cooling, the air surrounding the vessels being sufficient for this purpose. The most efficient refining action is obtained when the perforations in the blocks cross one another, like the meshes of a net. Of course, the blocks and perforations are made of sufficient size to avoid capillary action between the adjacent surfaces.—H. T. P.

Improved Method of and Apparatus for Obtaining an Accelerated Fermentation and Producing Sparkling Drinks. E. Edwards, London. From F. Hofmeister, Munich, Germany. Eng. Pat. 678, January 14, 1890. 8*d*.

The invention consists in spreading the ferment used over a large surface immersed in the liquid to be fermented. For this purpose the fermenting vessel is provided with a large number of diaphragms, bars, bands, or strips, preferably consisting of some pure tasteless fabric. In order to take up as little vat space as possible the supports are made very thin, and the surfaces are placed in an inclined position, and in some cases perforated to allow of the ready escape of the carbonic acid. Descriptions and drawings of several forms of fermenting vessels constructed on the above principle are given. The fermentation of wine, beer, &c., is started as follows: The ferment-supporting surfaces are sprinkled with old must, beer, &c., and the tun is closed and a current of air aspirated through the apparatus for 36 hours. The must, wort or other liquid is then run into the tun, when fermentation soon commences. Or, the arrangement of surfaces may be at once placed in a fermenting liquid, with the result that fermentation will be considerably accelerated. In order to produce sparkling drinks the tun and its ferment-carriers are placed in a strong vessel provided with a lid, which is fitted with a pressure gauge, tap, and man-hole. After fermentation the liquid may be drawn off through a tap at the bottom, which communicates with the fermenting vat. Two forms of the above apparatus are described. According to temperature and other factors, a pressure of 4—5 atmospheres is developed in a period of 1—6 days. If fermentation has been carried on slowly (3—6 days) the wine may be drawn off quite bright, provided the apparatus has been kept at rest.

The use of ferment-bearing surfaces is of great importance to breweries. Fermentation can be carried on at a lower temperature than usual, and since fermentation goes on rapidly, a smaller number of vessels will suffice. The invention will also be of great value to distilleries, leading to a considerable economy in time. The losses which usually occur owing to the passage of unfermented matter into the wash, and to acid fermentations produced at the expense of alcohol, will be entirely prevented by the rapid fermentations at comparatively low temperatures obtainable by the use of this system. The working efficiency of the apparatus increases with its age; only the deposits on the surfaces should be withdrawn about every two months.—H. T. P.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

(A.)—CHEMISTRY OF FOOD.

Report on Confectionery and Preserves with Sugar and Honey. Report of the Central Laboratory of the Italian Customs Department, 1886—1889, 192—281.

All substances belonging to the category are subject to a duty of 100 lire per quintal. Thus no analyses of imported goods are required, but in the case of exported goods a drawback is allowed for the sugar used in the manufacture, and the Administration reserve the right of determining the amount of sugar so as to assess the goods. But questions have arisen with regard to tamarinds, tea-biscuits, and farina, of which tamarinds, containing less than 32 per cent. of saccharin matter, pay 7 lire per quintal, but, if more, they are assessed as confectionery; tea-biscuits pay 45 lire per quintal (general duty), and 42 lire (conventional duty with Switzerland), provided that they do not contain more than 18 per cent. of sugar; farina, which is defined as "alimentary substances for infants, composed of the same material as tea-biscuits," provided that the sugar, naturally present and added, does not exceed 40 per cent., pays as biscuits, but if more, as confectionery.

As regards the drawback on exported goods a table is given of the various rebatements allowed by the different regulations since the year 1859 on superior and inferior kinds of candied fruits, plain and flavoured chocolate, condensed milk, mustard, vermouth, preserved chestnuts, and citrate of magnesia.

The general criteria on which the rebatement is based are also discussed, and recent alterations notified.

The method for the detection and analysis of various sugars, when separate and mixed, are also fully discussed, and the instructions laid down by the German Custom-house regulations are also given.

Results are also quoted of analyses of tamarinds, farina, candied fruits, and tea-biscuits, which were made in the Laboratory; short observations are made on certain especial samples.

Various methods for the analysis of condensed milks are discussed, and a note is given by A. Bignamini on a method for determining cane sugar invert and milk sugars when present in the same liquid. The method is briefly as follows: (1) A portion of the liquid is heated with a slight excess of Fehling's solution until the reduction due to the milk and invert sugar is complete; (2), the filtrate from the precipitate is acidified, the excess of copper removed by barium hydrate: the cane sugar is then inverted and the cupric oxide reducing power again determined; (3), in another portion equal to that taken in (1), the cane and milk sugars are first inverted and the cupric oxide reducing power determined. Then from the known cupric oxide reducing powers of the invert and milk sugars the factors for the requisite simultaneous operations are determined. Experience in the Laboratory has, however, shown that milk sugar is not inverted by hydrochloric acid under the conditions usually adopted.

In tables analytical results are given of samples of condensed milks exported from July 1886 to March 1888, when the drawback allowed was 78·50 lire per quintal, and from March 1888 to July 1889, with a drawback of 90 lire. In the first period the calculated total of cane sugar was 250·034,520 kilos., corresponding to rebatement of 196,277·10 lire, and in the second period 307,631·03 kilos., with a rebatement of 276,867·91 lire.

The regulations of the drawback on the so-called citrate of magnesia are the same as those of condensed milks; analyses of exported samples are given. The calculated amount of cane sugar in the former of the above periods was 2,112·97 kilos., corresponding to a rebatement of 1,658·68 lire, and in the latter 6,299·48 kilos., with rebatement of 5,669·53 lire.—V. H. V.

PATENTS.

Improvements in the Manufacture of Degerminated, Flaked, Boiled, and Torrefied Maize to be used for Brewing and Distilling Purposes, and also as a Prepared and Cooked Food, and in Apparatus employed therein. J. White, Belfast, Eng. Pat. 17,434, November 2, 1889. 8*d*.

See under XVII., *preceding page*.

Improvements in the Preparation of Malted Sweet Foods, Confections, and the like. W. Paterson, Glasgow. Eng. Pat. 6338, April 25, 1890. 6*d*.

A THICK syrup of any suitable sugar or mixture of sugars is carefully neutralised, for which purpose bicarbonate of soda is most convenient. The syrup is then concentrated until its boiling point reaches 325° F., or until a suitable consistency is obtained. The boiled sugar is poured out on a slab and allowed to cool to 167°—185° F., when a quantity of malt extract, previously heated to 170° F. on a water-bath, is thoroughly mixed with it. 20—30 per cent. of malt extract is the most suitable amount to use, and on no account must the temperature be allowed to exceed 185° F. Any colouring or flavouring agent added at this stage must be previously neutralised. In fact, the patentee lays great stress on the perfect neutrality of all the materials employed. The mixture is finally moulded into any suitable shape and preserved in well-corked bottles.—H. T. P.

Improvements in the Method of Treating, Preserving, and Packing Raw Flesh Meat, Beef, Veal, Mutton, Lamb, Pork, and the Stomachs, Bellies, Feet, and Tails of Cows, Bulls, Oxen, Calves, Sheep, Lambs, and Swine. E. Eardley, J. G. Cochrane, and E. Weild, Manchester. Eng. Pat. 12,065, August 1, 1890. 6*d*.

AFTER slaughtering and quartering the animals, they are stitched in canvas, allowed "to set," dipped in an antiseptic solution of borax, boracic acid, permanganate of potash or other material, then plunged in or covered with sweet warm fat, lard, tallow, paraffin wax, or other suitable composition. Stomachs, bellies, and feet, &c., after being thoroughly washed and scalded, are dried in a hydro-extractor and then treated as above, except that they are not covered with canvas. Tails are allowed to cool and then treated like the stomachs, &c., omitting the scalding. The barrels and packing cases are painted with antiseptic solution, then with the lard or other composition as above. —J. M. H. M.

(*B.*)—SANITARY CHEMISTRY.

PATENTS.

An Improved Method of and Means for Purifying the Waste or Impure Matters from Tanneries, Factories, Dyeworks, or similar or other Sources. J. W. Calvert and J. Chaffer, Leeds. Eng. Pat. 18,946, November 26, 1889. 6*d*.

See under I., *page* 36.

Improved Apparatus for Filtering Sewage and other Liquids. W. Birch, Manchester. Eng. Pat. 4732, March 26, 1890. 8*d*.

AN endless filtering band travelling through guide rollers traverses the bottom of a trough into which the liquid to be filtered is conducted by a pipe and spreader. Underneath the band is a grid in which are small flush guide rollers, and small rollers are also employed to keep down the upper surface of the band. On emerging from the trough, covered with sludge, the band is conducted over a concave support against which it is brushed or squeezed at intervals by a small roller having a backward and forward motion as well as one of rotation. The band is by this means freed from sludge and surplus water.—J. M. H. M.

(*C.*)—DISINFECTANTS.

PATENTS.

Improvements in Disinfectants and Antiseptics, and in Disinfectant and Antiseptic Soaps. M. Hargreaves, Preston. Eng. Pat. 18,460, November 19, 1889. 4*d*.

CHLOROPHENOLS and similar compounds are formed by treating carbolic and cresylic acids, vegetable tar, and the like with chlorine gas. Or the alkali salts of these chlorophenols are formed directly by the action of bleaching powder or alkaline hypochlorites upon the phenols in presence of water.

The chlorophenols or their salts are mixed with absorbents such as carbonate of lime (as obtained from causticising soda), sawdust, sand, &c., to form disinfecting powders, and with soap to form disinfectant soaps.—J. M. H. M.

An Improved Compound for Disinfecting and other Purposes. H. H. Lake, London. From W. F. Limes, Philadelphia, U.S.A. Eng. Pat. 12,323, August 6, 1890. 4*d*.

A DISINFECTANT and moth preventive composed of oil of camphor, "naphthaline," and caustic soda. The camphor oil is boiled with soda and the "soap" mixed with "naphthaline" and moulded into cakes, lozenges, &c.
—J. M. H. M.

XIX.—PAPER, PASTEBOARD, Etc.

Colloidal Cellulose. Papier Zeitung, 1890, 778.

A SUBSTANCE bearing the name of colloidal cellulose has been prepared by treating dried cellulose with sulphuric acid of 50° B. It is a gelatinous translucent mass which retains its condition for an indefinite time, even in the presence of an excess of acid, provided no rise of temperature take place. At 100° C. it is quickly converted into dextrin. The pure substance can be freed from acid by treatment with water and alcohol and drying at a low temperature. It then gives with water a milky fluid which can be filtered and suffers no change even after the lapse of several days, or on boiling. It is somewhat more soluble in hot than in cold water. Its solution appears orange-yellow by transmitted light, and a 100 mm. layer is dextro-rotatory to the extent of 0·75°. The solution is precipitated by the addition of small quantities of sulphuric acid, nitric acid, sodium chloride, and lead acetate; large quantities of alcohol produce the same effect. It does not become coloured on the addition of iodine, nor does it reduce cupric solutions. The residue left on evaporation is in the form of a shining film which swells up and dissolves in water. Prolonged treatment with sulphuric acid of 55° B. or short exposure to acid of 60° B., renders it insoluble in water, dextrin being formed at the same time. Well-dried colloidal cellulose undergoes nitration in much the same way as the ordinary variety, and the product is only distinguishable from the substance before nitration by being somewhat less translucent.

These properties of colloidal cellulose elucidate various facts observed in connexion with ordinary parchment paper. Certain weak parchment papers yield soluble cellulose on treatment with boiling water, whereas the stronger sorts are not attacked; doubtless a stronger acid is used in the preparation of the latter, whereby the soluble cellulose at first formed is reconverted into the insoluble variety. Parchment paper, therefore, appears to consist of a network of ordinary cellulose filled in with colloidal cellulose. This is borne out by the fact that filter paper treated on both sides with soluble cellulose and rolled, much resembles the product as usually manufactured.—E. B.

PATENTS.

Improvements in or Connected with Breaking and Beating Engines used in making Paper Pulp. A. H. Annandale, Polton. Eng. Pat. 14,558, September 16, 1889. 6*d*.

THE invention is applicable to breaking and beating engines, in which the operating roll works in a casing entirely closed, excepting the inlet and discharge openings. It consists in discharging the pulp from the engine against a head or back pressure by extending a discharge pipe from the outlet up some feet higher than the machine, the pulp being delivered from the top of such pipe. The height of this outlet is adjustable so as to secure the best effect under various conditions both as regards materials operated upon and the rates of feed, &c. of the roll.—C. F. C.

Improvements in Boilers for the Manufacture of Sulphite Cellulose and in the Method of Treating the Same. C. Kellner, Vienna, Austria. Eng. Pat. 4959, March 29, 1890. 8*d*.

THE improved boiler is provided with jackets composed of a number of separate parts, easily removable when it is desired to inspect the boiler. The space between boiler and jacket is filled with a liquid of high boiling point, which is heated to and maintained at a temperature somewhat higher than that in the boiler or digester which contains the wood and the bisulphite solution. The specification describes and illustrates a stationary and a revolving digester filled in the above manner.

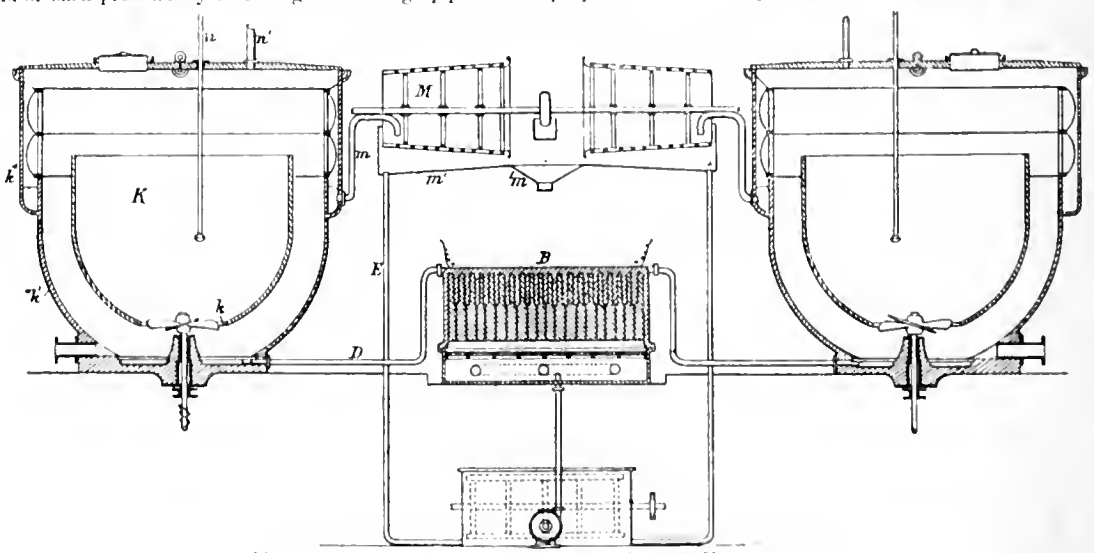
The inventor also claims an internal lining consisting of plates of tempered glass; these may be fixed by means of a mixture of equal parts of Portland cement and sand, or of a "mixture of quartz powder, glass powder, fire-tile powder, brick powder, carbonate of lime, phosphate of lime, and soluble glass."—C. F. C.

Process of Modifying the Properties of Fibres used in the Manufacture of Paper. C. Kellner, Vienna, Austria. Eng. Pat. 5128, April 2, 1890. 6*d*.

THE inventor claims that cotton and cotton-like fibrous materials are modified so as to resemble linen by boiling under pressure (3 atmos.) with weak solutions of certain acid salts, such as the bisulphites of the alkalis or sulphate of alumina. On the other hand linen-like fibrous materials are modified to resemble cotton by boiling under pressure with weak alkaline solutions. The inventor also claims that these modifications are produced by saturating the fibrous materials with solutions of salts, such as nitrates or sulphates, and causing the pulp so impregnated to pass between two metallic cylinders connected with the poles of an electric current generator.—C. F. C.

Improvements in the Process of and Means for the Manufacture of Cellulose with the Aid of the Electric Current. C. Kellner, Vienna, Austria. Eng. Pat. 5420, April 9, 1890. 8*d*.

THE present invention is a simplification of Eng. Pat. 15,942 of 1886 (this Journal, 1888, 132), for the same purpose, in that it dispenses with the aid of heat and with



MANUFACTURE OF CELLULOSE BY THE AID OF ELECTROLYSIS.

the employment of closed vessels. The reduction of wood to cellulose is effected by treatment in a suitable apparatus with the products of the electrolysis of certain metallic chlorides. The disposition of the parts, *i.e.*, decomposing vessels and electrolyser, is shown in the accompanying figure. The wood, in large pieces, is charged into the middle of the vessel K. The decomposing liquid is carried from the electrolyser B, through the pipe D, into the vessel *k'*, concentric with K. In the bottom of K is an agitator which causes a circulation of liquid, and continuously removes the cellulose disintegrated from the surface of the wood. The liquid carrying the suspended cellulose overflows into the annular casings k^1, through siphon pipes *m* into revolving conical sieve drums M, from the wider end of which the cellulose is discharged in the form of pulp, while the liquid passes through the sides of the drums into the gutters *m'*, and thence through pipes E into the recombining tank *a*. *n* is a small steam pipe for keeping the liquid about the ordinary temperature during cold weather, while *n'* communicates with the atmosphere.

—C. F. C.

Improvements in the Manufacture of Coloured Paper. J. H. Carpenter, Chicago, and C. E. O'Hara, New York, U.S.A. Eng. Pat. 6348, April 25, 1890. 4*d*.

The patentees claim the process of manufacturing coloured paper, which consists in applying colouring matter to the pulp while on the wire of the machine, the result being to produce shaded and clouded tints either in one or a mixture of several colours, an endless variety of colour effects being so obtained.—C. F. C.

A New or Improved Absorbent Writing Paper. P. Whiteside, Preston. Eng. Pat. 6458, April 28, 1890. 4*d*.

The invention consists "in making the paper with a sufficiently hard and smooth surface for comfortable writing, but the process of calendering the paper is not used to so great an extent as is the case in the highly-glazed non-absorbent papers."—C. F. C.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES AND EXTRACTS.

Rose-Oil. W. Markownikoff. Ber. **23**, 3191.

The author has investigated the nature of Bulgarian rose-oil. The results obtained are as follows:—The stearoptene which separates from the oil melts at 36·5° C., and has all the properties of a paraffin. It is perfectly odourless and has no influence on the commercial value of the oil. The elæoptene consists of a mixture of two bodies, $C_{10}H_{20}O$ and $C_{10}H_{18}O$, of which only one, forming the bulk of rose-oil, possesses an alcoholic nature.—H. T. P.

Cytisin. A. Partheil. Ber. **23**, 3201—3203.

The author recommends the following process for the preparation of cytisin, which occurs in the seeds of *Cytisus laburnum*. The coarsely-powdered seeds are extracted with alcohol containing hydrochloric acid. The alcohol is distilled off, and the residue dissolved in water and filtered through a wet paper in order to separate the fatty oil. The filtrate is treated with acetate of lead, which removes the greater part of the colouring matter. The filtrate from this is rendered alkaline with potash, and shaken out with amyl alcohol. From the amyl alcohol, dilute hydrochloric acid removes the alkaloid, and the solution thus obtained yields the chloride (still highly coloured) on evaporation. Cold absolute alcohol removes almost the whole of the colouring matter from the solid salt, and by subsequent repeated crystallisation from water the salt is obtained in well-formed, colourless, transparent crystals. The platinum double salt, $C_{11}H_{14}N_2O.H_2PtCl_6$, forms fine golden yellow needles. When heated it is decomposed without previous melting. It is easily soluble in water. The gold double salt, $C_{11}H_{14}N_2O.HAuCl_4$, is slightly soluble in water, and melts with decomposition at 212—213° C.—H. T. P.

Isocinchonine. O. Hesse. Annalen, **260**, 213—226.

Isocinchonine, $C_{19}H_{22}N_2O$, can be easily prepared by dissolving commercial cinchonine sulphate (30 grms.) or the free base in dilute (from 1 : 5 up to 10) sulphuric acid (150 grms.), and keeping the solution for 24 hours at the ordinary temperature, or heating it at 60°—80° for six hours. The solution is then poured into cold water, excess of soda carefully added, and the product extracted with a large volume of ether; after evaporating a considerable quantity of the ether, the residual solution is kept for some time at the ordinary temperature, whereon crystals are deposited. The ethereal solution is then decanted and evaporated completely to obtain the isocinchonine, which quickly solidifies; the crystalline product is pressed and then purified by recrystallisation from ether or by converting it into the crystalline hydrochloride, and decomposing this salt with soda. It melts at 125°, is readily soluble in acids and most neutral solvents except water, and is levo-rotatory. It forms with acids both neutral and acid salts which, as a rule, crystallise well. The hydrochloride—

$$C_{19}H_{22}N_2O.HCl + H_2O$$

loses its water of crystallisation at 140°—150°, and melts at 201°.

The crystalline deposit referred to above is always obtained, although only in very small quantities, when commercial neutral cinchonine sulphate is employed, it consists principally of hydrocinchonine and apocinchonine. These two compounds can be separated from one another by dissolving the mixture in concentrated sulphuric acid, and heating the solution at 80°—100° for a few hours, or by dissolving it in dilute sulphuric acid and adding potassium permanganate drop by drop until a permanent colouration is produced. If the freshly precipitated alkaloids are then treated with ether the apocinchonine passes for the most part into solution, whilst most of the hydrocinchonine remains undissolved, and can be obtained in a perfectly pure condition by means of its sulphate. It is possible, therefore, to isolate the hydrocinchonine present in commercial cinchonine sulphate without the aid of potassium permanganate. Even if the salt or base employed in the preparation of isocinchonine is free from hydrocinchonine, when it is treated with sulphuric acid and the solution kept for 24 hours, a small quantity of a crystalline deposit is always obtained from the ethereal solution in the manner described above. In such cases, however, it consists principally of apocinchonine, an alkaloid which is not converted into isocinchonine under these conditions.—F. S. K.

The Composition of Bees-wax. A. and P. Buisine. Bull. Soc. Chim. 1890, **3**, 867—873.

See under XII., *page* 52.

The Bleaching of Bees-wax and the Composition of White Wax. A. and P. Buisine. Bull. Soc. Chim. 1890, **4**, 465—470.

See under XII., *page* 52.

The Manufacture of Quinine in Madras. Board of Trade J. January 1891, 99—102.

The Administration Report of the Government Cinchona Department, Nilgiris, for the year 1889—90, contains an article on the manufacture of quinine at Naduvatam, in the province of Madras.

From this article it would appear that the manufacture of the sulphate of quinine upon a small scale was commenced about the end of June 1889, when many experiments were made for the purpose of finding out the most rapid and economical methods of extracting, first, the alkaloids from the bark; secondly, of obtaining the pure sulphate of quinine from the alkaloids; and also of training the native workmen in the business. All this took some time, and it was not till the beginning of October that the men were

sufficiently advanced to admit of the manufacture being begun upon a large scale. One of the chief difficulties to be contended with at first was the want of proper vats, and the designing and making of these all meant delay. The most serious matter, however, was the enormous loss of fusel oil which was experienced, the only costly ingredient needed for the extraction of the alkaloids from the bark; but this loss, though still considerable, has been greatly reduced by distilling the bark after the alkaloids have been extracted from it. The still required for this purpose was not put up till February, and the manufacture of quinine had to be suspended till that time. At this date it would have been possible to begin making quinine at the rate of 60 lb. or thereabouts per week, as a fresh supply of fusel oil had been just received from the Government of Bengal, pending the arrival of a fresh supply from England. Unfortunately, all calculations were upset by the outbreak of the Russian influenza epidemic; every one of the workmen who had been educated with so much care during the former months, being scared by the reports which they had heard respecting the disease, fled to their homes in Mysore, and fresh men had therefore to be drilled; it was only towards the middle of May that it became possible to recommence work on anything like a proper scale. It had been calculated that a steam-engine of six-horse power would be sufficient for working up the produce of three vats, and that these three vats would turn out 90 lb. of crude sulphate of quinine a week, and about 80 lb. of the pure sulphate or 4,000 lb. of quinine during the year. It has been found, however, that the engine, which is insufficient when heated by wood to warm up more than three of the pans simultaneously, still less is it able to heat up the still while the pans are being heated. To obviate the delay caused by having to use the engine separately for the pans and still, it will be necessary to obtain an additional boiler with a fire-box of larger dimensions than the present engine is fitted up with. The number of vats also must be doubled, and it is hoped, when these are fixed, that if nothing further untoward happens, the full amount of 4,000 lb. of quinine will be made during the present year, notwithstanding that so much time has been already lost.

The following is a detailed description of the methods adopted in extracting the alkaloids from the bark and of extracting the quinine from the alkaloids: 1st. The bark used is a mixture of the branch stem and root of *Cinchona officinalis*, or the crown bark, and which has the following alkaloidal value:—

Quinine	3·02
Cinchonidine	1·01
Quinidine	0·14
Cinchonine	0·24
Amorphous	0·30
Total	4·71
Sulphate of quinine	4·06

The bark is ground up by a Carter's disintegrator, which is fitted with screens the apertures in which are the $\frac{3}{64}$th part of an inch in width. The powder is then passed through a separator, which has a mesh of 64 strands to the inch. The fine powder which passes through the scalper is that which is used in the factory for the manufacture of quinine. The coarse powder which will not pass through the scalper is put a second time through the disintegrator.

Two hundred pounds of the powdered bark are placed in a cylindrical vat 6 ft. deep and 3 ft. in diameter, and to the powder is added 100 gallons of water in which there has been dissolved 14 lb. of solid caustic soda. There are also added 120 gallons of paraffin and fusel oil in the proportion of 4 parts of paraffin to 1 part of fusel oil, or 96 gallons of paraffin to 24 gallons of fusel oil. The mixture is then stirred by means of paddles, which are arranged on a central spindle after the fashion of a screw, so as to raise the heavier water and mix it completely with the lighter oils. The stirring is carried on for three hours, and the mixture is then allowed to stand overnight. In the morning the oils which have separated from the water and bark are removed by means of a tap which is placed at the junction of the water and the oil. The oil is then carried to the agitating casks, and to it is added water sufficiently acidulated with sulphuric acid to dissolve the alkaloids which are held in solution by the oil. The oils are washed with the acid water, by means of paddles, for 10 minutes, and then allowed to settle, when the acidulated water is drawn off by means of taps placed at the bottom of the casks. Some more water, not acidulated, is again added to the oils, and the washing is repeated twice. All the water which has been used to wash the oils is then removed to a separator, that is, a tall, conical tub with a tap at the bottom. The water, which always contains a quantity of oils and other impurities, is allowed to stand for half an hour, or other convenient period, and then run off through the tap. By this means the acid water, which contains all the alkaloids, is received in a much purer state than when taken direct from the agitating casks. The acid liquor is then filtered through charcoal and removed to tubs, where it is stored till a sufficient amount has been accumulated to fill the steam pans. The oil, which has been washed by the acid water, is then put back again into the vat and again stirred up with the bark, after which it is allowed to settle for another night, when it is drawn off and treated in the same manner as has been described above. The acid water containing the alkaloids is removed to the steam pans, each of which has a capacity of 50 gallons. Forty gallons of the acid liquor is poured into each pan and heated up to boiling point, when a handful of charcoal is thrown in, and the liquor neutralised by means of caustic soda. After the liquor has been allowed to boil (water boils at Naduvatam at 94° C.) for a quarter of an hour or so, it is filtered into cooling pans, when the greater part of the sulphate of quinine crystallises out; but it also contains 16·5 per cent. of cinchonidine. All the other alkaloids remain in the solution. The crystals the next day are filtered from the liquor, and as much of the liquor as possible is squeezed out by a screw press. The crystals are then removed to the hot room and there thoroughly dried. These are called crude crystals. To the liquor which remains behind, caustic soda is added in a sufficiency to precipitate the remaining alkaloids, and these are then removed for future treatment, when any quinine which they may contain is afterwards extracted. The crude crystals, after they have been dried, are powdered up and re-dissolved in boiling water. The solution is boiled for about a quarter of an hour with some charcoal, and is made very faintly acid; it is then passed twice through double filters into the cooling pans, where the "pure" sulphate of quinine crystallises out, containing about 4 per cent. of cinchonidine. The crystals are filtered from the liquor, and are allowed to drain as much as possible, after which they are placed upon some bibulous paper, on square blocks of plaster of Paris, 1 foot square by 1½ inches thick. The plaster of Paris absorbs rapidly a great deal of the water which the crystals hold; after this the crystals are placed on fresh filtering paper and put upon calico trays, which are removed to the shelves in the hot room, where the temperature is kept at from 15 to 20 degrees above that of the atmosphere. As the lumps of crystals dry they are broken up by forks, and when sufficiently dried, they are removed to the store-room, and the quinine is then ready for packing.

The result obtained from working up a rather large batch will give a rough idea of what is the cost of extracting the quinine from the bark.

From 6,000 lb. of bark there were obtained 227 lb. of sulphate of quinine out of a possible 243 lb., the cost of the chemicals used was—

	Rs.	a.	p.
(1.) 420 lb. of solid caustic soda and acid	23	0	0
(2.) 96 gallons of oil	110	0	0
(3.) Cost of fuel	10	0	0
(4.) Labour	84	0	0
(5.) Interest on building and plant at 10 per cent.	62	0	0
	289	0	0
(6.) Value of bark	3,626	12	0
	3,915	12	0
Value of quinine, at Rs. 17 4 a. per lb.	3,915	12	0

Bromine. Eng. and Mining J. 1891, **51**, 42.

The bromine industry in the United States was commenced in 1846 by Dr. David Alter, at Freeport, Pa. He continued the business until 1856, but from that time until 1866 no bromine was made in this country. In the latter year the manufacture was resumed at Freeport, and was also begun at Tarentum, Pa., but these works were abandoned again in 1871 and 1874 respectively, and no bromine has been made in either place since.

Works were begun at Canal Dover, O., in 1871, which have continued in operation to the present time. The districts in which bromine is now commercially produced are Pomeroy and the Tuscarawas Valley, in Ohio, Western Pennsylvania, West Virginia, and Michigan. Of these, the Pomeroy and West Virginia regions are the most important.

Bromine is a valuable by-product of the salt industry, occurring in the form of bromides in the bittern. It is prepared from the latter by the addition of sulphuric acid, forming hydrobromic acid, and an oxidising agent—potassium chlorate or manganese binoxide.

The proportion between the bromides and salt differs in different localities; at Canal Dover, in the Tuscarawas Valley, O., from 1877 to 1887, both years inclusive, there were produced 222,669 lb. of bromine and 259,350 barrels of salt, or about 6 lb. of bromine to 7 barrels of salt. In the Pomeroy district the proportion was 1 lb. of bromine to 2 barrels of salt.

More than two-thirds of all the bromine made is used in the manufacture of sodium and potassium bromide for medicinal purposes and photography, while the remainder is used in the colour industry. Attention is now directed to the great efficiency and value of bromine as a disinfectant.

The production in the United States in 1882 was 250,000 lb.; in 1883, it was 301,100 lb.; in 1884, 281,100; in 1885, 310,000. In the early part of the last year, the price of bromine had fallen to 25 cents per lb., when a combination of all the producers, the National Bromine Company, was formed, and the entire product of the country pooled and sold by one agency. Owing to this combination the price rose steadily from 25 cents to 30 cents in April and to 33 cents before the close of the year.

It was in that year, also, that Michigan first began the manufacture of bromine. At Midland, Midland County, an isolated system of wells yields bittern containing 1·2 per cent. bromine, which is now worked, and produces about one-eighth of the entire product of the country. Prior to this attempts to work Michigan brines had been unsuccessful, bromides being present in too small amount.

In 1886 the production amounted to 428,334 lb.

In May 1887, many of the bromine manufacturers ceased operations temporarily on account of the dulness of the trade and accumulations of stock, but the production for the year amounted to 199,087 lb. The average price was held at 31 cents. The same price continued in 1888, in which year the product increased to 307,386 lb.

The use of bromine as a disinfectant assumed a more important output in 1889 than ever before in this country, 6,800 lb. being used at Johnstown after the flood.

The production of bromine for the year 1889 is estimated to have been 250,000 lb., valued at 92,500 dols., three-fifths of this amount coming from the Ohio and West Virginia region.

The price, which was controlled by the combination of producers, was further increased, and, in 1889, averaged from 37 to 38 cents per lb.

In 1890 the estimated production of bromine in the United States has been as follows:—Michigan, 40,000 lb.; Pennsylvania, 70,000 lb.; Ohio and West Virginia, 200,000 lb.; total, 310,000 lb.; valued at 147,250 dols. The price remained steady at from 37 to 38 cents per lb. during the year.

PRODUCT OF BROMINE IN THE UNITED STATES, 1883 TO 1890, INCLUSIVE.

Sources.	1883.	1884.	1885.	1886.	1887.	1888.	1889.	1890.
	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.
Pomeroy, Ohio	171,116	159,881	110,000	111,866	59,312	20,470	..	
Tuscarawas Valley, Ohio	23,334	21,710	15,000	15,000	45,850	11,070	150,000	200,000
West Virginia	106,650	99,509	85,000	126,391	16,125	61,609	..	
Pennsylvania	..	..	60,000	49,549	78,000	100,113	60,000	70,000
Michigan	..	..	40,000	125,528	..	81,124	40,000	40,000
Total	301,100	281,100	310,000	428,334	199,087	307,386	250,000	310,000

The consumption of pyrolusite in the manufacture of this amount of bromine is estimated at from 400,000 to 500,000 lb., from 1½ to 2 lb. of pyrolusite being required for each pound of bromine produced. The binoxide of manganese is used as the oxidising agent in the manufacture of bromine by nearly all the producers of the United States with the exception of those in Michigan. The high percentage of calcium chloride in the salines of the latter State makes potassium chlorate preferable as the oxidising agent, since it requires less sulphuric acid and thus avoids the heavy precipitate of calcium sulphate.

During the calendar year 1886, 44,189 lb. of bromine, valued at 12,008 dols.; and in 1887, 66,307 lb., valued at 16,216 dols., were imported into the country. There have been no other importations before or since, so far as known.

PATENT.

Improvements in Processes and Apparatus for the Preparation of an Extract of Tea, and in the Utilisation of the By-products. E. Sonstadt, Cheshunt. Eng. Pat. 20,182, December 16, 1889. 8*d*.

In this invention the tea to be extracted is placed in a digester of conical form, provided with a moveable perforated false bottom, and communicating by means of a siphon tube with another vessel used as a boiler and placed at a lower level. A supplementary boiler is also added at a higher level, from which water is run into the digester. In order to ensure the better extraction of the tea-leaves the digester is provided with a rod, sliding through a stuffing box, and provided with spokes; and through the lid of the digester a cohobating apparatus is passed connected with small chambers charged with wool, which serve to condense the aroma. The tea is introduced into the digester and hot water run in from the higher boiler, and a current of steam from the lower boiler. When the extraction is complete the latter is shut off and the infusion sucked into the lower boiler, from whence it is run into an evaporator.

The liquid is then concentrated until a sample taken from it hardens on cooling; during the process it is best to keep the mixture in agitation. Part of the wool on which the aroma is condensed is stored up with lump sugar in a closed vessel when some of the aroma is abstracted; the rest of the wool is placed in a mixer with sugar, and the whole moistened with water or "aroma-water. The aromatised sugars can be expressed from the wool and stored in suitable receptacles; the wool is washed and used over again. The more or less dried tea infusion is mixed with the "aromatised sugar," and the whole heated to 100°

in a closed vessel provided with a mechanical agitator, which is worked until it moves smoothly without resistance. After partial cooling the plastic mass is rolled and cut into convenient shapes. The extract may be used for making a "cup of tea," or for the purposes of confectionery; the spent tea-leaves from the digester are compressed and made into blocks to be disposed of as manure; or they may be carbonised in a closed retort to obtain tea-charcoal and tea-tar, which contains ammonia, other nitrogen compounds, acetic acid and other products.—V. H. V.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

An Apparatus for the Development of Photographic Plates without the Use of a Dark Room. A. Watt.

See pages 16—17.

Reversal and Second Negative. H. J. L. Rawlins.

See page 18.

Grease-Spot Photometer Measures. W. de W. Abney.

See pages 18—20.

The Sector and Grease-Spot Photometers and their Results. F. Hurter and V. C. Driffield.

See pages 20—21.

Action of Borax in the Alkaline Developers. P. Mercier. Compt. Rend. **111**, 644—645.

Borax, although it has an alkaline reaction, acts as a retarder when mixed with pyrogallol or catechol, doubtless because, as Lambert has shown, it combines with polyhydric phenols to form energetic conjugated acids. No similar reaction takes place, however, with quinol, resorcinol, "eikonogen," or hydroxylamine hydrochloride, and with these compounds borax acts as an excellent accelerator. A solution of two parts of borax in 100 parts of water with two parts of quinol or "eikonogen," gives very good results. —C. H. B.

Reversal of the Negative Photographic Image by Thiocarbamides. J. Waterhouse. Phot. News, 1890, 727—728, 743—744, and 804.

Phenylthiocarbamide added in very small quantity to the ordinary "eikonogen" developer converts the negative image more or less completely into a positive image, even when the plate has received a normal or even an under-exposure. No similar result is obtained with pyrogallol, quinol, or ferrous oxalate developers. A large proportion of phenylthiocarbamide prevents reversal; 12 to 15 parts of the saturated solution (0·1 per cent.) in 100 parts of eikonogen developer will give the best results. A small quantity of potassium bromide, and in some cases traces of ammonia, seem to aid reversal. Over-exposure prevents reversal. A preliminary oxidising bath of nitric acid (5 per cent.) is useful in copying work, and the use of a bath of cupric bromide before fixing also gives clearer lights. Potassium dichromate does not answer so well as a preliminary oxidiser as nitric acid.

Allyl-thiocarbamide, though less regular in its action, produces even stronger effects of reversal with eikonogen, with pyrogallol containing sulphite, and with quinol containing sulphite and sodium carbonate.

Thiocarbamide in small quantity produces reversal with the eikonogen developer, and also with a quinol developer on Wratten's "ordinary" plates, and seems to be a very powerful accelerator with both developers, but is much less regular in its action than the substituted thiocarbamides.

Carbamide produces no reversal, and hence it would follow that the sulphur plays an important part.

All the thiocarbamides in presence of alkali darken silver haloid salts which have not been exposed to light. In absence of alkali they have no effect, except in the case of allyl-thiocarbamide, which dissolves and seems to combine with the silver haloids.—C. H. B.

PATENTS.

Improvements in Photography. E. H. Farmer, London. Eng. Pat. 17,773, November 7, 1889. 4*d*.

When dichromates or similar reagents are brought into contact with silver surrounded by gelatin or other colloid, the latter is rendered insoluble to an extent depending on the proportion of silver present. Gelatino-bromide plates are prepared in the ordinary manner except that no hardening material is added, and are exposed and developed in the ordinary manner, preferably with the ferrous oxalate developer. The plate is then immersed in a 20 per cent. solution of ammonium dichromate for about a minute, washed and dried. It can then be used in the same manner as an ordinary chromated film, *i.e.* etching on copper, production of a Woodburytype mould, direct printing, as in collotype, or for the production of an image in fatty ink which can be transferred to a lithographic stone. The dichromate may be placed in the film or in the developer, but the method described is preferred.—C. H. B.

Improvements in the Method for Producing Intense Light by Magnesium or by other Glowing Materials. J. W. t'. C. Schirm, Berlin, Germany. Eng. Pat. 11,784, July 28, 1890. 8*d*.

See under II., *page* 38.

Improvements in or Relating to the "Dusting-on" Process of Producing Pictures by Photography. G. W. Wood, Gateshead-on-Tyne. Eng. Pat. 13,191, August 22, 1890. 4*d*.

The sensitive preparation is spread on a surface of ferrotype, vulcanite, or other black or dark coloured material, dried, and exposed under a negative. The process is carried out in the ordinary manner, but the material used for dusting-on is some lustrous substance such as the white, gold or other light-coloured bronze-powders, or powdered aluminium, magnesium, zinc, tin, silver or other suitable metal or alloy. Any other white or nearly white powder may be used, but substances with a metallic lustre give the most brilliant images. Silver precipitated from a solution of silver nitrate by an acidified mixture of ferrous and ferric sulphates gives good results. A sheet of plain glass or other transparent medium may be used as a support and is afterwards backed with black varnish or black paper.

This method has the advantage of giving positives from negatives.—C. H. B.

XXII.—EXPLOSIVES, MATCHES, Etc.

On Precautionary Regulations during the Preparation of Nitroglycerol. F. Scheiding. Zeits. f. angew. Chem. 1890, 609—613.

The author first suggests that the mixing of the acids should be made in a vessel provided with a cover and chimney for conveying the acid fumes out of the building. The mixing can be effected by means of compressed air, and the cover prevents any of the acids from being thrown out of the vessel. Montejus should be made of cast or wrought iron, preferably not lined with lead. The cast iron withstands the action of the acid better than the wrought iron but is liable sometimes to crack, especially when the air-cock is opened. This cock should therefore be placed outside of the building or separated from the Montejus by a wall, and the Montejus should stand clear of everything so that any leak could easily be observed. In the next

operation which properly may be called dangerous, viz., the nitration of the glycerin, rise of temperature which might lead to explosion may be caused by impure glycerin or the accidental admixture of water. The chemical examination of the glycerin is therefore essential.

The nitrating vessel must be made of thick lead and stand clear on all sides in a well lighted building, yet not exposed to the direct rays of the sun. The contents of the nitrating vessel should be kept cool by several separate coils of thick leaden pipe through which cold water passes. In order to prevent any water from escaping into the acid mixture should one of the worms be damaged during the operation, the cooling water should flow from a higher lying vessel and discharge into a lower lying tank. The cooling worm would thus act as a syphon and draw some of the acid and nitroglycerin mixture into the lower tank, where its presence would be recognised by the turbidity produced, or by means of litmus paper. The agitating or stirring is best effected by compressed air, and the workman should always ascertain by means of a manometer whether there is sufficient air pressure before commencing the nitration. In order that no water may be carried over with the air, a condensation box should be fitted at the lowest point of the air pipe. The nitrating vessel must be provided with a cover or hood and chimney which will convey the acid fumes out through the roof. The whole apparatus stands over a large tank containing water, into which the whole contents of the nitrating vessel can be promptly discharged through a large earthenware cock, should the temperature rise to 40° C.

The floor of this building in certain districts consists of sand, in others of clay. The author prefers a clay floor slightly sloping towards a gutter in the middle which passes underneath the door. The floor should be kept always damp and covered with sawdust, and the place where the men stand covered with a soft mat. The mat should be washed twice a week, and the sawdust renewed once a week and the removed sweepings burned.

The author suggests the erection of one or two shelter-huts in which one or two workers could take refuge when an explosion threatened, and be protected from falling pieces. An alarm horn should be hung in the shelter-hut by which a warning signal could be given for the whole factory. As explosions have been caused in other buildings by débris falling through the roof, the author advises that the roofs of the buildings in which nitroglycerin or dynamite are present should be provided with a strong double lining. The intervening space would also keep the building cooler in summer and warmer in winter. An electric bell should be near the nitrating apparatus, by which a signal could be sent to the laboratory in the event of anything unusual occurring during the operation. The plug of the discharge cock should be carefully examined before each operation to see that it is quite free from any grit or frozen nitroglycerin.

For conducting the nitroglycerin and waste acids through the mound surrounding the building a brick channel thickly covered with tar is recommended, just sufficiently wide to take an open leaden gutter, through which a leaden pipe can be pushed. This pipe can be daily cleansed by rinsing first with concentrated sulphuric acid and then with water.

The author considers the combination of the nitrating apparatus with the separator in one building as injudicious. The separator should be provided with a perforated pipe for compressed air, that in the event of heating taking place, which often occurs only at separate spots, the mixture could be agitated and the danger possibly avoided. It should also have electric thermometers which would ring a bell when a certain temperature was reached. The separator should also have a hood with chimney passing through the roof. Outside of the mound surrounding the separator house there should be a pipe for compressed air with a cock by means of which the agitation of the liquid in the separator could be started should the workmen have fled from the building on signs of danger without starting the air agitator. Should the bells in connexion with the thermometers cease ringing the building can safely be re-entered. An essential condition of safety is that daily all the apparatus should be carefully examined to see if they are in proper working order. After the nitroglycerin has passed to the washing house the most danger is passed. There the greatest cleanliness should be observed and care taken that no wash-water, which always contains some nitroglycerin, is splashed about. The nitroglycerin must be washed quite free from acid. (This Journal, 1890, 265 and 476.)—W. M.

The Analysis of Dynamite. F. Scheidling. Zeits. f. angew. Chem. 1890, 614—615.

See under XXIII., *page* 70.

PATENT.

A Process and Apparatus for the Manufacture of Nitrated Starch. W. Schuckher, Vienna, Austria. Eng. Pat. 14,625, September 16, 1890. 6*d*.

Starch, preferably potato starch, is dried at 100° C., and finely ground. It is then dissolved at 20°—25° C. in nitric acid of 1·501 sp. gr., using 10 kilos. of acid to 1 kilo. of starch. The solution is added to a mixture of nitric and sulphuric acids, which, for the sake of cheapness, may be the waste acid from nitroglycerin manufacture, containing about 70 per cent. of sulphuric acid and about 10 per cent. of nitric acid. 5 kilos. of this waste acid are employed to every kilo. of the nitrated starch solution, the mixture being kept at a temperature of 20°—25° C. Nitrated starch is precipitated as a fine powder, and is collected on a filter of gun-cotton. The bulk of the acid is then removed from the precipitate by hydraulic pressure. The cakes produced are well washed in water, and treated with 5 per cent. of a soda solution. After 24 hours the cakes are ground between rollers, the creamy mass formed being afterwards dried by means of a centrifugal machine or a filter-press. Finally, about 1 per cent. of aniline is added to the residue (still containing 33 per cent. of water).

Nitrated starch so prepared dissolves readily in nitroglycerin. In the cold it forms at first a mass resembling lime, but as more of the nitrated starch is added a hard waxy material is produced. For details and drawings of apparatus, in which the above operations are to be performed, the original specification must be consulted.—H. T. P.

XXIII.—ANALYTICAL CHEMISTRY.

INORGANIC CHEMISTRY.

QUANTITATIVE.

International Standards for the Analyses of Iron and Steel. Extracts from the work of the American Committee. J. W. Langley. Eng. and Mining. J. 1890, **50**, 455.

In view of the work about to be commenced on the above subject by the committees in America, England, France, Germany, and Sweden, the American committee decided to make some preliminary trials of methods of analysis with a set of experimental standard steels before using the material of the international standards. The results were laid before the recent meeting of engineers, &c., in the United States. It appears from them that all analyses made hitherto of carbon by the combined double chloride and combustion process are unreliable on account of the variable action of the double chloride solution. The following are the analyses by C. B. Dudley of the same steel, wherein were used solutions of the uncrystallised and once and twice crystallised double chloride of copper and ammonium, these solutions also being used basic, neutral and acid:—

—	Basic.	Neutral.	Acid.
Mother-liquor solution.....	1·078	..	1·142
First crystals	1·027	1·031	1·077
Second crystals	1·023	..	1·052

Other methods were employed without using the double chlorides, but the results varied from 0·788 to 1·040 per cent. The variable results obtained by various chemists of the committee are shown by the following few averages:—

By Igneous Combustion.

Chemist.	Ingot.	Hammered Bar.
Dudley	1·058	1·053
Blair, one method	1·014	1·022
Blair, another method ..	1·049	1·046
Blair, another method ..	1·010 to 1·044	..
Shimer	1·055	1·052

By Chromic Acid Method.

Langley	1·040 to 1·145	1·034 to 1·075
Langley, another set....	1·058	1·025

The conclusions arrived at by this preliminary investigation are:—(1.) That the combustion of carbon in a porcelain tube in a stream of purified oxygen, when the precautions indicated are used, gives reasonably accurate results. (2.) That the use of a small quantity of hydrochloric acid in a solution of the double chloride invariably gives higher results than when a neutral solution is employed. (3.) The most important discovery made by the committee in this work pertains to the variable action of the double chloride solutions.

The problems now before the committee, as suggested by these conclusions, are:—"The determination of carbon in steel by some direct process not involving the use of the double chloride; the direct combustion of finely divided metal in oxygen or chromic acid is one of these, or by fusion in a mixture of bisulphate and bichromate of potassium. The determination, if possible, whether a neutral or alkaline double chloride liquid may not dissolve a portion of the carbonaceous residuum, and thus lead to results which are too low. The determination whether the addition of acid simply prevents this tendency or whether the use of it favours the precipitation of pre-existing organic matter in the liquid, and its retention by the carbon sponge, thus leading to results which are too high. The investigation of the cause of the influence of repeated crystallisations of the double chloride on the apparent quantity of carbon."—A. W.

The Analysis of Hypophosphorous, Phosphorous and Hypophosphoric Acids. L. Amat. Compt. Rend. **111**, 676—679.

The oxygen compounds of phosphorus may be distinguished from each other by the quantity of oxygen they respectively need to convert them into phosphoric acid. This may be determined by oxidation with mercuric chloride or potassium permanganate. Rose applied the method of oxidation by mercuric chloride in the cases of hypophosphorous and phosphorous acids, but it has not yet been extended to that of hypophosphoric acid, as it was believed that this acid was unacted upon by mercuric chloride. Péan de Saint-Gilles (Ann. Chem. Phys. 1859, **55**, 374) experimented with hypophosphorous acid and potassium permanganate, and came to the conclusion that this acid was not completely oxidised to phosphoric acid by potassium permanganate, and that consequently this salt could not be used in estimating the acids of phosphorus. He further suggested the existence of a new body, P_2O_7, since the oxidation appeared to stop at a point corresponding to such an oxide. Salzer, however, afterwards succeeded in oxidising hypophosphoric acid by potassium permanganate, and since this body does not exert so great a reducing action as phosphorous and hypophosphorous acids, it seems all the more likely that these acids would be completely oxidised by potassium permanganate.

The author shows that hypophosphoric acid may be estimated by means of mercuric chloride, and that the volumetric estimation of phosphorous and hypophosphorous acids may be effected by means of potassium permanganate.

To effect the oxidation of hypophosphoric acid by mercuric chloride the operation must be carried out in a hot and acid solution. One grm. of the acid sodium hypophosphate, $P_2O_6Na_2H_2 + 6\ H_2O$, was dissolved in 10 cc. of strong hydrochloric acid and nearly evaporated to dryness, the object of which was to bring about the decomposition of the hypophosphoric acid into phosphoric and phosphorous acids. The pasty mass was then dissolved in a little water, and a solution of mercuric chloride then added (68 grms. of mercuric chloride and 20—40 cc. of hydrochloric acid per litre; 1 cc. of this solution = 0·002 grm. of O). The liquid was then digested at 80° C. for 24 hours, the precipitated mercurous chloride collected on a filter, washed, dried at 100° and weighed. The filtered liquid must be tested to see if the reaction is completed. In using potassium permanganate for oxidising the acids of phosphorus, a solution of the salt equivalent to a solution of oxalic acid containing 63 grms. of the crystallised acid per litre was employed. The salt to be analysed was dissolved in about 20 cc. of water and 3 cc. of concentrated sulphuric acid. About 35 cc. of the permanganate solution were then added, and the solution heated to 50° C. and digested for half an hour. 20 cc. of oxalic acid solution were then added, which effected the reduction of the excess of permanganate, and the oxalic acid in excess was then titrated with standard permanganate solution.

Hypophosphites, phosphites, pyrophosphites, and hypophosphates may be estimated by this process. In the case of hypophosphates it is necessary to digest with the 20 cc. of water and 3 cc. of sulphuric acid for about half an hour before adding the permanganate. The author considers the mercuric chloride method the more accurate, and the permanganate method the more rapid.—H. S. P.

ORGANIC CHEMISTRY.—QUALITATIVE.

A Characteristic Reaction of Cocaïne. F. de Silva. Bull. Soc. Chim. 1890, **4**, 471—743.

Allrydy appeared (Compt. Rend. **111**, 348—349), this Journal, 1890, 1155.

The Detection of the Impurities contained in Alcohol. E. Mohler. Monit. Scient. **34**, 893—898.

The author has prepared separate solutions in pure alcohol (50 per cent. by volume) of all the impurities likely to occur in commercial alcohol, and has examined the action of the following reagents on these solutions:—1. Strong sulphuric acid. 2. Bisulphite of rosaniline. 3. Aniline acetate. 4. Potassium permanganate.

(1.) The colour produced by heating impure alcohol with strong sulphuric acid depends on the time and manner of heating, and it is therefore necessary to operate always under identical conditions. The following method of working was decided upon:—10 cc. of the alcohol to be tested (previously brought to a strength of 50 per cent. by volume) are placed in a flask of 125 cc. capacity and 10 cc. of sulphuric acid at 66° B. are gradually poured down the side of the flask so as to avoid mixing the two liquids. The flask is then held over a Bunsen flame and the contents are quickly mixed by shaking. The mixture becomes very hot, and after about five

seconds heating begins to boil. At this moment the flask is removed from the flame and allowed to cool in a place out of the reach of air currents. After cooling, the mixture is placed in a glass cell with parallel sides 25 mm. apart, and the colour is compared with Savalle's standard tints (obtained by the action of sulphuric acid on alcohol, containing from $\frac{1}{100000}$ to $\frac{5}{100000}$ of a mixture of impurities). Operating in the above manner, the following results were obtained with solutions containing 1 in 1,000 of the various bodies :—

Alcohols.	Tint.	Aldehydes.	Tint.	Ethers.	Tint.
	°				°
Capryl	7	Furfurol	Intense black	Amyl acetate	3
Isobutyl	6	Isobutyric	9	Ethyl acetate	0
Heptyl	4	Paraldehyde	8	Ethyl propionate	0
Amyl	2	Propionic	7	Ethyl butyrate	0
Propyl	0	Oenanthylic	5	Ethyl isobutyrate	0
Isopropyl	0	Valerianic	5	Ethyl valerianate	0
Butyl, normal	0	Ethylic	3	Ethyl caproate	0
Glycerol	0	Methylal	2·5	Ethyl œnanthylate	0
Methyl	0	Acetal	1·5	Ethyl sebate	0
		Butyric	0	Ethyl succinate	0
				Ethyl benzoate	0
				Ethyl salicylate	0
				Methyl salicylate	0
				Methyl formate	0

The following table shows the smallest quantity of those substances, which give a colouration with sulphuric acid, that can be detected :—

Substance mixed with Alcohol of 50 Per Cent.	Dilution of the Solution.	Weight of Substance contained in 1 Litre of Alcohol.
		Grm.
Furfurol	1 : 100,000	0·010
Paraldehyde	1 : 8,000	0·125
Isobutyric aldehyde	1 : 8,000	0·125
Ethylic aldehyde	1 : 8,000	0·125
Oenanthylic aldehyde	1 : 4,000	0·250
Propionic aldehyde	1 : 4,000	0·250
Valerianic aldehyde	1 : 4,000	0·250
Methylal	1 : 2,000	0·500
Acetal	1 : 2,000	0·500
Capryl alcohol	1 : 20,000	0·050
Isobutyl alcohol	1 : 8,000	0·125
Heptyl alcohol	1 : 2,000	0·500
Amyl alcohol	1 : 2,000	0·500
Amyl acetate	1 : 4,000	0·250

The colour produced is not proportionate to the amount of impurity present, as will be seen by reference to the next table :—

Substance Mixed with Alcohol at 50 Per Cent.	Savalle Degrees Corresponding to a Strength of		
	1 in 1,000.	1 in 2,000.	1 in 4,000.
	°	°	°
Isobutyric aldehyde	9	3	¼
Paraldehyde	8	4	½
Propionic aldehyde	7	2·5	¼
Oenanthylic aldehyde	5	2·5	Trace of colour.
Valerianic aldehyde	5	1	Trace of colour.
Ethylic aldehyde	3	3	½
Methylal	2·5	Trace of colour.	..
Acetal	1·5	Trace of colour.	..
Capryl alcohol	7	3	½
Isobutyl alcohol	6	2·5	¼
Heptyl alcohol	4	Trace of colour.	..
Amyl alcohol	2	Trace of colour.	..
Amyl acetate	3	Trace of colour.	..

(2.) The bisulphite of rosaniline solution was prepared as follows :—

	cc.
Solution of magenta (1 in 1,000)	39
Sodium bisulphite at 34° B.	20
Water	200
Sulphuric acid at 66° B.	3

to be mixed in the order given.

10 cc. of alcohol to be tested are mixed with 4 cc. of the above reagent. The maximum violet colouration is developed in about half an hour, remaining constant for about 2 hours, when it begins to disappear.

The following table gives the smallest quantity of the aldehydes detectable in solution in 50 per cent. alcohol:—

Substance Dissolved in Alcohol of 50 Per Cent.	Strength of Solution.	Weight of Substance contained in 1 Litre of Alcohol.
		Grm.
Ethylic aldehyde.....	1 : 100,000	0·01
Acetal.....	1 : 100,000	0·01
Oenanthylic aldehyde....	1 : 100,000	0·01
Valerianic aldehyde.....	1 : 50,000	0·02
Propionic aldehyde	1 : 20,000	0·05
Isobutyric aldehyde.....	1 : 20,000	0·05
Paraldehyde	1 : 2,000	0·50
Methylal.....	1 : 2,000	0·50
Furfurol.....	1 : 2,000	0·50
Butyric aldehyde	1 : 2,000	0·50
Acetone.....	1 : 2,000	0·50

(3.) Aniline acetate is peculiarly the test for furfurol. It gives no colouration with solutions (1:1,000) of any of the other substances mentioned before. To apply the test, 10 drops of aniline and 2 cc. of acetic acid are added to 10 cc. of the alcohol under examination. The colour attains its maximum intensity in about half an hour, remains for some time and then disappears. A solution of furfurol containing 1 in 1,000 gives a strong red colour. When only 1 in 1,000,000 is present the colour is distinct, and even when there is only 1 in 10,000,000 the tint is still perceptible. As the colouration obtained is proportionate to the amount of furfurol present, that body may be estimated colorimetrically.

(4.) Potassium permanganate is instantaneously reduced by paraldehyde, isobutyric aldehyde, and isobutyl alcohol, in presence of acid.

25 cc. of solution of paraldehyde (1 in 1,000) absorbed 2·60 cc. of decinormal potassium permanganate. In the case of isobutyric aldehyde 0·7 cc. were required, whilst isobutyl alcohol absorbed 0·4 cc.

The other bodies before mentioned reduce potassium permanganate, but in such an irregular manner that it is impossible to distinguish between them.—H. T. P.

ORGANIC CHEMISTRY.—QUANTITATIVE.

Some Laboratory Experiences. B. W. Gerland.

See pages 25—26.

Turkey Red Oil. J. A. Wilson.

See pages 26—28.

The Effect of Exposure under certain Conditions upon some Constants of Oil. H. Ballantyne.

See pages 29—32.

On the Estimation of Fat in Milk. J. Gorodetzky. Zeits. f. angew Chem. 1890, 118—121.

This paper contains a detailed description of extensive comparative experiments on the estimation of fat in milk by the "sand method," Rose's method, and Soxhlet's areometric method respectively. The general results show that:—Rose's method gives the most accurate results; in the "sand method" a more prolonged extraction must be used than usual, viz., 6 to 8 hours for ordinary milk and 10 to 20 hours for skimmed milk, and in order to make analyses by the "sand method" comparable, the duration of the extraction should be stated; the areometric method is simple and rapid but frequently gives too low results.

—H. K. T.

Contributions to the Chemistry of Fat. A. Thum. Zeits. f. angew. Chem. 1890, 482—483.

In these experiments it was sought to determine—(1) the behaviour on saponification with an insufficient amount of alkali, of a mixture of oleic, stearic, and palmitic acids; (2) in what proportion are the above acids liberated when oil containing them becomes rancid.

According to Baudot (D.R.P. 37,397) stearic acid can be prepared by treating the crude mixture of fatty acids with dilute potassium or sodium hydrate at a temperature of 65°—90°, the stearic acid combining with the alkali whilst the oleic acid rises to the surface. After repeated trials, however, the author failed to effect a separation by this means. In order to test the matter more thoroughly the following experiment was made.

Ten grms. of oleic acid having an iodine number = 78·7 were mixed with 10 grms. of commercial stearic acid. The mixture was dissolved in boiling alcohol, free from acid, and 48 cc. of potassium hydrate solution containing 1·73 grm. of solid potash were added, this amount of alkali being sufficient to neutralise the oleic acid only. The cooled liquid was mixed with a little water, shaken out with petroleum ether, and the petroleum extract washed with water and distilled. The residue, which weighed rather more than 10 grms., was boiled with dilute sulphuric acid, washed, and titrated by Hubl's method. It gave an iodine number = 37·2. The alcoholic soap solution left after the treatment with petroleum ether was next diluted with water, decomposed with dilute sulphuric acid, and the alcohol boiled off. The residue gave an iodine number 40·8. Hence there is no marked difference between oleic acid and solid fatty acids in their behaviour with alkali, and this reagent cannot be used for their separation.

In order to ascertain if oleic, palmitic, and stearic acids are liberated in the same or in a different proportion to that in which they exist in fats, when the latter become rancid, palm oil and olive oil were examined. These fats were mixed with alcohol and exactly neutralised at the boiling temperature with potassium hydrate, using phenolphthalein as an indicator. The neutral fat and soap were then separated from the mixture by means of petroleum ether as described above, the neutral fat being afterwards saponified. The original palm oil had an acid number 94·0, and an iodine number 55·0. The iodine number of the free acid was 52·1; that of the acid separated from the neutral fat was 55·2. Olive oil gave acid number 93·0, iodine number 79·2; the iodine numbers of the free fatty acid and of the fatty acid existing in the neutral fat being 77·8 and 79·0 respectively. These values show that the ratio between oleic acid and solid fatty acid in the free acids of palm and olive oils is the same as that in which they exist in the neutral fat.—H. K. T.

Report on Confectionery and Preserves with Sugar and Honey. Report of the Central Laboratory of the Italian Customs Department, 1886—1889, 192—281.

See under XVIII. *A., page* 60.

Report on Animal Products, &c. Report of the Central Laboratory of the Italian Customs Department, 1886—1889, 441—465.

See under XII., *page* 51.

The Analysis of Dynamite. F. Scheiding. Zeits. f. angew. Chem. 1890, 614—615.

In the estimation of moisture in dynamite, the sample must be dried over sulphuric acid at the ordinary temperature, as nitroglycerin volatilises between 40° and 50° C. For the same reason when the nitroglycerin has been extracted with ether, after the latter has been evaporated, the residue must also be dried at the ordinary temperature in the same manner.

Should the dynamite be suspected to contain besides nitroglycerin another body soluble in ether, then the nitrate nitrogen and possibly the total nitrogen will require to be determined, the latter by Dumas' method. The former can

be estimated in a Lunge nitrometer, but the author prefers the Schulze-Tiemann process.

In the analysis of gelatin dynamite the first solvent to be used is ether; this destroys the gelatin, then the saltpetre is extracted with water, and after drying the residue, the collodion cotton is dissolved out by acetic ether. Should it be necessary to estimate the amount of gun-cotton present, then the acetic ether extraction must be preceded by treatment with "ether alcohol," as the acetic ether dissolves both nitrocelluloses.

The aqueous extract may also contain soda; it should therefore be made up to a known volume and in different portions should be determined: 1st, the total dry residue; 2nd, the alkalinity by titration; and 3rd, the nitrate nitrogen by Schulze-Tiemann's process. To collect the evolved nitrogen dioxide the author employs a burette of his own devising, described in this Journal, 1890, 896.

The presence of heavy spar in gelatin dynamite is to be regarded as adulteration, but in dynamite its presence is necessary when good kieselguhr is used in order to impart the required softness to the dynamite.—W. M.

ANALYTICAL AND SCIENTIFIC NOTES.

Dry Decomposition of Diazo-amido Compounds. F. Heusler. Annalen, **260**, 227—250.

When diazo-amidobenzene or its homologues is mixed with 8 to 10 parts of liquid paraffin, and the mixture heated, the diazo-compound first dissolves, and at a higher temperature is slowly decomposed with evolution of nitrogen, yielding ortho- and para-amidodiphenyl, diphenyl, benzene and aniline. Under the same conditions the diazo-compound obtained from para-toluidine yields toluene and para-tolnidine, and that obtained frrm para-chloraniline gives chlorobenzene and para-chloraniline.

Benzenediazobenzylanilide gives benzene, benzaldehyde, aniline, benzylaniline, and small quantities of diphenyl. Benzenediazopiperidide (565 grms.) yields benzene (122 grms.), diphenyl (23 grms.), piperidine, very small quantities of aniline, and a base which seems to have the composition C_5H_9N; the author names this base *isopiperidēine*, but it may be a mixture.

When benzenediazodimethylamide is dropped on to sand heated to 250°, it is decomposed, yielding benzene, diphenyl, dimethylamine, and small quantities of a liquid base, the nature of which has not been ascertained.—F. S. K.

The Injurious Action of Copper on Rubber. Engineer, 1891, 8.

Dewar observed, accidentally, that metallic copper when heated to the temperature of boiling water in contact with the rubber exerted a destructive effect upon it. With a view of finding whether this was due to the copper *per se*, or to its power of conducting heat more rapidly to the rubber, he laid a sheet of rubber on a plate of glass and on it placed four clean discs—one of copper, one of platinum, one of zinc, and one of silver. After a few days in an incubator at 150° F., the rubber under the copper had become quite hard, that under the platinum had become slightly affected and hardened at different parts, while the rubber under the silver and under the zinc was quite sound and elastic. This would lead one to infer that the pure metallic copper had exerted a great oxidising effect on the rubber, the platinum had exerted a slight effect, while the zinc and silver respectively had had no injurious influence on it. A still more curious result was this, that the rubber thus hardened by the copper contained no appreciable trace of copper; the copper, therefore, presumably sets up the oxidising action in the rubber without itself permeating it.

Discovery of Hydronitric Acid (N_3H). D. Mendeleef. J. Russ. Chem. Soc. **22**, 506—515.

The author regards the discovery of this new compound by Curtius as one of the most brilliant acquisitions of chemical science for the last year. It ought to throw considerable light on the whole field of little known metallic azo-compounds.

He considers hydronitric acid to be one of the nitriles of the ammonum salt of nitric acid.

Hydrates.	Ammonium Salts.	Nitriles.
Meta . . $N_2O_3H_2O$	NH_4NO_3	$-2\,H_2O = N_2O$
Pyro . . $N_2O_3\,2\,H_2O$	$NH_4NO_3NH_3$	$-3\,H_2O = N_3H$
Ortho . $N_2O_3\,3\,H_2O$	$NH_4NO_3\,2\,NH_3$	$-3\,H_2O = N_4H_4$

the first nitrite being the common nitrogen monoxide, the second hydronitric acid, and the third an ammonium salt of the latter.

Being a nitrile, its H ought to have the properties of that of an acid and not of ammonia, like that of the hydrogen in hydrocyanic acid, the nitrile of formic acid. Partly by induction and partly by analogy to hydrocyanic acid, the author predicts for hydronitric acid, phenomena of polymerism, of complex and double compounds, and of isomerism. Thus he expects its ammonium salt (N_3H_4) to form an amide $N(NH_2)(NH_2)N$ as ammonium cyanate $CNO(NH_4)$ forms amide $(NH_2)CO(NH_2)$.

The double potassium ferronitrates if existent ought to be characterised by their peculiar shades of colour; while the compounds corresponding to the Prussian blue ought to explode in the dry state.—N. W. T.

New Books.

Aids in Practical Geology. By Grenville A. J. Cole, F.G.S., Professor of Geology in the Royal College of Science for Ireland. London: Chas. Griffin and Co., Exeter Street, Strand.

This work, which is inscribed in "Memory of many Expeditions," to Arthur Wells Bawtree, is a practical guide for the discrimination of minerals and rocks. The author boldly advocates a judicious union of chemical analysis with palæontological research to this end, and on this principle his book is arranged. But in the scientific union referred to, the author is also by no means unmindful of the important aids afforded by spectroscopy and the microscopical examination of rock sections, which are included. Hence, to give the clearest idea of the scope of the book, and more especially to the practical man, it might be even better defined, as a work on practical mineralogy in which the aid of the science of palæontology is in a due degree made use of.

In the compilation the author admits indebtedness to the instruction and published papers, of Judd, as also to the works of Brush, Lacroix, Rosenbusch, Zirkel, and others.

The work is profusely illustrated with 136 woodcuts, and closes with an instructive and practical "Suggested List of characteristic Invertebrate Fossils," and an Alphabetical Index to the entire volume.

The text is subdivided as follows:—Part I. The Sampling of the Earth's Crust. II. The Examination of Minerals. III. The Examination of Rocks. IV. The Examination of Fossils. The price of the book is 10*s.* 6*d.*

Fuels, Solid, Liquid, and Gaseous, their Analysis and Valuation. For the Use of Chemists and Engineers. By H. Joshua Phillips, F.C.S. London: Crosby, Lockwood and Son, 7, Stationers' Hall Court, Ludgate Hill. 1891.

Small 8vo. volume, bound in cloth, price 3*s.* 6*d.* It contains Preface, Table of Contents, and Text covering 63 pages, containing also five wood engravings. The work treats of the following branches of the subject:—Methods of Analysis, Methods of Valuation, Tables, &c., and, finally, Analyses of

various Gaseous Fuels, such, *e.g.*, as American Natural Gas, Bessemer-Converter Gases, Blast-Furnace Gases, Blowhole Gases, Coal Gas, Gases occluded by Coal, Oil Gas, Siemens Producer-Gas, various Water-Gases. As stated in the Preface, "this little book comprises within small limits that which would otherwise have to be gleaned from widely-scattered sources and larger works, and the author's endeavour has been to make it a practical and theoretical help both to the chemist and the engineer."

Technisch-Chemisches Jahrbuch, 1889—1890. Ein Bericht über die Fortschritte auf dem Gebiete der Chemischen Technologie, vom April 1888 bis April 1889. Herausgegeben von Dr. Rudolf Biedermann, 12ter Jahrgang. Berlin: W. Carl Heymann's Verlag 1891.

Octavo volume, strongly bound in cloth and gilt-lettered, price 12*s*. The work contains Preface, Table of Contents, List of Abbreviated Titles of Works referred to in the text, 622 pages of subject-matter, including a copious Alphabetical Index of matter and authors. With the text are interspersed 300 wood engravings. A valuable review of New Books which have appeared during the session 1889—1890 is included—the subjects of such works covering the branches of Physics, Chemistry, Chemical Technology, Mineralogy, Geology and Botany.

The arrangement of the subject-matter is as follows:—I. Eisen. II. Alkali-metalle, Magnesium, Aluminium. III. Gold und Silber. IV. Kupfer. V. Blei. VI. Zink und Cadmium. VII. Zinn. VIII. Nickel und Cobalt. IX. Chrom und Mangan. X. Antimon, Arsen, Wolfram, Quecksilber, und Platin. XI. Chlor, Salzsäure. XII. Schwefel, Schwefligе Säure, Schwefel Säure. XIII. Wasserstoff, Wasserstoffsuperoxyd, Kohlensäure. XIV. Soda: 1. Kochsalz; 2. Sulfat und Soda. XV. Kaliumverbindungen. XVI. Ammoniak. XVII. Alkalische Erden. XVIII. Thonerde. XIX. Glas. XX. Thonwaaren. XXI. Cement. XXII. Künstliche Steine. XXIII. Explosivstoffe. XXIV. Leuchtstoffe. XXV. Heizstoffe. XXVI. Zucker. XXVII. Stärke und Stärkezucker. XXVIII. Wein. XXIX. Bier. XXX. Spiritus. XXXI. Fette, Harze, Seife, &c. XXXII. Wasser. XXXIII. Nahrungsmittel. XXXIV. Dungemittel, Abfalle, Disinfection. XXXV. Gerberei. XXXVI. Leim. XXXVII. Organische Säuren. XXXVIII. Alkaloide. XXXIX. Farbstoffe. XL. Gespinnstfasern, Bleichen, Färben, Drucken. XLI. Papier. XLII. Photographie. XLIII. Apparate. XLIV. Bücherschau.

An Introduction to the Study of Metallurgy. By W. C. Roberts-Austen, C.B., F.R.S., Chemist and Assayer to the Royal Mint, Professor of Metallurgy in the Royal College of Science, &c. London: Chas. Griffin and Co., Exeter Street, Strand. 1891.

Octavo volume, bound in cloth, price 7*s*. 6*d*. It contains frontispiece illustrating a Stamp Battery and Frue-vanner, Preface, Table of Contents, and text covering 286 pages. The work is concluded with an Alphabetical Index. The pages of the book are illustrated by 83 wood engravings.

The subject-matter is sub-divided as follows:—Chap. I. The Relation of Metallurgy to Chemistry. II. Physical properties of Metals. III. Alloys. IV. The Thermal treatment of Metals. V. Fuel. VI. Materials and Products of Metallurgical Processes. VII. Furnaces. VIII. Means of supplying Air to Furnaces. IX. Typical Metallurgical Processes. X. Economic considerations.

The Chapters on "Alloys" and "The Thermal Treatment of Metals" offer special interest.

Trade Report.

TARIFF CHANGES AND CUSTOMS REGULATIONS.

Customs Tariff of Nicaragua.

With reference to the statement published on pp. 640—51 of the *Board of Trade Journal* for December 1889, the following is a revised statement of the rates of import duty now levied under the Customs tariff of Nicaragua. This statement has been prepared by Mr. Marshall Vaughan, Her Majesty's Consul at Granada. The duty in each case is leviable per pound avoirdupois English weight, on the gross weight of the package, without any deduction whatever for cases or wrappers. When a package contains several distinct classes of goods the weight of the packing is distributed proportionately over each kind.

Note.—Peso = 2*s*. 10*d*. (about).

Articles.	Rates of Duty per English Pound.
Medicines, Drugs, and Apothecary's Sundries.	Pes. Cts.
Oils, olive, linseed, almond, castor, cocoanut, cod-liver, and any other similar oil	0·03
Acids, chlorhydric, muriatic, sulphuric, and nitric	0·03
Do., carbolic, acetic, and oxalic	0·05
Spirits of turpentine, and gaseous, mineral, and acidulated waters	0·02
White lead or carbonate of lead	0·04
Alum	0·02
Liquid ammonia or volatile alkali	0·03
Sulphur of any kind	0·03
Bicarbonate of soda or crystallised carbonate of soda	0·02
Borax	0·05
Chloride of lime	0·01
Medicinal barks	0·15
Chalk, pipeclay, &c.	0·02
All kinds of glass bottles and glass articles for chemists and druggists	0·05
Perfumed and medicinal essences	1·00
Glycerin	0·08
Gum arabic and shellac	0·15
Aromatic bitters	0·18
Soaps and syrups, medicinal	0·15
Syringes, syphons, and any other articles of india-rubber and gutta-percha	0·30
Syringes and other similar articles of metal, except gold and silver	0·10
Syringes and other similar articles of glass	0·05
Linseed and linseed flour	0·03
Cocoa butter	0·15
Fat for ointments and pomades	0·05
Medicines and drugs, in paste, powder, liquid gum, or any other form, prepared in any manner not otherwise specified	0·15
Oxide of zinc	0·04
Filtering paper	0·05

CUSTOMS TARIFF OF NICARAGUA—*continued.*

Articles.	Rates of Duty per English Pound.
	Pes. Cts.
Rosin	0·02
Epsom and glauber salts	0·02
Sal-ammoniac, chloride of ammoniac	0·05
Saltpetre or nitrate of potash	0·03
Medicinal seeds	0·15
Persian sherbet	0·05
Caustic soda	0·02
Sulphate of iron	0·01
Do. of zinc or white vitriol	0·02
Do. of copper	0·03
Do. of quinine	0·30
Do. of soda	0·05
Sticking plasters, cerecloths, &c.	0·25
Tinctures of all kinds, medicinal or not	0·15
Turpentine oil	0·10
Utensils for chemists and druggists of china, stone, or any other composition, such as mortars, basins, &c.	0·03
Vaseline, cosmoline, and petrolate	0·10
Poisons for tanning, killing insects, &c.	0·10
Medicinal wines, such as quinine, beef, &c.	0·15
MISCELLANEOUS ARTICLES.	
Mineral oils, such as petroleum or naphtha	0·01
Perfumed oils	0·10
Alcohol	Prohibited
Starch	0·03
Tar, pitch, and lampblack	0·02
Aniline and carmine	0·30
Varnish of all kinds	0·08
Earthenware, glazed or unglazed	0·01
Leather	0·27
Blacking for shoes, &c.	0·03

FRANCE.

Higher Duties on Chemicals.

The Tariff Commission has recommended that the duty on muriatic acid be raised from 30 to 37 cents. in the minimum list, and that a duty of 13 frs. and 9·50 frs., maximum and minimum respectively, be imposed on barium binoxide. Caustic soda is to pay 10 frs. and 8 frs. The duty in each case is the rate per 100 kilos.—*Chemist and Druggist.*

CANADA.

Fertilisers.

The law in Quebec as regards the importation, manufacture, and sale of fertilisers is very strict. Before any kind is offered for sale it must be approved of by the Government authorities, and the official analysis is kept for comparison with samples obtained any time within a year after the sale of the fertiliser has been authorised. In the case of fertilisers put up in packets, a copy of the Government analyst's certificate must be printed on each packet. Then every manufacturer or importer who sells or offers fertilisers for sale must register his name and address every year with the nearest Inland Revenue officer, and pay a registration fee of one dollar.—*Ibid.*

MISCELLANEOUS TRADE NOTICES.

PAPERS INTERESTING TO TECHNOLOGISTS.

The following articles in the *Board of Trade Journal* for January 1891 will repay perusal:—

"Beer in the Philippine Islands," p. 56, *seq.*
"Flax Industry of New Zealand," p. 80, *seq.*
"Mine Explosions in France," p. 89, *seq.*
"India as a Wool-producing Country," p. 96, *seq.*

RUSSIAN PETROLEUM TRADE.

The following is extracted from a report by the Belgian Consul General at Odessa, dated the 12th December:—

In 1881 there were extracted 40,500,000 poods of raw naphtha (pood is equivalent to 36 lb. avoirdupois) from which 12,800,000 poods of petroleum were derived. Since then the produce of the mineral oil has gone on increasing, as is shown by the following figures:—

—	Naphtha.	Petroleum.
	Poods.	Poods.
1882	50,500,000	13,500,000
1883	60,400,000	15,100,000
1884	90,800,000	22,000,000
1885	117,100,000	30,000,000
1886	151,200,000	35,000,000
1887	166,000,000	44,300,000
1888	194,000,000	51,000,000
1889	205,500,000	61,200,000

The working of naphtha wells, in the island of Apcheron, occupies at the present time 60 companies or associations.

The first place belongs to Nobel Brothers, whose production, in 1889, was 31,800,000 poods. Then come: The Caspian Company, with 24,400,000 poods; Tsatouroff and Co., 14,900,000; Tougieff, 14,000,000; Baku Naphtha Company, 13,200,000; Black Sea and Caspian Sea Company, 11,800,000 poods. These are the most important.

One hundred and sixty firms distilled naphtha in 1889. They produced 61,200,000 pouds of petroleum and 3,400,000 poods of lubricants.

The export from Baku of naphtha and its derivatives is effected by the Caspian Sea chiefly towards Russia, and by the Transcaucasian and Black Sea Railway.

The exports *viâ* the Caspian Sea were respectively:—

In 1888, 20,000,000 poods of petroleum, 600,000 poods of oils, 53,600,000 poods of residues, and 6,100,000 poods of naphtha.

In 1889, 23,800,000 poods of petroleum, 300,000 poods of oils, 82,200,000 poods of residues, and 3,500,000 poods of naphtha.

Those by the Transcaucasian and Black Sea Railway were:—

In 1888, 30,000,000 poods of petroleum, 2,000,000 poods of oils, 5,500,000 poods of residues, and 700,000 poods of naphtha.

In 1889, 37,300,000 poods of petroleum, 3,000,000 poods of oils, 6,400,000 poods of residues, and 300,000 poods of naphtha.

Of the exports from Batoum, 4,400,000 poods were sent to Russia, 7,500,000 poods to Turkey, 7,100,000 poods to Great Britain, 6,600,000 poods to Austria-Hungary, 1,700,000 poods to Belgium, and 1,300,000 poods to France.

Towards the extreme East, Russia exported 3,100,000 cases in 1888 and 4,300,000 cases in 1889.

Notwithstanding the competition of Russian petroleums, American production has steadily gone on increasing. In 1888 the United States exported 130,000,000 poods; in 1889 they reached the figure of 155,000,000 poods.

Norwegian Industries.

Norway is wealthier in nickel ores than any other European country, but only two mines are now working, producing from 100 to 130 tons per annum. The price of the metal, which in 1875 was 20 krōners per kilogramme, has now fallen to 4 kroners per kilogramme.

Notwithstanding the depression in the wood-pulp business, new mills are still building in this country, and the exportation of pulp shows a steady increase. At present the Norwegian mills number 54, and the production will probably soon exceed the demand. The exportation of mechanical pulp rose in 1889 to 200,000 tons from 100,000 tons in 1885, while that of chemical pulp was estimated at 35,000 tons, against 24,000 tons in 1888. The prices of the latter article, which was produced at 15 mills, 11 of which were for sulphite pulp and four for sulphate cellulose, were considered remunerative, notwithstanding the increasing price of the raw materials. The aggregate value of pulp exported in 1889 was estimated at 3,210,000 dols. America is still a heavy importer of Norwegian pulp, chiefly shipped by the direct Thingvalla line to New York, although her own production of wood pulp has more than trebled during the last 10 years.* The exportation of pulp from this district to the ports of New York, Boston, and San Francisco amounted, according to the declared exports, in 1889, to 17,872 tons, most of which was chemical pulp, against 17,954 tons in 1888.—*Board of Trade Journal.*

Opium Cultivation in the Chinese Province of Sz-Chuen.

The following account of the cultivation of opium in the Chinese province of Sz-Chuen appears in the last report by the United States Minister at Pekin:—

The growth of opium has in recent years assumed great importance in Eastern Sz-Chuen. The poppy is grown over vast areas, forming, in many instances, a regular winter crop of the bean and Indian corn lands. This crop is very profitable to the farmer, not only for the drug produced from the sap, but for the oil pressed from the seed, the lye manufactured from the ashes of the stalks and the leaves, which furnish food for pigs. Thirty catties of seed will yield 10 catties of superior oil for illuminating purposes or for food. Though it is doubtless chiefly for the opium produced that it is cultivated, it is said that the other products of the poppy would remunerate the grower. It is not difficult to raise, will mature in time to allow other crops to ripen on the same ground the same year, and the opium produced is readily converted into cash, all of which tends to make it popular with the farmer. The facility with which opium, on account of its convenient form and small bulk in comparison with its value, can be carried over the mountainous roads of Sz-Chuen, enabling the bearer to exade vexatious *likin* stations and to smuggle it duty free into neighbouring markets, tends also to make it an exceedingly profitable product. Some idea of the inducement to the smuggling can be formed when it is remembered that the Customs duty on imported opium is 110 taels per chest. A large percentage of that produced in Sz-Chuen evades all taxation whatever. The area under cultivation annually increases, and the drug of Sz-Chuen, with that of Manchooria, to which, however, it is inferior, constantly encroaches on the market of the Indian product.

The American Wood Pulp Trade.

Bradstreet's for the 29th November says:—

The American output of wood pulp has more than trebled within the past 10 years. It is now ardently expected by the manufacturers that they will not only be able to supply the home demand, but that the exports will soon be as large as the imports of the last few years. The new inventions and processes which are constantly being constructed are rendering it possible to use it in making all grades and styles of paper, and it is now found also that by mixing chloride of zinc with the pulp a substance as tough as wood is produced, which has been made into gas pipes, boxes, and boards suitable for roofing.

The enlargement of old mills and the construction of new ones to meet the increased demand is not confined strictly to the east, but is progressing as rapidly in the south and west. While the production of straw fibre has increased 76 per cent. since 1880, the production of wood pulp has increased 500 per cent. The process of making pulp was patented in 1858, and up to 1881, when the patent ran out, its manufacture was controlled by five firms. There are now 210 factories engaged in its manufacture, 183 producing it by the mechanical process, 15 by the soda, and 12 by the sulphite methods. Of the mills employing the mechanical process, 62 are in New York State, of which the majority are located among the Adirondack mountains. In the last three years 200,000 acres of spruce and hard timber have been cleared to supply these mills. These factories have a daily capacity of 969,800 pounds, or about three times the output of the 18 mills in the State of Maine.

But the chemical processes, of which there are now two, are rapidly gaining favour over the older and slower mechanical method. The chemical pulp mills are mostly in the east, principally in Maine, Massachusetts, and New York. They differ only as to the method of reducing the thin pieces of wood to fine threads, or, as it is generally known, pulp. One method employs an acid, and the other an alkali, to disintegrate the fibres. After the wood has been reduced to pulp, the substances used in effecting this result are then eliminated by processes which save from 70 to 80 per cent. of the chemical solution, which can thus be used over and over again in further manufacture.

It is claimed, after many careful tests by distinguished German chemists, that paper produced by the *mitscherlich* or sulphite process exceeds all other papers in strength, surpassing paper made from rags by from 17 to 27 per cent. in tensile tearing strength, but falling below this paper in elasticity by 38 to 58 per cent.

The presence of resinous matter in the pulp diminishes by so much the elasticity of the fibres, and as the strength of the paper depends upon the degree of elasticity of the fibres, recent inventions have been directed to attaining this result. The fact that the quality of paper made from pulp in this country has been steadily improving within the past two years is sufficient evidence that the various processes are rapidly reaching perfection. It is also becoming possible to use a larger per cent. of pulp in the manufacture of paper. While a few years ago the common newspaper contained but from 50 to 75 per cent. of pulp now it contains over 90 per cent. This has enabled printers to run their presses at a high rate of speed, for the greater the per cent. of pulp the faster will it absorb the ink.

For the nine months ending September 30th, 1890, the imports of wood pulp amounted to 1,182,193 dols.; for the same period of the preceding year it was but 497,454 dols., or about two-fifths as large. The value of the wood pulp imported during the last three years about equalled the imports of paper.

Mining and other Industries of Chili.

The following statistics of the mining industries of Chili are extracted from the last report of the Belgian Representative at Santiago:—

Different Mines.

The general exports of mineral products were less by 6,750,000 piastres in 1889 than in 1888; in fact this export represented, in 1888, 63,200,000 piastres, and in 1889, 56,450,000 only. The diminution is due to the low prices of copper and nitrates.

* See Report on American Wood Pulp Trade.

Copper.

From 1884 to 1888 Chili has exported about 1,402,000,000 kilos. of fine copper, worth about 467,500,000 piastres. Copper in bars was exported in 1888 to the value of about 14 millions; in 1889 hardly 6,000,000. During the first quarter of 1890 copper in bars to the value of 1,200,000 piastres only has been exported.

Iron and Coal.

The exports of manganese ores were valued in 1888 at 180,000 piastres; in 1889, 265,000 piastres; of mineral coal, in 1888, at 1,300,000 piastres, representing 128,000 tons; in 1889 they reached 146,000 tons, worth 1,315,000 piastres.

Saltpetre, Nitrates.

While, in 1889, the Customs revenue of Valparaiso, Talcahuano, Coquimbo, Coronel, Caldera, and Carrizal-Bayo fell off by reason of the diminution in the export of copper and wheat, that of Iquique, Pisagua, Antofagasta, Taltal, and Tocopilla increased by reason of the advance in the export of nitrates.

In 1888, 785,000,000 kilos. of nitrates were exported with a value of 34,000,000 piastres, and in 1889, 921,000,000 kilos., worth 36,000,000 piastres; in 1888, 91,000 kilos. of iodine, worth 900,000 piastres, and in 1889, 200,000 kilos., worth about 2,000,000 piastres.

In the first four months of 1890 the export of nitrates aggregated about 248,000,000 kilos., worth nearly 9,000,000 piastres, paying 3,000,000 duties, and more than 2,000,000 surtax; in May the export and sale were 1,990,500 kilos., worth from 2·47½ to 2·65 piastres per kilogramme. During the year 1889 the port of Iquique shipped 440,000,000 kilos. of nitrates.

The Mineral Wealth of Canada.

The annual volume of statistics collected by the Geological Survey of Canada has, says the *Canadian Gazette*, just been issued at Ottawa. The mineral output of the country in the past year is valued at 3,909,000*l.*, showing an increase of 600,000*l.* for the twelve months. There was an increase of 60,000*l.* in the value of minerals exported, which reached a total of 883,834*l.* More than 80 per cent. of this, amounting to 750,670*l.*, went to the United States, while this country took minerals valued at 84,471*l.*, and 30,662*l.* worth went to Newfoundland. The mineral exports included (in value) gold, 121,850*l.*; asbestos, 72,000*l.*; iron and steel, 62,000*l.*; gypsum, 39,000*l.*; copper, 33,691*l.*; phosphates, 78,953*l.*; silver, 42,230*l.*; lime and cement, 32,251*l.*; petroleum, 2,151*l.*; mica, 6,100*l.*; iron ore, 7,973*l.*; manganese, 5,870*l.*; sand and gravels, 10,530*l.*; salt, 478*l.*; and slate, 660*l.*; with 9,915*l.* worth of wrought and unwrought stone, and 1,257*l.* worth of glass and glass ware.

Far the most important in the list of Canadian minerals, however, was coal, of which 2,719,478 tons were produced, and 665,315 tons were exported, the values being 1,116,836 and 466,981*l.* respectively. The coal production showed an increase of 61,344 tons and 65,000*l.*, but the average increase of the past few years was not maintained. The quantity produced by the Nova Scotian mines, indeed —1,967,032 tons—was less than the previous year's output by 22,000 tons; and the North-West Territories fell off to the extent of 17,760 tons, bringing their figure down to 97,364. On the other hand, British Columbia's 649,409 tons were over 100,000 tons more than in the previous year. No less than 1,600,021*l.* worth of coal was imported to the Dominion, anthracite contributing most largely to this amount.

The total value of minerals and mineral products imported by the Dominion during the year was 5,130,533*l.*, including iron and steel, 1,930,130*l.*; petroleum, 101,199*l.*; paints, 106,670*l.*; lead, 71,346*l.*; tin, 266,913*l.*; salt, 61,212*l.*; glass and glass ware, 251,532*l.*; brass and copper, 198,359*l.*; building stone, 41,221*l.*; precious stones, 31,989*l.*; marble, 21,819*l.*; zinc, 21,219*l.*; asphalt, 6,710*l.*

The Sudbury Nickel Deposits in Canada.

The *Canadian Gazette* says that the commissioners appointed by the United States naval authorities to visit and report upon the nickel-bearing districts of Canada have presented their report to the Washington authorities. It is dated October 14th, 1890, and is signed by Commodore William F. G. Folger, Chief of the Bureau of Ordnance, and Lieutenant B. H. Buckingham, an officer of the department, and furnishes a valuable confirmation of previous unofficial reports upon the wealth of nickel-bearing ores in the Sudbury district. These extracts from the report will indicate its general character:—

We are fully convinced, from the surface indications and the shafts already sunk, that they have an amount of mineral which cannot be exhausted by this generation. The deposits of nickel lie between walls of granite and diorite, and are easily to be distinguished, showing that there was absolutely no danger of the commissioners being deceived by mere surface indications.

But not only is the ore easily distinguished, it is easily handled when branch railways are built to the mines. The report states that the country for hundreds of miles is broken by rocky ridges from 100 to 600 feet high, with bare rocks cropping out in many places and the rest covered by a thin soil upon which are pine forests. "Between the hills are marshy valleys and numerous lakes and streams capable of furnishing abundant water-power." And again:—"It is important to notice, from an economic point of view, that these ores can be smelted in their natural state—that is, they do not require the admixture of fluxing substances. The dead pine timber found in great abundance in the neighbourhood, and which can be delivered at the furnace at 1 dol. 80 cents a cord, is a good fuel for roasting, though hardwood would be better, but owing to the fusible qualities of the ores and the intermixed rock, it answers the purpose. Coke is hence the only material that has to be brought from abroad. This is procured from Pittsburg, and can be delivered at the works at 7 dols. a ton."

The report closes with a summary in figures. The commissioners give an "estimate of tons of ore above the surface of the ground in deposits seen by us—650,000,000." That is, as the Toronto *Globe* puts it, an amount equal to five times all the iron that has been taken out of the rich mines of the Lake Superior district (United States side) in the whole 40 years of their working. If this ore were raised and shipped it would give more than three times as much freight as the whole of the railways of Canada have raised since the first locomotive began to run. The amount of ore taken from the mines up to October 1st is about 175,000 tons. The daily crushing capacity of the machinery at work on the ground is about 1,750 tons, and the daily furnace capacity of matter is about 100 tons.

Mineral Wealth of New South Wales.

A volume, entitled "The Wealth and Progress of New South Wales, 1889—90" by Mr. T. A. Coghlan, Government Statistician, has recently been issued from the Government press at Sydney.

In that section of the book dealing with mines and minerals, the following table is published showing the approximate number of persons actually engaged in the principal departments of mining during each of the past seven years:—

Persons engaged Mining for	1883.	1884.	1885.	1886.	1887.	1888.	1889.
Gold	6,750	6,548	5,911	6,767	6,060	8,278	10,192
Silver and silver lead	..	45	929	1,297	1,670	4,215	6,587
Copper	1,913	1,746	1,000	622	503	1,214	542
Tin	4,100	2,850	3,395	2,814	3,188	3,499	1,234
Coal	5,481	6,227	7,097	7,847	7,998	9,301	10,277
Shale	293	116	324	100	120	253	138
Total	18,537	17,532	18,656	19,447	19,539	26,760	28,970

There were also 47 men engaged in mining for bismuth, 90 iron miners at Lithgow, and 77 men mining for various other minerals, making a total of 29,184 miners at work in 1889, representing with their families a population of about 138,000 persons directly dependent upon mining for a livelihood.

The summary here under shows the quantity and value of the products of the various minerals since their first discovery, as well as the quantity won in the year 1889. It will be seen that the colony has produced various minerals of the total value of over 75½ millions sterling:—

Minerals.	During the Year 1889.		To the end of the Year 1889.	
	Quantity.	Value.	Quantity.	Value.
	Oz.	£	Oz.	£
Gold	119,759	434,070	10,092,356	37,614,887
Silver	416,895	72,001	3,714,996	751,535
	Tons.		Tons.	
Coal	3,655,632	1,632,849	46,803,383	22,787,156
Shale	40,561	77,667	556,682	1,234,149
Tin	..	207,670	..	5,362,643
Copper	..	122,444	..	3,278,021
Iron	..	..	..	265,465
Antimony (metal)	66	3,344	557	73,501
„ (ore)	155		3,548	
Bismuth	42	11,349	165	35,836
Silver-lead ore	81,545	1,899,197	140,242	4,168,397
Lead (pig)	523	6,711	523	6,711
Oxide of iron	489	1,329	489	1,329
Sundry minerals	..	1,707	..	44,763
Total value	..	4,170,318	..	75,625,319

BOARD OF TRADE RETURNS.

Summary of Imports.

	Year ending 31st December	
	1889.	1890.
	£	£
Metals	22,084,845	23,710,901
Chemicals and dyestuffs	8,635,378	8,190,389
Oils	7,122,998	6,991,653
Raw materials for non-textile industries	13,691,671	11,626,155
Total value of all imports	427,595,142	420,885,625

Summary of Exports.

	Year ending 31st December	
	1889.	1890.
	£	£
Metals (other than machinery)	40,214,429	45,251,431
Chemicals and medicines	7,932,921	8,918,591
Miscellaneous articles	33,071,211	34,541,171
Total value of all exports	248,935,195	263,542,509

Imports of Metals for Year ending 31st December.

Articles.	Quantities.		Values.	
	1889.	1890.	1889.	1890.
			£	£
Copper:—				
Ore ..... Tons	136,514	111,028	1,050,348	902,798
Regulus ..... „	113,219	104,307	3,163,088	3,008,150
Unwrought .... „	38,659	49,473	2,035,036	2,766,059
Iron and steel:—				
Iron ore ..... „	4,023,620	4,469,390	3,121,357	3,586,456
Iron bolt, bar, &c. „	111,803	92,899	1,031,102	925,318
Steel, unwrought.. „	10,870	8,144	96,865	85,442
Lead, pig and sheet „	145,451	158,649	1,878,850	2,099,046
Pyrites ..... „	643,879	656,881	1,210,961	1,219,488
Quicksilver ..... Lb.	5,074,813	1,455,733	562,227	588,761
Tin ..... Cwt.	605,735	540,769	2,815,049	2,547,316
Zinc ..... Tons	56,842	56,205	1,084,101	1,288,358
Other articles ...Value £	..	..	4,032,861	4,633,709
Total value of metals	..	..	22,084,845	23,710,901

Imports of Chemicals and Dyestuffs for Year ending 31st December.

Articles.	Quantities.		Values.	
	1889.	1890.	1889.	1890.
			£	£
Alkali ..... Cwt.	47,405	37,341	31,693	29,240
Bark (tanners, &c.) „	463,766	579,438	207,347	263,259
Brimstone ..... „	736,055	568,641	172,076	120,470
Chemicals..... Value £	..	..	1,416,426	1,441,909
Cochineal ..... Cwt.	8,695	7,808	50,297	51,067
Cutch and gambier Tons	25,107	27,445	678,548	717,820
Dyes:—				
Aniline ..... Value £	..	..	272,329	264,538
Alizarine ..... „	..	..	317,641	307,832
Other ..... „	..	..	21,066	22,603
Indigo ..... Cwt.	90,483	81,841	1,783,256	1,521,369
Madder ..... „	14,139	11,373	17,139	15,545
Nitrate of soda.... „	2,351,310	2,177,842	1,102,583	903,632
Nitrate of potash . „	328,533	312,757	287,322	282,089
Valonia ..... Tons	31,361	25,272	454,405	501,869
Other articles... Value £	..	..	1,822,347	1,738,367
Total value of chemicals	..	..	8,635,378	8,190,389

IMPORTS OF OILS FOR YEAR ENDING 31ST DECEMBER.

Articles.	Quantities.		Values.	
	1889.	1890.	1889.	1890.
			£	£
Cocoa-nut..... Cwt.	218,470	184,409	278,057	261,083
Olive ..... Tuns	22,954	20,187	818,352	785,787
Palm ..... Cwt.	1,019,077	873,923	1,078,605	1,000,535
Petroleum ..... Gall.	102,647,478	104,809,146	2,593,173	2,389,269
Seed ..... Tons	17,127	22,810	463,554	611,894
Train, &c..... Tuns	21,051	20,302	442,689	419,296
Turpentine ..... Cwt.	408,074	424,453	662,681	644,886
Other articles .. Value £	..	..	785,877	878,303
Total value of oils ...	..	..	7,122,998	6,991,653

IMPORTS OF RAW MATERIALS FOR NON-TEXTILE INDUSTRIES FOR YEAR ENDING 31ST DECEMBER.

Articles.	Quantities.		Values.	
	1889.	1890.	1889.	1890.
			£	£
Bark, Peruvian .. Cwt.	129,600	116,811	430,563	341,377
Bristles..... Lb.	3,337,443	2,988,100	471,451	443,200
Caoutchouc..... Cwt.	236,274	264,009	2,612,704	3,265,088
Gum :—				
Arabic..... „	65,368	52,790	243,117	159,704
Lac, &c..... „	78,602	91,834	276,274	389,538
Gutta-percha .... „	48,042	70,176	576,896	798,296
Hides, raw :—				
Dry..... „	575,158	455,098	1,573,132	1,191,240
Wet ..... „	647,250	584,948	1,500,455	1,323,176
Ivory..... „	12,051	14,349	573,470	755,164
Manures :—				
Guano..... Tons	26,804	28,005	190,783	167,181
Bones..... „	62,855	69,949	310,263	372,048
Paraffin..... Cwt.	314,086	499,489	373,185	636,600
Linen rags..... Tons	42,470	34,889	426,614	354,306
Esparto..... „	215,723	217,048	1,083,518	1,045,742
Pulp of wood .... „	121,534	137,837	688,571	766,742
Rosin..... Cwt.	1,337,844	1,627,446	295,451	376,841
Tallow and stearin „	1,243,006	1,385,517	1,644,946	1,729,349
Tar ..... Barrels	134,524	181,141	99,849	129,831
Wood :—				
Hewn ..... Loads	2,389,491	2,278,374	5,635,118	5,004,554
Sawn ..... „	5,318,750	4,778,314	13,142,333	11,092,221
Staves ..... „	170,155	155,995	694,115	669,243
Mahogany ..... Tons	39,858	39,842	354,479	360,965
Other articles....Value £	..	..	10,497,384	10,253,876
Total value	..	..	43,694,671	41,626,155

Besides the above, drugs to the value of 863,534*l.* were imported as against 816,500*l.* in 1889.

EXPORTS OF METALS (OTHER THAN MACHINERY) FOR YEAR ENDING 31ST DECEMBER.

Articles.	Quantities.		Values.	
	1889.	1890.	1889.	1890.
			£	£
Brass..... Cwt.	107,663	106,298	486,049	502,282
Copper :—				
Unwrought ..... „	650,713	901,872	1,536,917	2,634,803
Wrought..... „	309,300	269,540	932,463	915,874
Mixed metal .... „	306,459	350,473	817,430	1,004,837
Hardware ..... Value £	..	..	2,989,188	2,765,340
Implements..... „	..	..	1,253,093	1,340,059
Iron and steel..... Tons	4,186,182	4,001,579	29,142,129	31,582,172
Lead ..... „	52,040	55,536	757,830	812,159
Plated wares... Value £	..	..	438,232	403,948
Telegraph wires, &c. „	..	..	1,038,540	1,602,263
Tin ..... Cwt.	108,583	102,551	522,750	503,333
Zinc ..... „	132,862	164,428	103,834	162,998
Other articles .. Value £	..	..	895,974	1,021,366
Total value	..	..	40,914,429	45,251,434

EXPORTS OF MISCELLANEOUS ARTICLES FOR YEAR ENDING 31ST DECEMBER.

Articles.	Quantities.		Values.	
	1889.	1890.	1889.	1890.
			£	£
Gunpowder..... Lb.	10,679,600	10,448,600	273,700	252,745
Military stores.. Value £	..	..	1,171,633	1,350,935
Candles..... Lb.	12,669,100	13,549,000	231,397	261,483
Caoutchouc ..... Value £	..	..	1,125,555	1,224,603
Cement..... Tons	631,660	627,870	1,231,649	1,282,426
Products of coal Value £	..	..	1,111,825	1,416,822
Earthenware ... „	..	..	2,089,467	2,047,050
Stoneware ..... „	..	..	197,221	189,446
Glass :—				
Plate..... Sq. Ft.	3,896,673	3,059,195	243,127	189,784
Flint..... Cwt.	121,166	112,503	275,059	260,795
Bottles..... „	982,388	932,705	464,742	436,070
Other kinds.... „	216,983	200,924	164,407	179,292
Leather :—				
Unwrought .... „	143,099	153,110	1,313,830	1,388,024
Wrought ..... Value £	..	..	413,874	349,866
Seed oil..... Tons	68,629	65,126	1,490,594	1,499,115
Floor cloth ..... Sq. Yds.	17,195,200	16,615,900	819,124	782,702
Painters' materials Val. £	..	..	1,558,579	1,577,080
Paper ..... Cwt.	989,383	966,312	1,764,423	1,681,110
Rags..... Tons	58,860	53,888	473,254	404,658
Soap..... Cwt.	493,392	497,067	503,465	534,523
Total value	..	..	33,071,211	34,541,171

EXPORTS OF DRUGS AND CHEMICALS FOR YEAR ENDING 31ST DECEMBER.

Articles.	Quantities.		Values.	
	1889.	1890.	1889.	1890.
			£	£
Alkali..... Cwt.	6,032,200	6,334,506	1,572,922	2,088,303
Bleaching materials ,,	1,524,600	1,735,841	563,313	506,157
Chemical manures. Tons	328,155	318,511	2,050,170	2,070,246
Medicines..... Value £	..	..	971,415	1,047,387
Other articles... ,,	..	..	2,775,101	3,236,298
Total value	..	..	7,932,921	8,948,391

SULPHATE OF AMMONIA.

Production, Deliveries, and Exports during Five Years, 1886—1890.

—	1890.	1889.	1888.	1887.	1886.
Production :—	Tons.	Tons.	Tons.	Tons.	Tons.
England, Scotland, and Ireland, from all sources	140,000	132,000	122,800	113,700	106,500
Deliveries and exports :—					
Germany, Denmark, Sweden, Russia, &c.....	31,000	32,000	32,000	33,000	34,000
France, Spain, and Italy ..	17,000	18,000	19,000	21,000	16,000
Belgium and Holland	23,000	20,000	18,000	16,000	19,000
America and Colonies.....	19,000	17,000	14,000	11,500	10,000
Home consumption for agricultural and chemical purposes (including the liquor used in various processes of manufacture)	44,000	40,000	31,500	30,100	25,500
Stocks at works.....	6,000	5,000	8,500	1,800	2,000
	140,000	132,000	122,800	113,700	106,500

—*Bradbury and Hirsch.*

QUICKSILVER.

—	Imports.	Exports.	Price. Highest.	Price. Lowest.
	Bottles.	Bottles.	£ s. d.	£ s. d.
1890	59,410	61,465	10 6 6	8 18 0
1889	67,964	57,568	9 12 0	7 7 0
1887	61,212	62,476	11 5 0	6 10 0
1885	55,153	48,823	6 15 0	5 10 0
1883	54,520	48,567	5 17 6	5 2 0
1881	56,261	24,842	7 0 0	6 2 6

Estimated consumption, United Kingdom, 12,000 bottles per annum.

Monthly Patent List.

* The dates given are the dates of the Official Journals in which acceptances of the Complete Specifications are advertised. Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the said dates.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

APPLICATIONS.

1890.

20,445. E. A. Cowper. Improvements in the method and apparatus for drying air for metallurgical and other processes. December 15.

20,606. R. J. M. Regnault. Improvements in gas furnaces for use in glass and other works. Complete Specification. December 17.

20,834. F. C. Nunn. Improvements in apparatus for purifying water. December 20.

20,844. J. L. Wade. An improved indestructible compound for protecting boilers, pipes, cylinders, and other like bodies, and preventing radiation. December 20.

20,951. J. A. Drakenberg. A mode of and apparatus for separating fat, grease, or other impurities from the feed-water of steam boilers and other water. December 23.

20,955. O. Clausen. A manufacture of porous magnesian bricks for the linings of stoves, furnaces, fireplaces, and flues, and the construction of stoves and furnaces with such bricks. December 23.

1891.

84. C. G. Mayer. Improvements in or appertaining to refrigerating apparatus. Complete Specification. January 2.

101. W. H. Willcox. Improved filter for oils, lubricants, and other fluids. January 2.

381. C. Herzog. An improved pump, specially applicable to thick or viscous fluids. January 8.

384. E. Crowe, R. Howson, and G. Dyson. Improvements in or relating to multiple-effect evaporating apparatus, applicable for the manufacture of salt from its solution, and the concentration or evaporation of other liquids. January 8.

COMPLETE SPECIFICATIONS ACCEPTED.*

1889.

20,792. A. Lusuardi and A. Falco. Pressure and vacuum gauges. December 31.

1890.

1307. A. Capillery. Apparatus for filtering liquids. January 14.

2070. C. A. Sahlström and A. F. Hill. Furnaces for burning liquid fuel. January 14.

2218. R. Marshall and E. FitzGerald. Surface condensers. January 21.

2313. T. Wrigley. Mechanical stokers. January 21.

2427. A. Fryer. Process and apparatus for evaporating solutions or liquids. January 14.

2502. W. R. Renshaw. Apparatus for heating, cooling, and condensing fluids. January 21.

3186. J. Procter. Mechanical stokers. January 7.

4594. E. Jones. Apparatus for separating liquids or solids from vapours or gases in which they are suspended. January 21.

6460. J. von Langer and L. Cooper.—From G. Pietzka. Recuperators for utilising the waste heat of furnaces. January 21.

11,807. W. P. Thompson.—From A. Raps. Mercurial pumps. December 31.

16,761. W. P. Thompson.—From A. Mason and J. Wilson. Process and apparatus for effecting and maintaining combustion in secondary chambers of furnaces. January 14.

19,110. J. A. Morrell. Methods and apparatus for evaporating and concentrating solutions. January 21.

19,587. F. Soxhlet. Method of closing bottles suitable for sterilised liquids. January 7.

19,736. A. Hart. Vessels and appliances for boiling, infusing, steaming, washing, and bleaching. January 7.

20,606. R. J. M. Regnault. Improvements in gas furnaces for use in glass and other works. January 21.

II.—FUEL, GAS, AND LIGHT.

Applications.

1890.

20,752. V. B. Lewes. Improvements in the manufacture of hydrogen gas, or a mixture of hydrogen and carbon monoxide, and apparatus therefor. December 19.

1891.

23. J. O. Spong. Improved arrangement of apparatus for obtaining chromatic illumination from gas or other flame. January 1.

112. H. Williams, of The Illuminating, Heating, and Power Gas Co., Limited. Improvements in exhausters and blowers for gas or air. January 3.

179. A. S. Davy. Improved method of and apparatus for treating smoke and gases from furnaces and other fires. January 5.

340. C. F. Claus. Improvements relating to the manufacture and carburetting of hydrogen, and to apparatus therefor. January 7.

578. N. Bourgoin and H. Decoree. Improved apparatus for making gas. January 12.

660. J. H. W. Stringfellow. Improvements in the manufacture of artificial fuel. January 13.

764. D. Rylands and R. Potter. Improvements in flues or other similar means for conveying combustible gas from the producer to the point where such gas is consumed. January 15.

Complete Specifications Accepted.

1889.

19,310. J. Watts. Firelighters. January 14.

1890.

2559. H. S. Maxim and G. S. Sedgewick. Carburetting or enriching coal and other gas, and apparatus therefor. December 31.

6463. E. Neave. Method and apparatus for obtaining oxygen from the air. January 14.

9394. J. C. Chandler. Charging gas retorts, and apparatus therefor. January 7.

14,115. H. H. Lake.—From J. Lundström and Co. Manufacture of artificial fuel. January 14.

14,968. W. R. Lake.—From N. O. Goldsmith. Apparatus for withdrawing coke from ovens. December 24.

15,379. J. Platt. Apparatus for obtaining more perfect combustion of fuel in furnaces. January 21.

16,760. W. P. Thompson.—From A. Mason. Method and apparatus for burning coal and hydrocarbon fuel. January 7.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, ETC.

Applications.

1891.

249. H. E. Ryeroft and A. Mason. An improved process of and apparatus for distilling and refining petroleum and other hydrocarbons; applicable also for distilling and refining animal, vegetable, and fruit oils, saccharine juices, syrups, essential oils, and other substances. Complete Specification. January 6.

327. M. Bohm. Improvements in distilling crude petroleum, mineral oil, tar, and the like, and in apparatus therefor. Complete Specification. January 7.

844. F. Lennard. Improvements in and apparatus for distilling, more especially intended for distilling tar. January 16.

IV.—COLOURING MATTERS AND DYES.

Applications.

1890.

20,563. B. Willcox.—From The Farbenfabriken vormals F. Bayer and Co., Germany. Improvements in the manufacture of indigo carmine from glycocoll and its homologues and analogues. December 17.

20,845. H. H. Lake.—From Wirth and Co., agents of Kalle and Co., Germany. Improvements in the manufacture of colouring matters. December 20.

20,889. O. Imray.—From The Farbwerke vormals Meister, Lucius, and Brüning, Germany. Production of azo colouring matters. December 22.

21,102. O. Imray.—From The Farbwerke vormals Meister, Lucius, and Brüning, Germany. Production of compounds of gallic acid with primary bases. December 27.

21,205. T. Peters. Processes for the manufacture of red colouring matters. Complete Specification. December 30.

21,284. J. R. Geigy. Manufacture of diethyldibenzyl-diamidodiphenylmethan-disulpho acid and violet dyestuffs therefrom. December 31.

1891.

16. J. Reakes. Improvements in water stains for colouring or staining various surfaces. January 1.

517. C. R. Bonne.—From H. Köhler, Germany. Improved method of combining acetic radicles with aromatic amine. January 10.

551. J. Dawson and R. Hirsch. A new process for the production of colouring matters belonging to the induline series. January 12.

583. J. C. L. Durand, D. E. Huguenin, and A. J. J. d'Andiran. Manufacture of new colouring matters. Filed January 12. Date applied for June 13, being date of application in France.

857. S. Pitt.—From L. Cassella and Co. Improvements in new colouring matters from triphenylmethane. January 16.

COMPLETE SPECIFICATIONS ACCEPTED.

1890.

1828. B. Willcox.—From The Farbenfabriken vormals F. Bayer and Co. Manufacture of azo colouring matters. December 24.

3098. H. H. Lake.—From A. Leonhardt and Co. Manufacture of colouring matters. December 31.

3397. B. Willcox.—From The Farbenfabriken vormals F. Bayer and Co. Manufacture of alpha-naphthol sulpho acids and dioxy-naphthaline sulpho acids, and dyestuffs therefrom. January 14.

3398. B. Willcox.—From The Farbenfabriken vormals F. Bayer and Co. Manufacture of mordant dyeing azo colouring matters of the triphenylmethane group. January 14.

5155. The Clayton Aniline Co., Lim., and J. Hall. Manufacture of colouring matters. January 7.

18,526. J. Imray.—From La Société L. D. Huguenin et Cie. Manufacture of colouring matters obtained by the action of amines of the fatty series upon gallocy-anine. December 24.

V.—TEXTILES, COTTON, WOOL, SILK, ETC.

APPLICATIONS.

1890.

20,514. G. Broadhead and J. Clegg. Improvements in the treatment of spent tan for the production of fibrous material therefrom. December 16.

20,806. J. Longmore and R. Williamson. Improvements in the treatment of rhea and similar inelastic fibres. December 20.

21,230. J. W. Barker. Improvements in woven fabrics. Complete Specification. December 30.

1891.

92. C. W. Kimmins and T. Craig. *See* Class XII.

207. J. Lussiez et Cie. An improved apparatus for winding and dyeing wool or other textile materials. Complete Specification. January 5.

COMPLETE SPECIFICATIONS ACCEPTED.

1889.

20,314. H. A. Lowe. Treating or finishing materials from cotton or similar fibres containing cellulose. December 24.

20,665. C. Baswitz. Treating textiles by ammoniacal oxide of copper to render them waterproof and non-combustible. December 24.

1890.

18,018. A. J. Boult.—From G. Rudel. Treating vegetable materials to obtain textile fibres, and cellulose for use in the manufacture of paper. January 14.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

APPLICATIONS.

1890.

20,748. R. Holliday and Sons, Limited, and P. R. E. Seidler. Improvements in dyeing and printing with certain azo colouring matters. December 19.

21,062. C. E. Maistre and J. M. Compagne. Improvements in or connected with the dyeing of textile fabrics or materials with indigo, and in the manufacture of saponaceous matter employed therein; also applicable for other operations in which saponaceous material is required. December 24.

1891.

1. E. V. Goad and F. Redman. An appliance for use in dyeing, blueing, and starching clothes and the like. January 1.

86. C. S. Bedford. Improved process of dyeing or of fixing certain colouring matter on cotton and other kindred material. January 2.

207. J. Lussiez et Cie. *See* Class V.

478. H. A. Foster and J. Frost. Improvements in means and method of dyeing or colouring wool, silk, hair, fur, feathers, and other animal or vegetable fibres, or plain, cut pile, raised pile, or looped fabrics composed thereof. January 10.

595. W. L. Wise, from K. Schniter. A process of dyeing or treating fibres. January 12.

679. L. Kern. A method of preventing the escape of noxious gases in the processes of bleaching and otherwise treating textile materials. January 13.

COMPLETE SPECIFICATION ACCEPTED.

1890.

3009. S. D. Keene. Method and apparatus for bleaching, dyeing, &c. fibrous materials. December 31.

VII.—ACIDS, ALKALIS, AND SALTS.

APPLICATIONS.

1890.

20,775. J. Hawliczek. Improvements in and connected with the manufacture of bleaching powder. December 20.

21,071. A. Campbell, W. Boyd, and A. J. Kirkpatrick. Improvements in and connected with the treatment of crude bicarbonate of soda to obtain caustic soda, carbonic acid, and other products. December 27.

21,078. J. Leith. Improvements in the production of bicarbonate of soda and sulphuretted hydrogen, and in apparatus therefor. Complete Specification. December 27.

21,217. C. W. Heaton. Improvements in the treatment by the Claus process of gases containing sulphuretted hydrogen, and recovery of valuable products therefrom. December 30.

21,225. F. M. Lyte and O. J. Steinhart. Improvements in the production of chlorine and of strong hydrochloric acid. December 30.

1891.

266. J. Anderson and A. Braud. Improvements in the manufacture of alkalis and chlorine. January 6.

891. O. Imray.—From The Farbwerke Greisheim on Main, W. Noetzel and Co. Process for obtaining pure nitric acid direct in nitric acid reaction apparatus. January 17.

Complete Specifications Accepted.

1889.

20,078. A. Martignier. Extracting tartrate of lime contained in lyes, &c., and transforming it into cream of tartar or tartaric acid. December 24.

1890.

393. R. C. Wilson. Method and apparatus for evaporation of brine and manufacture of salt therefrom. January 14.

1584. F. Ellershausen. Manufacture of soda and potash. January 7.

3391. O. E. Pohl. Process and apparatus for manufacture of salt. January 21.

12,670. J. Simpson. Process and apparatus for treating minerals or slag containing phosphate of lime, for obtaining the latter in a concentrated form, with or without the production of alkali as a by-product. December 31.

VIII.—GLASS, POTTERY, and EARTHENWARE.

Applications.

1890.

20,121. D. Rylands and B. Stoner. Improvements in the manufacture of glass taps and glass tees and other hollow glass ware. December 15.

20,606. R. J. M. Regnault. Improvements in gas furnaces for use in glass and other works. Complete Specification. December 17.

20,857. G. Swift. Improvements in tiles, faience ware, and other fictile ware required to be cemented to plane or other surfaces. December 22.

20,866. D. Rylands and A. Husselbee. Improvements in glass measures, glass reservoirs or fountains, and other hollow glass ware, and in the process of manufacturing the same. December 22.

20,955. O. Clausen. A manufacture of porous magnesian bricks for the linings of stoves, furnaces, fireplaces, and flues, and the construction of stoves and furnaces with such bricks. December 23.

21,072. E. Arthur. An improved glaze or enamel for tiles, bricks, and like articles. December 27.

21,181. W. W. Pilkington. Improvements in furnaces and appliances for melting, fining, settling, and casting plate glass. December 30.

21,212. J. B. Alzugaray. Improvements in the manufacture of refractory materials or articles. December 30.

1891.

118. F. T. Pover. Improvements in or relating to ovens for the firing of bricks, tiles, potters' goods, and the like. January 3.

374. H. J. Godfrey. Improvements in the manufacture of soup, dinner, dessert, and other plates. January 8.

903. M. Bauer. Improvements relating to the manufacture of glass bottles and similar vessels, and to apparatus therefor. January 17.

Complete Specifications Accepted.

1890.

352. E. Robson. Making porcelain tablets or letters. January 14.

927. W. W. Pilkington. Kilns and machinery for annealing rolled plate and plate glass. December 24.

3203. C. Leigh. Coating and tinting glass surfaces. January 14.

18,609. J. Bond. Apparatus for drying bricks, &c. December 24.

20,606. R. J. M. Regnault. *See* Class 1.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, and CEMENTS.

Applications.

1890.

20,164. T. Curran. Improvements in portable plaster slabs, methods of making the same, and moulds therefor. Complete Specification. December 16.

20,782. W. Briggs. An improved marine cement. December 20.

20,918. C. G. Wernaer and O. Wernaer. Method of manufacturing artificial granite and marble. December 23.

21,278. E. Nutzinger. Improvements in asphalt pavements and coverings. December 31.

1891.

291. T. Potter. The construction of fire-resisting concrete floors and ceilings combined. Complete Specification. January 7.

524. T. D. Hayton. Improved means and apparatus for preparing paving and like slabs. January 10.

907. J. Sickler, L. G. Hamilton, and E. W. Dow. Improvements in the process of calcining gypsum. January 17.

Complete Specifications Accepted.

1890.

2896. W. Joy. Process and apparatus for manufacturing cement. December 31.

3413. W. T. Sier. Hardening and preparing soft porous stone for enamelling, &c. December 24.

17,795. F. Oschwald. New or improved building material. January 14.

18,459. C. S. Haensler. Fire and weather-proof roofing. December 31.

18,468. F. Jurschina and R. Ritter von Gunesch. Manufacture of artificial stone, and building blocks, &c. thereof. December 31.

18,732. A. Cajot. Apparatus for enriching phosphate of lime and phosphated chalks for the preparation of cements, marls, and starches. December 24.

18,924. A. F. E. de St. Dalmas. Improvements in paving blocks. December 31.

X.—METALLURGY, MINING, Etc.

Applications.

1890.

18,869A. A. Gutensohn. Improvements in apparatus for preparing metal plates and sheets for annealing, and for coating with tin or other metal. Originally included in No. 18,869, and therefore dated November 21.

20,415. H. R. Haigh. Improvements in the construction of furnaces for puddling or heating and other purposes. December 15.

20,419. J. McCracken. Improvements in making steel. December 15.

20,445. E. A. Cowper. *See* Class 1.

20,446. E. A. Cowper. Improvements in the method and apparatus for drying air for blast furnaces. December 15.

20,529. Williams, Foster, & Co., Limited, and S. W. Carlton. Improvements in apparatus suitable for the reduction of copper from its ores and other copper-bearing materials, such as regulus and mattes. December 16.

20,533. D. Brennan, jun. Improvements in apparatus for reducing ores. Complete Specification. December 16.

20,550. S. O. Cowper-Coles. Improvements relating to the coating or plating of metallic articles, and to apparatus therefor. December 16.

20,588. R. Martin and R. Evans. Improvements in means or apparatus employed in pressing or consolidating quantities of scrap metal. December 17.

20,609. A. Watt. Improvements relating to the extraction of zinc and lead from their ores. December 17.

20,666. H. Pritchard. Improvements in and connected with the manufacture or production of aluminium. December 18.

20,721. J. F. Hall. Improvements relating to the casting of ingots and other forms of metal. December 19.

20,768. G. J. Atkins and E. Applegarth. Improved means and apparatus for separating alkaline and earthy metals and other products from the salts of such metals, or from other substances containing them. December 19.

20,895. J. E. Bott. Improvements in the manufacture of armour plates and other similar articles. December 22.

20,944. S. Elliott. An improved method of condensing lead and other metallic fumes arising from furnaces. December 23.

20,951. O. Imray.—From L. A. F. Rang and M. C. A. Rutlin. A process for annealing iron plates, and removing oxide from their surface. December 23.

21,009. G. H. Smith and B. Cooper. An improved method of and means for casting white metal coupdings and other similar white metal objects required to stand confined pressure. December 24.

21,025. L. Mond. New or improved manufacture of articles of nickel, and of nickel-plated goods. December 24.

21,129. F. C. W. Harmsen. A new method of untinning the waste of tin plates by heating it with the liquid nitrate of potash or soda. Complete Specification. December 27.

21,221. W. D. Bohm. Improvements in and apparatus for the separation of gold and silver from ores or materials containing them. December 30.

21,222. F. Siemens. Improvements in the reduction of iron ore. December 30.

21,234 E. A. Bath. Utilisation of refuse or scoria of copper smelting furnaces as a grinding or polishing agent or as a substitute for emery. December 30.

21,266. B. C. Sykes and G. Blamires. Improvements in furnaces for heating steel wire in the process of hardening and tempering, and also for appliances for removing the oxide or bluing when formed. December 31.

1891.

37. J. B. Aizugaray. Improvements in fluxes for use in treating metals, ores, and the like. January 1.

165. A. Swiller. Improvements in the manufacture or production of metal plates hardened at one side. January 3.

205. C. Cochrane. An improvement in blast furnaces. January 5.

216. T. Langer. Improved fusible mass for case-hardening purposes. January 5.

213. D. Edwards. Improvements in apparatus used in the manufacture of tin, terne, and other coated metal plates. January 5.

214. D. Edwards. Improvements in apparatus used in the manufacture of tin, terne, and other coated metal plates. January 5.

215. D. Edwards. Improvements in apparatus used in the manufacture of tin, terne, and other coated metal plates. January 5.

251. W. R. Hinsdale. Process for forming ingots. Complete Specification. January 6.

275. H. Pike. Improvements in metallic alloys. January 6.

283. E. L. Mayer. Improvements in or connected with the extraction and recovery of gold. January 6.

500. R. Heathfield. Improvements in the process of coating metals. January 10.

516. A. Watt. Improvements in the treatment of copper ores. January 10.

557. A. E. Tucker and F. W. Harbord. Improvements in the removal of scale from iron or steel sheets, plates, or bars, and apparatus for the same. January 12.

652. O. B. Peck. An improved process for centrifugally treating particles of metallic or mineral-bearing substances of different degrees of specific gravity. Complete Specification. January 13.

673. O. B. Peck. Improvements in machinery for centrifugally treating particles of metallic or mineral-bearing substances of different degrees of specific gravity. Complete Specification. January 13.

674. O. B. Peck. Improvements in machinery for centrifugally treating particles of metallic or mineral-bearing substances of different degrees of specific gravity. Complete Specification. January 13.

795. J. E. Bott. Improvements in the manufacture of ferro-bronze and other alloys. January 15.

Complete Specifications Accepted.

1890.

1355. A. E. Haswell and A. G. Haswell. Coating iron, steel, nickel, tin, &c. to prevent corrosion. December 24.

1913. W. P. Thompson.—From E. Carez. Utilisation of scrap tin or terne plates, &c. January 21.

2002. G. Shenton.—From M. J. Berg. Production of aluminium. January 21.

3275. G. Simonin. Reduction of metallic ores. January 14.

3369. G. H. Cammell. Welding metals. January 7.

3532. W. Crookes. Amalgamating and extracting gold from refractory and other ores. January 14.

16,724. J. B. Renshaw. Manufacture of cast iron. January 21.

18,171. W. P. Thompson.—From M. F. Coomes and A. W. Hyde. Manufacture and tempering of steel. January 21.

18,601. L. L. Burdon. Compound gold wire. December 24.

18,915. W. P. Thompson.—From C. H. Laud. Manufacture of coated aluminium plates or surfaces, and application of same for coating or soldering to other metals. January 21.

19,163. H. W. Lash and J. Johnson. Reduction of ores. December 31.

19,179. J. C. Bayles. Uniting iron or steel plates or sheets by welded joints. December 31.

XI.—ELECTRO CHEMISTRY and ELECTRO-METALLURGY

Applications.

1890.

20,540. W. P. Thompson.—From C. L. Coffin. Improvements in welding metals electrically. Complete Specification. December 16.

20,632. S. O. Cowper-Coles. Improvements relating to the manufacture and coating of metallic articles by electro-deposition, and to apparatus therefor. December 17.

20,712. E. Ortelli. Improvements in and relating to electric batteries. December 18.

20,784. W. J. Eogledue. Improvements in metallic elements for galvanic batteries. December 20.

20,838. H. Birkbeck.—From O. Henrichsen. A new or improved dry couple or element for electrical purposes. December 20.

20,986. H. H. Lake.—From H. Lemp, United States. Improvements in apparatus for electrically welding and otherwise working metals. Complete Specification. December 23.

21,031. P. J. Davies. Improvements in the production of lead plates for secondary batteries, and the connections, straps, or lugs to the same. December 24.

1891.

49. W. Wensky. Element and process for producing constant electric currents. Complete Specification. January 1.

223. W. H. Todd. Improvements in primary electrical batteries. January 6.

400. T. D. Bottom. Improvements in and relating to the desilverisation of lead, and simultaneous manufacture of white lead by electrolysis of argentiferous lead. Complete Specification. January 9.

593. T. Coad. Improvements in electric primary batteries. January 12.

667. W. P. Thompson.—From The Hess Electric Storage Battery Co., United States. Improvements in electrodes for voltaic accumulators. Complete Specification. January 13.

668. W. P. Thompson.—From The Hess Electric Storage Battery Co. Improvements in or appertaining to voltaic accumulators. Complete Specification. January 13.

743. W. O. Rooper. Improvements in the application of electricity for mining purposes. January 15.

884. C. Wells. Improved apparatus for the production of electricity. January 17.

887. The Electrical Inventions Co., Limited, and A. Andreoli. Improvements in or relating to the electrochemical extraction of gold, silver, and other precious metals from their ores. Complete Specification. January 17.

899. H. T. Eager and R. P. Milburn. Improvement in electric cells or batteries. January 17.

Complete Specifications Accepted.

1890.

1246. D. G. FitzGerald and A. C. Falconer. Electrolytic generation of chlorine and compounds of chlorine with earthy bases, more especially for bleaching purposes. December 31.

1306. C. Smith.—From W. L. F. Hellesen. Galvanic dry elements. January 14.

2091. W. P. Thompson.—From The Gibson Electric Co. Secondary batteries and plates or elements therefor. January 14.

2845. E. T. Mackrill. Secondary batteries. January 21.

7186. W. P. Thompson.—From C. L. Coffin. Process and apparatus for welding metals electrically. December 24.

13,557. T. S. E. Dixon. Secondary batteries. January 21.

16,064. J. K. Pumpelly and F. Butterworth. Electrical batteries. January 14.

16,346. S. C. C. Currie. Apparatus for use in the distribution of electricity by storage batteries. December 24.

18,491. R. Kennedy. Dynamo-electric machines. January 7.

18,625. H. H. Lake.—From H. Lemp. Apparatus for electric welding, forging, &c. December 24.

18,631. H. H. Lake.—From E. Thomson. Welding metals by electricity. December 24.

19,155. H. H. Lake.—From G. E. Hatch. Electrical storage batteries. January 21.

19,162. M. W. Dewey. Electric welding and metal working. December 31.

XII.—FATS, OILS, AND SOAP MANUFACTURE.

Applications.

1890.

21,112. H. Harford. An improved lubricant. December 27.

21,196. J. W. Evans. Improvements in the naphtha process of extracting oil. Complete Specification. December 30.

1891.

59. H. Wilkinson. Improvements in the purification of oils and fats. January 1.

92. C. W. Kimmins and T. Craig. Improvements in the separation or treatment of fatty or greasy matters from the wash-waters of wool-washing or scouring establishments. January 2.

101. W. H. Willcox. *See* Class I.

Complete Specification Accepted.

1890.

983. H. Grimshaw. Soap and soap-powder for use with hard and sea waters. December 24.

XIII.—PAINTS, PIGMENTS, VARNISHES, AND RESINS.

Applications.

1890.

20,690. A. van Winkle and E. N. Todd. Improvements in protecting sheets of gelatin by pyroxiline or nitrocellulose varnishes. Complete Specification. Filed December 18. Dated applied for, June 6, being date of application in United States.

20,966. G. Stevens. Improvements in anti-fouling or corrosive compositions or paints. December 23.

1891.

169. N. B. Dennys. Improvements in anti fouling paint for submerged surfaces of wood and metal. January 5.

684. W. Astrop and F. H. Parker. Improvements relating to the manufacture of carbonate of lead or white lead, and to apparatus therefor. January 13.

Complete Specifications Accepted.

1890.

985. H. Grimshaw. A new white pigment. December 24.

1821. C. B. Phillips and H. R. Lewis. Application of metallic copper to the hulls of vessels or to submerged structures, to prevent fouling thereof, and manufacture of compositions or pigments to be used for this purpose. January 21.

18,609. J. Bond. Transferred to Class VIII.

XIV.—TANNING, LEATHER, GLUE, AND SIZE.

Applications.

1890.

20,514. G. Broadhead and J. Clegg. *See* Class V.

20,827. J. Pullman. An improved process for treating and colouring leather. December 20.

1891.

601. A. J. Boult.—From M. M. Rotten, Germany. Improvements in the manufacture of a light coloured product containing albumen and globuline from blood. January 12.

Complete Specification Accepted.

1890.

9042. O. Potelune, J. Rivet, L. Rivet, and L. Sautour. Apparatus for treating skins. January 14.

XV.—AGRICULTURE AND MANURES.

Complete Specifications Accepted.

1889.

20,076. H. Fewson. Method of nitrogenising substances in the manufacture of manures. December 24.

1890.

16,793. J. Patterson. Fertilising compounds. January 14.

XVI.—SUGARS, STARCHES, GUMS, Etc.

Applications.

1890.

21,066. A. Boake and F. G. A. Roberts. An improvement in the manufacture of caramel. December 24.

21,101. F. W. Tompson. An improvement in the manufacture of invert sugars. December 27.

1891.

581. H. H. Leigh.—From W. V. Fry, Peru. Process for the defecation of sugar-cane juice. January 12.

XVII.—BREWING, WINES, SPIRITS, Etc.

Applications.

1890.

20,430. P. L. F. E. Vignier. Improvements applicable to the manufacture of pure grape spirit, and apparatus used for the same or other spirits, and also the ageing of the same. Complete Specification. December 15.

20,803. T. Fletcher. *See* Class XVIII. A.

20,909. G. Keng. A yeast tube for conveying yeast from beer in casks during course of fermentation. December 23.

20,985. H. H. Lake.—From H. Götter, United States. Improvements relating to the manufacture of fermented liquids, and to apparatus therefor. Complete Specification. December 23.

1891.

654. D. Quertain and H. Becker. Improvements in the process of and apparatus for brewing beer. Filed January 13. Date applied for June 14, 1890, being date of application in Belgium.

852. F. König. Process and apparatus for the manufacture of champagne and other beverages charged with carbonic acid. January 16.

Complete Specifications Accepted.

1890.

2990. H. S. G. Stephenson. Apparatus for generating and supplying carbonic acid gas to vessels containing fermented liquor. January 21.

14,118. G. Roskilly. Composition for refining and heading malt liquors. January 14.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

Applications.

1890.

A.—Chemistry of Foods.

20,411. E. Sonstadt. Improvements in stoppering or closing vessels containing solid or liquid articles of food or other organic matters, in order to exclude micro-organisms, and in sterilising such matters conjointly with the stoppering. December 15.

20,593. The Denaeyer's Peptonoids and Extract of Meat Co., Limited.—From A. F. Denaeyer. An improved preparation of meat and method of making the same. December 17.

20,640. W. Budenberg. Improvements in sterilising milk and other substances. December 17.

20,678. A. Farr and A. Velluet. The effectual preservation of meat, poultry, game, fruits, vegetables, and all other perishable articles from putrefaction and decay without deterioration of flavour or quality. December 18.

20,803. T. Fletcher. Improvements in the preparation of diastase for use in the manufacture of bread and biscuits, and for other purposes. December 20.

20,946. L. Bregha and F. Breza. Improvements in the process of and in the apparatus for preserving articles of food. Complete Specification. December 23.

21,006. E. Sonstadt. Improvements in obtaining an extract of malt and hops, and in preparing a confection of the same. December 24.

21,019. E. Sonstadt. Improvements in making an extract of coffee and confection of the same, and in preserving liquid coffee extracts. December 24.

21,068. E. G. N. Salenius. Improvements relating to the manufacture of butter, and to churns or apparatus therefor. Complete Specification. December 24.

21,106. E. Sonstadt. Improvements in making an extract of tea and a confection of the same, and in preserving liquid tea extracts. December 27.

21,213. W. H. Lever, J. D. Lever, and E. G. Scott. New or improved process for recovering the mustard from mustard dross, or for obtaining the mustard with little or no waste from the seed. December 30.

1891.

625. G. W. Patterson. Preservation of food. January 13.

B.—Sanitary Chemistry.

1890.

20,996. F. P. Candy. Improvements in the method of, and in means for, treating sewage and impure waters. December 24.

1891.

44. H. Fewson. Improvements in the treatment of sewage and other foul matters. January 1.

502. J. E. Keirby. Improvements in apparatus for feeding or supplying precipitating, deodorising, or purifying materials or chemicals in the treatment of sewage or other foul liquids, and for other analogous purposes. January 10.

COMPLETE SPECIFICATIONS ACCEPTED.

A.—Chemistry of Foods.

1890.

2742. J. G. Johnson.—From C. Risk. Process and apparatus for curing cocoa, &c. December 24.

4554. J. Shoveller. Cooked food for horses, cattle, &c. January 21.

8551. A. W. Stokes. Means of obtaining acidity or alkalinity in milk and other substances. January 14.

B.—Sanitary Chemistry.

1890.

1623. W. Warner. Apparatus for treating sewage. January 14.

C.—Disinfectants.

1890.

1017. W. Dammann. Rendering tar oils soluble in water, and production of disinfectants and other useful products therefrom. January 14.

3134. I. S. McDougall and J. T. McDougall. Compounds for washing or dipping sheep and other animals for extermination of parasites. December 31.

XIX.—PAPER, PASTEBOARD, ETC.

APPLICATIONS.

1891.

341. H. Moss. Improvements in manufacturing pasteboards and such like. January 8.

748. R. C. Menzies, and E. J. Bevan. Improvements in the manufacture of paper for cheques and like documents. January 15.

826. R. Brown and G. Mackay. Improvements in paper-making machines for making the surface of the paper equal on both sides. January 16.

COMPLETE SPECIFICATIONS ACCEPTED.

1890.

2832. E. Applegarth. Treatment of straw, esparto grass, &c., and compounds therefor. December 31.

17,012. G. L. Anders and C. H. Elliott. Use and application of xylonite, celluloid, and the like. January 21.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES, AND EXTRACTS.

APPLICATIONS.

1890.

21,006. E. Sonstadt. *See* Class XVIII. *A*.

21,019. E. Sonstadt. *See* Class XVIII. *A*.

21,044. A. Foelsing. Process for the preparation of hop extract. December 24.

21,106. E. Sonstadt. *See* Class XVIII. *A*.

21,294. W. W. Horn.—From F. de Mare, Comte N. Ney, M. Sannier, and G. Dambmann. An improved process for the production of camphor. December 31.

1891.

48. G. Link and R. Avenarius. Improvements in the manufacture of artificial perfumes. Complete Specification. January 1.

115. G. Link and R. Avenarius. Improvements in the manufacture of artificial perfumes. Complete Specification. January 3.

249. H. E. Ryeroft and A. Mason. *See* Class III.

588. H. H. Lake.—From Ichthyolgesellschaft Cordes, Hermanni & Co., Germany. Improvements in coatings for therapeutical purposes. January 12.

853. A. J. Boult.—From O. Schweissinger and L. Hoffmann, Germany. Improvements in the manufacture of extract of hops. Complete Specification. January 16.

XXI.—PHOTOGRAPHIC PROCESSES AND MATERIALS.

APPLICATIONS.

1890.

20,438. R. W. Thomas. Improvements in and relating to flash lights for photographic purposes. December 15.

20,501. S. H. Fry. Improved method of holding and exposing sensitive photographic surfaces. December 16.

21,059. G. F. Redfern.—From J. M. Jordan. Improvements in or connected with the production of photographic negatives. December 24.

1891.

880. W. Mathieu. A process of photography by which from a single negative, permanent prints are produced in the natural colours of all objects. January 17.

COMPLETE SPECIFICATIONS ACCEPTED.

1890.

15,091. A. McDonald. Preparation of chemicals adapted to the development of photographic plates. January 14.

19,658. A. J. Boult.—From G. Eastman. Photographic films. January 7.

XXII.—EXPLOSIVES, MATCHES, Etc.

Applications.

1890.

20,978. H. H. Lake.—From G. M. Mowbray, United States. Improvements relating to the manufacture of nitro-cellulose or pyroxylin. Complete Specification. December 24.

21,122. G. Quick. Improvements in the manufacture and form of perforated cake powder for ordnance, a part of which improvements is applicable in the manufacture of gunpowder generally. December 27.

1891.

298. F. J. Ryves. Improvements relating to the manufacture of explosives, and to apparatus therefor. January 7.

330. C. E. E. Hell. Improvements in the manufacture of matches. January 7.

336. J. Y. Johnson.—From Zellstoff-fabrik Waldhof, Germany. The treatment of cellulose for the manufacture of cellulose nitrates or gun-cotton. January 7.

843. G. G. Andre and C. H. Curtis. Improvements in the manufacture of gunpowder, and in apparatus therefor. January 16.

Complete Specifications Accepted.

1890.

2769. H. A. Schlund. Percussion fuses. December 24.

3604. F. E. D. Aeland. Time and percussion fuses. January 14.

18,319. J. S. Walter. Explosive compounds. December 24.

XXIII.—ANALYTICAL CHEMISTRY.

Application.

1891.

713. M. M. Hanly. An improved method of and instrument for testing milk. January 14.

THE JOURNAL

OF THE

Society of Chemical Industry:

A MONTHLY RECORD

FOR ALL INTERESTED IN CHEMICAL MANUFACTURES.

No. 2.—Vol. X.] FEBRUARY 28, 1891. [Non-Members 30/- per annum; Members 21/- per Set of extra or back numbers; Single Copies (Members only) 2/6.

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Authors of communications read before the Society, or any of its Local Sections, are requested to take notice that under Rule 41 of the bye-laws, the Society has the right of priority of publication for three months of all such papers. Infringement of this bye-law renders papers liable to be rejected by the Publication Committee, or ordered to be abstracted for the Journal, in which case no reprints can be furnished to the author.

Notice is hereby given, for the information of members and advertisers, that the advertisement columns of this Journal have been contracted for by Messrs. Eyre and Spottiswoode, the Society's printers and publishers, to whom all communications respecting them should be addressed.

The Secretary is instructed to negotiate for the purchase of copies of the Society's Journal for January and May 1883, and January, February, and April 1886. Members possessing odd copies of these numbers are particularly requested to communicate at once, stating price required, with Mr. Cresswell. The stock of all other numbers is at present sufficient for the Council's requirements.

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University College, Nottingham.

SESSION 1890-91.

March 24th.—Mr. C. H. Bothamley, "Some recent Advances in Photography."

London Section.

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SESSION 1890—91.

March 2nd.—Mr. V. H. Veley. "The Chemical Changes between Nitric Acid and Metals."

March 16th:—
Mr. W. Crowder. "Observations made in the Working of Vitriol Chambers."
Mr. A. H. Allen. "The Chemistry of Whisky and Allied Products."

April 6th:—
Election of five members to replace an equal number retiring from Committee. Nominations to be sent to the Hon. Secretary on or before Monday, March 24th.
Professor Vivian B. Lewes:—
1. "The Analysis of Illuminating Gases."
2. "The Products of Checked Combustion."

April 20th.—Mr. W. P. Rix. "Stoneware; and its Application to Chemical Apparatus."

May 4th.—Professor Dewar, F.R.S., and Mr. Boverton Redwood, F.R.S.E. "A Process for the Conversion of Heavy Mineral Oils into Lighter Hydrocarbons suitable for Illuminating and other purposes."

June 1st.—Dr. W. S. Squire. "The Artificial Production of Cold theoretically and practically explained."

Meeting held Monday, January 19th, 1891.

MR. THOS. TYRER IN THE CHAIR.

At the commencement of the proceedings, the Chairman made a few remarks referring to the fact that the last issue of the Society's Journal had appeared somewhat later than usual. This, he said, was due to the fact that, for the first time in the history of the Society, the index for the year was included in the December number. He trusted that the modifications which had been introduced into it would render the new index of greater value to technologists and the members generally.

ON THE CONSTITUTION OF BUTTER.

BY J. ALFRED WANKLYN, CORRESPONDING MEMBER OF THE ROYAL BAVARIAN ACADEMY OF SCIENCES.

The commonly received view of the constitution of butter is that it, like other animal fats, consists mainly of oleine and margarine, or rather of oleine, palmitine, and stearin; and that it differs from the common fats inasmuch as it contains a small proportion of butyrine and other glycerides. Twenty years ago I was of that opinion, and you will find that statement in my book on milk analysis. But since that time I have learnt better; and I will now describe some experiments made in 1883, but never yet published.

I took 50 grms. of butter with 9·42 grms. of dry hydrate of lime, making a total of 59·42 grms. These materials were placed in a platinum dish provided with a stirrer, and the vessel with its contents was heated on the water-bath and constantly stirred for a long period. From time to time it was allowed to cool, and was then weighed, five times in all. There was a steady loss of weight, and ultimately the weight of the compound fell to 58·510 grms., showing a loss of 0·910 grm. of water.

I attach great importance to this experiment. If butter were pure glyceride there could have been no such loss, inasmuch as hydrate of lime loses nothing in the water-bath, and hydrate of lime and a glyceride react without production of water, yielding only lime salts and glycerin. The loss of water could arise from two sources: either from the action of free fatty acid in the butter, or from the action of the lime on an iso-glyceride. An iso-glyceride, as I explained many years ago, is an ether of a glycerin in which all the hydroxide is allied with one atom of carbon. On saponification such an iso-glyceride yields an iso-glycerin which instantly falls to pieces and forms water and a fatty acid, which latter also gives water by reaction with lime. There are these two ways in which the water could be formed, and possibly there is a third.

Continuing the experiment on the saponification of butter, it was shown in a decisive manner that the yield of glycerin by butter is too small to admit of the possibility of butter being pure glyceride. The lime compound in the platinum dish weighed, as I have said, 58·510 grms. To it were added 6·460 grms. more hydrate of lime, making the total 64·970 grms. The mixture was then digested with 600 cc. of water and filtered, and the lime compounds were digested with 300 cc. of strong alcohol, the solution evaporated to dryness, and the residue weighed. The results were, in the case of the residue of the aqueous solution, 1·991 grms., and in the case of the alcoholic solution, 4·606 grms. The insoluble substance after thorough drying weighed 58·140 grms.

The work was done with great care; and there is a most satisfactory agreement between the weight of the total mass and the sum of the extracts and the insoluble residue. Thus:—

	Grms.
Aqueous residue.....	1·991
Alcoholic residue	4·606
Insoluble lime salts.....	58·140
	64·737
The material that produced these..	64·970

The agreement, therefore, is very close. Considering the possibilities of error which must necessarily exist in such a determination, it is as close as we can expect to get. The difference is 2 decigrammes, and is due to the escape of butyric acid in the shape of butyric ether. I insist on the significance of the correspondence. It shows that nothing important had escaped by evaporation, or was otherwise lost. That the saponification was pushed to completeness was shown by the fact that the 600 cc. of water was not alkaline. That shows that the whole of the hydrate of lime was used up, and that perfect action must have taken place; and for every equivalent of butter acids there were two equivalents of lime. All the glycerin arising from the saponification of the 50 grms. of butter fat must have been comprised in the aqueous extract and in the soluble part of the alcoholic extract. These were 1·991 and 1·405 respectively, or 3·396 in all. From this a deduction of about 3 decigrammes has to be made for the lime in the extracts, which was determined in each case by actual experiment. This leaves approximately 3·1 grms. as the total amount of glycerin to be got from 50 grms. of butter, or 6·2 from 100 grms.

I believe that some chemists are under the impression that if you boil down a weak solution of glycerin it escapes with the water. The following experiment may be cited. Taking half a litre of water, I dissolved in it from 1 to 2 grms. of glycerin, and distilled off 250 cc. and examined the distillate. The total amount of glycerin in the distillates

did not exceed 2 mgrms. So the proof is double that there is no loss of glycerin. I have weighed all my materials, accounting for everything and experimenting directly; and the total amount of glycerin from 50 grms. of butter fat is not more than 3·1 grms.

If butter were a pure glyceride, it would furnish more than 10 grms. of glycerin from 100 grms. of butter fat, so that 40 per cent. of the glycerin is missing. That means that in every 100 parts of butter fat at least 40 per cent. is something else.

This result is diametrically opposed to the views that are held at the present day, but it is perfectly in harmony with the classical researches of Chevreul published early in the century. If you will consult that admirable book, Gerhardt's "Traité de Chimie Organique," published about 30 years ago, you will find an excellent résumé of Chevreul's researches, and in Vol. 2, page 855, you may read that when Chevreul examined a pure glyceride derived from beef fat he found 9·8 of glycerin, but when he used what he calls the stearin derived from butter, all he got was 7·2. I get 6·2 from the total butter. Chevreul got 7·2 from the less fusible portion of the butter. The stearin of butter is described as being obtained by partially melting butter, and taking out by pressure such part as will flow, leaving behind that which will not flow.

The nature of the butter acids has also been made the subject of study. The acids insoluble in water are commonly described as oleic, palmitic, and stearic acids. There is, however, no oleic, no palmitic, and no stearic acid, but something quite different. More than half of the fatty acid produced from butter fat by saponification is a new fatty acid of the formula $C_{16}H_{30}O_2$. This fatty acid, which I name alde-palmitic acid, bears the same relation to palmitic acid that aldehyde bears to alcohol. It melts at about 12° lower than palmitic acid, namely, at about 50° C. It is insoluble in water, sparingly soluble in cold alcohol, but at temperatures above 25° C. it is soluble in its own weight of alcohol. It is only moderately soluble in cold ether, but extremely soluble in boiling ether. Bisulphide of carbon and pentane dissolve it readily. It is a non-crystalline solid, with a lustre like silk. Its behaviour with alcohol is most extraordinary. I have here a specimen of the product prepared eight or nine years ago, and this little preparation was made this day by taking 1 part by weight of the acid and 5 parts by weight of alcohol, warming very gently until the acid dissolved, and then allowing to cool. The acid has the remarkable property of being able to solidify five times its own weight of alcohol. The bottle contains 1½ grms. of the acid with 10 cc. of 85 per cent. alcohol, and, as you see, its contents do not flow.

When the contents are placed on filter-paper a change takes place. A part of the alcohol passes into the filter-paper, and there remains behind a chemical compound of the acid with alcohol, containing 1 molecule of the acid to 4 of alcohol. On heating in the water-bath more alcohol is lost, and there remains a compound of 2 molecules of the acid with 1 of alcohol.

This compound will just bear fusion in the water-bath, but if maintained there the alcohol goes off and the pure acid remains behind. I have a satisfactory analysis of the compound of 2 molecules of the acid with 1 molecule of alcohol. This analysis shows 11·65 per cent. of hydrogen. Palmitic acid contains 12·5 of hydrogen, and if the palmitic acid were combined with alcohol the percentage of hydrogen in the compound would be a little higher. A baryta salt was obtained by dissolving the substance in ether, and pouring the solution into baryta water, using a slight excess. On boiling, the baryta salt was precipitated to the bottom. The liquid was then decanted, and the almost dry precipitate washed with boiling water, dried in the water-bath, and then treated with cold ether. After removing the ether, the substance was again dried in the water-bath and analysed. The determination of barium was not by precipitation, but by ignition with sulphuric acid, which is a better process in such cases, and I obtained the theoretical quantity of baryta for the new acid. Palmitate of baryta contains 21·17 of barium. My salt contained 21·32, which is the theoretical number for alde-palmitate of baryta. The experimental difference between these two formulæ was 5 milligrammes of sulphate of baryta, and that is a quantity within the reach of the careful operator.

A silver salt has likewise been prepared. The baryta salt differs from the palmitate of baryta physically. The text-books describe palmitate of baryta as a lustrous crystalline compound. But the alde-palmitate is perfectly amorphous; it has no lustre whatever.

I have prepared a soda salt by taking alde-palmitic acid, carbonate of soda, and alcohol, and treating them in the water-bath. The soda salt contains two atoms of water of so-called crystallisation.

The various salts of the new acid are at present under investigation, and, as far as possible, I am avoiding preparation by double decomposition. I learnt this lesson more than 30 years ago from Bunsen, whose pupil I was. I had propionic acid, arising from a new reaction, and was about to make the baryta salt by double decomposition, when Bunsen said: "You must not make it in that way. You will risk getting a double salt, and I don't know what besides." So I set to work in another way, and got a baryta salt which gave me the theoretical numbers.

In operating upon butter for the extraction and separation of the butter acids, I base my process of separation on the observation that, whilst alde-palmitic acid is only sparingly soluble in cold alcohol—viz., to the extent of about 5 per cent.—the acids which accompany it are very soluble in cold alcohol. In one experiment, I operated upon 76 grms. of the insoluble fatty acids obtained by decomposing butter by means of potash and alcohol, with subsequent decomposition of the butter-soap by sulphuric acid. Starting with 76 grms. of the fatty acid, I mixed with it 25 cc. of alcohol of about 85 per cent. strength. The semi-solid mass was placed on bibulous paper, and pressed. The residue which the paper did not absorb was again mixed with 25 cc. of alcohol, and again pressed. After four such pressings (the body having thus been subjected to the solvent action of 100 cc. of alcohol), the final residue was put into a platinum dish, fused in the water-bath, and weighed. Its weight was 41·7 grms., and on being submitted to analysis, gave the following figures:—

0·2515 grm. substance taken: 0·264 grm. H_2O: 0·678 grm. CO_2.

—	Calculated.		Found.
C_{31}	408	73·65	73·50
H_{62}	66	11·91	11·65
O_5	80	..	..
	554	100·00	..

$$2\,(C_{16}H_{30}O_2) + C_2H_6O = C_{34}H_{66}O_5.$$

By using alcohol and bibulous paper, the 76 grms. was divided into two parts, viz., 41·7 grms. unabsorbed and about 34 grms. absorbed by the paper. By means of ether, 23 grms. of fatty acid was extracted from the first bundle of paper. The other bundles were not operated upon, as the more soluble part would not predominate. Instead of alcohol, ether may be used, and in a similar manner, only the quantity of ether must be much smaller than the quantity of alcohol employed in the operation I have just described. Operating on a sample of butter acids with ether, I have divided them into fractions, much in the same manner as when using alcohol.

The portion unabsorbed by the bibulous paper is alde-palmitic acid. What, then, is the portion absorbable by the paper? I have only partially investigated it at present; but this is certain: it is not oleic acid. It solidifies at about 30° C. I am at present at work on this body.

I must express my sense of the incompleteness of this investigation. The results have, however, been accumulating for nearly 10 years. The subject is one of extreme difficulty, and my opportunities of working at it have been very much restricted. I hope shortly to publish a more detailed account of alde-palmitic acid.

The specimen in this bottle is the remains of the 41·7 grms. of alde-palmitic acid prepared in 1882. When first prepared, it consisted of 1 molecule of alcohol to 2 of the acid, and on examination was found to lose quite enough on heating in the bath. After the lapse of eight years, however, it has lost the greater part of the alcohol, and diminishes in the water-bath only to the extent of 2 per cent. Traces, as evidenced by the smell, have in the course of years suffered etherification.

The small bottle which I passed round before contains the white jelly-like mass produced by bringing together the acid and a considerable quantity of alcohol.

Founded on the results of this investigation, there are practical methods of distinguishing between butter and butter substitutes, and these methods I have resorted to in dealing with the question of adulteration. At present, as is well known, though we can say whether a specimen of butter consists to a large extent (say half and half) of common animal fat, yet small quantities of adulterants are not ascertainable by the ordinary processes of examination. By new methods, there is a prospect of detecting the presence of about 2 per cent. of ordinary fat in butter.

Discussion.

Dr. C. R. Alder Wright said that anyone who had attempted to follow the work done by the author in former years must feel that he had a difficult task if he endeavoured to controvert or even criticise his statements. He therefore felt some diffidence in asking one or two questions, though he did so purely for his own information. In the first place, he had gathered that the butter fat examined was not derived from any one particular kind of cow, and that there was a possibility that different species of the bovine race might yield different fatty acids. There was nothing to show whether the butter treated by the author was an abnormal specimen or of the usual average quality. In the next place, he had noted that the method adopted was carried out on quantities of material not exceeding 100 grms. in any one case. He would like to ask, therefore, whether the stearo-palmitine of the fatty acids was subjected to any treatment which would prove whether it was a homogeneous body or a mixture. If one started with one or two kilogrammes and fractionally crystallised or precipitated it, repeating the process fifty or a hundred times, one might get two fractions, one at one end of the series and another at the other end, which would present considerable differences. Such an experience was common in the history of fatty acids. He would like to know whether Mr. Wanklyn had satisfied himself that his alde-palmitic acid was one single substance and not a mixture, and if so, upon what evidence. With reference to the analytical figures, the difference between 21·17 and 21·32 was not so great as to lie outside the limits of experimental error, and the same remark would apply to the percentages of carbon and hydrogen determined by combustion. It hardly seemed to him to be legitimate to lay much stress upon a divergence of one or two tenths per cent. between the calculated and the found proportions as proving anything. The author had said that the body which he had named alde-palmitic acid bore the same relation to palmitic acid that aldehyde bore to alcohol. Was he to understand that it contained the aldehyde group COH? If so, he failed to see that it was a fatty acid at all, because as only two atoms of oxygen were present, it could not also contain the group CO.OH. If the author meant that it was a true fatty acid containing two atoms of hydrogen less than palmitic acid, then it was an unsaturated acid, and ought to combine with iodine or bromine. He would like to ask whether the iodine absorption had been determined. With regard to the percentage of glycerin, all would agree that the exact determination of that body was a very difficult point. Certainly some fatty matters either naturally contained or yielded larger proportions than others. In the case of cocoa-nut oil, for example, the quantity of glycerin obtainable generally fell but little short of the theoretical amount, calculated as a triglyceride, and assuming the mixture of fatty acids there present to have the molecular weight which represented their average, something like 200. But in the case of other substances, tallow, &c., it was often difficult, even with the best processes, to work out such a quantity of glycerin as came up to 95 per cent. of the theoretical quantity, an amount easily obtainable in the case of cocoa-nut butter. With regard to the moist process of combustion, he did not know whether Mr. Wanklyn's patent for it had yet run out. The fact of its being a patented process had been in the way of his having any experience of it, and he believed that this was the case with most other chemists. With reference to the baryta salts, there was one method of preparing them which he had found convenient. It was a slight modification of the method recommended by the author, and consisted in treating with a small excess of hydrate of barium, blowing carbonic acid through the liquid, and subsequently boiling to decompose the bicarbonate formed. That method of working ensured that the whole of the acid was converted into the barium salt, whereas if the carbonate were used one could not always be sure what one would get. The molecular compound with alcohol seemed to be an interesting body; but he would point out that that was not the only case in which alcohol acted so remarkably. Even with calcium chloride and other inorganic salts, alcohol was known to combine and form crystallisable bodies, in the same way as water with sulphate of copper. As somewhere about two molecules of the new body were said to combine with one of alcohol, he would ask the author whether that did not rather suggest that he was dealing with a mixture of bodies, of which about one half combined with a molecule of alcohol, and the others did not combine at all.

Mr. Otto Hehner said that he would have personally preferred to have refrained from making any remarks, but he felt it to be his duty as a public analyst to make a few observations in reference to the paper on the constitution of butter. For a number of years past Mr. Wanklyn had given utterance to his views on that subject, but those views had not agreed with each other. He remembered that, as long ago as 1874, when it was first found that butter contained a larger quantity of soluble and a lesser quantity of insoluble fatty acids than had formerly been believed, Mr. Wanklyn pointed out that that difference was perhaps due to the butter fats analysed not being quite dry. That was the only way in which he could account for the deficiency in insoluble fatty acids. Later on, he started—though without giving any analyses—his iso-glycerin theory, which attempted to explain—and did, on paper, satisfactorily explain—the author's inability to get out of butter any glycerin. When it was shown afterwards that there was no difficulty in getting the theoretical quantity of glycerin, they heard no more of the iso-glycerin theory until to-night. With regard to the matter before the meeting, he must confess that he had never known such great and startling deductions drawn from such small analytical results, especially by a man with a European reputation. What was the experiment which the author had first described, and upon which the theories propounded were based? He added some lime to a certain quantity of butter fat and heated the mixture. There was a loss. That loss was assumed to be due to water. He (Mr. Hehner) would like to see some evidence of that. It was well known that if lime were added to fat, a more or less incomplete saponification ensued; glycerin was formed; and glycerin was a somewhat volatile body, as anybody might easily convince himself by placing some concentrated glycerin in a water oven, when thick white vapours would be seen escaping. It was only a very small loss; but Mr. Wanklyn proceeded to account for it by the assumption that butter was not an ordinary glyceride. Mr. Wanklyn had then tried to estimate the glycerin. But he surely knew that a fat could not be completely saponified by lime without pressure and steam. It had been proved that saponification with lime was incomplete and could not yield the whole of the glycerin. If the saponification were done by means of alkalis, it was possible to extract the theoretical quantity of glycerin. He therefore felt justified in receiving cautiously the statement that there was only 6 per cent. of glycerin in butter, for others like himself had been able to get out 11 or 12 per cent. But it was to be remembered that Mr Wanklyn's theory depended upon that experiment. If he had

obtained the full quantity of glycerin, there would have been no question of new fatty acids nor theory of iso-glycerin. Then, later on, in order to prove that his loss could not be glycerin, an experiment by boiling a dilute solution of glycerin in water was made. But it was well known, and he had proved long ago (see Analyst, Vol. XII. 65) that a dilute solution of glycerin could be boiled without loss of glycerin until the liquor had a strength of about 7·1 per cent. of glycerin. It was quite possible that Mr. Wanklyn's experiments agreed well with the deduction of Chevreul, and he would accept Mr. Wanklyn's statement that Chevreul did obtain a less quantity of glycerin from butter fat. But on the other hand Chevreul showed that butter fat contained some low atomic fatty acids which combined with a larger percentage of glycerin, and it followed therefore that butter must yield more glycerin than other fat. Mr. Wanklyn had said that butter contained 50 per cent. of glyceride and 40 per cent. of iso-glyceride of alde-palmitic acid and free fatty acids.

Mr. WANKLYN: No, certainly part of that is iso-glycerides, and possibly some free acids.

Mr. HEHNER, continuing: But it was proved that perfectly fresh butter fat was free from fatty acids. It, therefore, Mr. Wanklyn were not sure whether there were free fatty acids in butter fat, he was afraid he could not attach much weight to his other statements.

Mr. WANKLYN: I said that there was 50 to 60 per cent. of glyceride, and that the remainder was either iso-glyceride or a mixture of iso-glyceride with free fatty acids. I do not pronounce an opinion as to whether there are any free fatty acids or not.

Mr. HEHNER, continuing, said they had the author stating that there might be some free fatty acids. That was a matter easy of proof and their amount determined by any chemist in 10 minutes. Hence he was surprised that Mr. Wanklyn had not satisfied himself on the point. As to the analyses of the barium salt of alde-palmitic acid no chemist need be ashamed if, in two analyses of one and the same compound, he obtained figures so nearly approaching agreement as those between the two compounds whose analyses were on the board. Nevertheless, upon such a slight difference as 0·2 per cent. a theory was constructed. They had heard how the new fatty acid had been obtained by crystallising four times with an insufficient quantity of alcohol. But it was well known that it was quite impossible to obtain any fatty acid in a perfectly pure state by crystallising even many more times with alcohol. It was futile to attempt to obtain a fatty acid in the middle of a long series of acids by four crystallisations. It was an impossibility. But when they came to examine the matter they found that Mr. Wanklyn himself supplied the evidence that it was not one fatty acid that he was dealing with, but a mixture. He said that if he added an insufficient quantity of nitrate of silver to prepare the silver salt of the new fatty acid, his analysis did not agree with the quantity required by the formula; that was to say, by adding insufficient silver nitrate he had succeeded in fractionating the mixture of acids. Mr. Wanklyn, therefore, supplied the proof that this new fatty acid was not a homogeneous substance, but a mixture. He would like to have heard more of Mr Wanklyn's views on soluble fatty acids. So much work had been done on them recently that anyone who now neglected what was considered the most important constituent of butter was, to say the least, rather out of touch with the subject. Dr Wright had pointed out that there would probably be an iodine absorption. He himself would expect that there would be an enormous iodine absorption, judging by the alleged formula of the new fatty acid. In the case of butter fat, they had an absorption of about 33 per cent., and if Mr Wanklyn had got 40 or 50 per cent. of this fatty acid, the iodine absorption should exceed by far the actual iodine absorption of butter fat. He was of opinion that the publication of Mr. Wanklyn's results was premature.

Mr. A. H. ALLEN, as an old admirer of Mr. Wanklyn, and one accustomed to read his productions for the last 25 years, had listened with great interest to the paper just read. He had hoped to be instructed by an explanation and demonstration of the constitution of butter, and he might fairly say that Mr. Wanklyn had put the constitution of butter before them from a novel point of view. He (Mr. Allen) agreed with almost every word of scientific criticism that had fallen from Dr. Wright and Mr. Hehner; in fact, some of his own notes bore upon the same points, which were points which would naturally occur to one conversant with the matter under discussion, or with the accepted methods of working in organic chemistry. But there were some special points in addition which he would like to touch upon. In the first place, there was the deficient quantity of glycerin obtained by the treatment of the butter fat with lime. He fully agreed with Mr. Hehner that they had not had a satisfactory explanation of that point; and as Mr. Wanklyn did not appear to have ascertained the nature of the residue and proved that there was no undecomposed fat contained in it, he failed to see the value of the experiment. They had methods of estimating glycerin with fair accuracy; they had Mr. Wanklyn's own method, which had been referred to as the "moist combustion" process, but was better known as the permanganate method. That was a process based on the production of oxalic acid when the glycerin was oxidised by permanganate in alkaline solution. It was originally suggested by Mr. Wanklyn, improved by himself in conjunction with Mr. Fox, afterwards taken up by Benedikt and Zsigmondy, and subsequently modified by the speaker. He (Mr. Allen) could bear witness as to the admirable results obtained by that method in the analysis of fats. Working by this, which for brevity he would call the Wanklyn process, Benedikt and Zsigmondy obtained from 10·2 to 11·6 per cent. of glycerin to be formed by the saponification of butter, and he (Mr. Allen) had obtained 11·06 of glycerin from butter fat, while Liebshutz had isolated 13·75 per cent. Such results were very different from those brought before them that night by Mr. Wanklyn. Then, the author had referred to Chevreul. He did not, however, quote Chevreul direct, but through Gerhardt; and, unfortunately, only gave a figure obtained by the analysis of so-called butter-stearin, and not that yielded by butter-fat itself. By a method of analysis which was fully laid down in Chevreul's *Researches Chimique sur les Corps Gras d'origine animale*, published in 1823, a copy of which he held in his hand, Chevreul obtained from butter fat 11·85 per cent. of glycerin. So far, then, from the figure for glycerin obtained in 1823 by Chevreul being 6·2, it was 11·85. That, he thought, did away with anything like the deficiency of glycerin, which was the chief basis of Mr. Wanklyn's iso-glycerin theory. The author had adduced no single fact in favour of the existence of iso-glycerin or iso-glycerides, which could not be replied to and had not already been replied to in Mr. Wanklyn's presence. Then, Mr. Wanklyn had been content to lump together all the fatty acids of butter which were not soluble in water or alcohol, and had called them "alde-palmitic acid." It was a misfortune that Mr. Wanklyn had not used some of the good old tools of the chemical laboratory in his attempts to isolate this acid. For example, there was the invaluable method of fractional precipitation of the fatty acids as magnesium salts first employed by Heintz, and the well-known method of conversion into lead salts, and treatment of these with alcohol or ether, both of which methods had done good service in the past, and were admirably adapted for Mr. Wanklyn's purpose; and it seemed strange that one who was anxious to examine a new fatty acid should not have ascertained how this "alde-palmitic" acid behaved when made into a magnesium or a lead salt. There were other methods of research which would have afforded valuable information, such, for instance, as the determination of the bromine or iodine absorption of the acid. The amount of iodine absorbed by butter fat was well known to be small as compared with ordinary fats, and very much less than would be the case if the butter contained a large proportion of a body of the constitution of this "alde-palmitic" acid. This being the case, he failed to recognise any proof that this "alde-palmitic" acid existed as a distinct individual and not as a mere mixture of oleic acid with

palmitic acid and its homologues. Then, Mr. Wanklyn had said that he saw his way to detect 2 per cent. of adulteration in butter by these new researches. He (Mr. Allen) was glad of that, and hoped that he would tell the profession how to do so. Their present difficulty was not that they could not analyse within 2 per cent., but that the natural variations in butter were so great that 2 per cent. would not cover them. That was an important matter, and Mr. Wanklyn would have to consider it before he seriously determined to use his process for the detection of adulteration of butter. He could only say in conclusion that he was sorry Mr. Wanklyn had not supported his contentions by stronger evidence, which at present was missing, but which he hoped would appear when the interesting paper, of which they had just heard the abstract, came to be published.

Dr. W. Johnstone had listened with interest to the paper, as he was at present working on the same subject himself, and the results obtained by him tended to establish the fact that there were two kinds of natural butter, one yielding 85·81 per cent. of insoluble fatty acids, a definite chemical compound, a compound triglyceride. The second kind was what one might term a compound complex triglyceride yielding insoluble fatty acids up to 90 per cent. He quite agreed with the author that oleic acid was not present in butter fat, and what was previously supposed to be oleic acid now proved to be iso-oleic acid, and might be summed up thus—

$$\left.\begin{matrix} C_{13}H_{25}O \\ C_4H_7O \end{matrix}\right\} CH_2$$

or lntro-methane tridacotic acid, which, when saponified, split up into tridacotic and butyric acid.

If one took the formula of a molecule of butter fat as follows:—

$$\left.\begin{matrix} C_{18}H_{33}O_2 \\ C_{16}H_{31}O_2 \\ C_{10}H_{19}O_2 \end{matrix}\right\} C_3H_5$$

which theoretically gave 85·81 per cent. of insoluble fatty acids, and butyric acid 11·76 per cent. He had himself actually found 11·7 per cent. He would not go further into the matter then, as he proposed to enter into it in a paper at a later date. He agreed generally with the remarks of Mr. Hehner and Mr. Allen as to the estimation of glycerin, having found 12·23 per cent. against a theoretical yield of 12·30 per cent.

Mr. J. A. Wanklyn, in reply, said that he had listened to the criticisms on his paper with great attention, as he was not unprepared for them. In reading a paper on such a subject it would be tedious to publish all the details of the investigation, and in this instance much had been kept back. Dr. Wright had inquired what was the evidence upon which he relied as to the existence of alde-palmitic acid, and that he was dealing with a single substance. Part of the evidence was that he had 40 grms. of the substance, had made combustions and a baryta salt, and barium determinations. The homogeneous nature of the substance was shown by resorting to the method of fractional solution; no change in the equivalent of the acid was manifested. That, he thought, was fair evidence that he was dealing with a single substance. Having got this acid, the question arose whether the substance was palmitic acid or not. The evidence that it was not palmitic acid was the deficiency of hydrogen. That deficiency was eight-tenths per cent., and carefully made combustions did not err to that extent. Then he had backed that up by a determination of barium salt, carefully fractionated and prepared by the best known methods, in which he had got the theoretical result. In ordinary analytical work one could not distinguish between 21·17 and 21·31 of barium in a substance. But this was extraordinary work, using a large quantity of the material and adopting unusual precautions. In the preparation of the baryta salt he had employed a method which would give him a salt of great purity. As he had said, he proposed to work extensively on the alde-palmitic acid, though he had no doubt as to the composition of that body. In naming it he was careful to say that it bore the same relation to palmitic acid that aldehyde did to alcohol. That was one way of saying that it differed by two equivalents of hydrogen. He had carefully avoided saying that it belonged to the oleic sereies; it belonged to another series altogether. Then he had noticed a number of little peculiarities that distinguished it from palmitic acid. He might mention, however, that it was not easily attacked by the method of limited oxidation. With respect to the question of determining glycerin from butter, judging from the criticisms he had heard he thought that the gentleman who had uttered them could hardly have understood what he had done. He had taken butter and hydrate of lime and heated them for a long time, with constant stirring. He had then treated with boiling water in successive portions, and then with boiling alcohol, using about a litre of those solvents to 60 grms. of material. That, he thought, was a good extraction. With regard to the volatility of glycerin he was quite prepared to admit that vapours might be seen escaping under certain circumstances; but that those vapours were glycerin was another question. If one could take a dilute solution of glycerin and boil it down without appreciable loss, that was proof that one need not fear loss of glycerin in the water-bath. With regard to the experiment of Chevreul, he had quoted from a well-known book. There was at the bottom of the page a statement of the amount of glycerin that Chevreul got from various fats. He had got the correct quantity from stearin of beef, and using the stearin of butter he got only 7·2. He (Mr. Wanklyn) had not referred to the original paper. With regard to the question of the iso-glycerin, he had been misrepresented as to the evidence on which he had stated its existence. Butter presented a remarkable reaction. If boiled with alcohol it gave no butyric ether; but if one put in potash it instantly gave butyric ether, and 2 or 3 per cent. of butyric ether distilled out. What could be the origin of that butyric ether? Potash decomposed butyric ether; and it was a remarkable thing therefore that potash and alcohol should give this ether by reacting upon anything. In order to explain the action, one must assume that the potash was consumed and that the butyric ether was produced as a secondary product. One took an iso-glyceride and saponified it, and iso-glycerin was liberated, and the iso-glycerin fell to pieces and gave water and a fatty acid. The evidence of the existence of the iso-glyceride was that reaction and the fact that one did not really get the theoretical quantity of glycerin from butter. He would conclude by saying that he had no doubt of the accuracy of the work that he had brought before the meeting.

Answering Dr. Wright's question as to the kind of butter operated upon, the butter employed eight years ago came direct from one of the best London dairies. He quite appreciated the necessity of making sure of the genuineness of the material, and Hudson Brothers had kindly placed some of their butter at his disposal for the continuation of the investigation. Mr. Walter Cole had also been kind enough to send him butter obtained by the Simplex process.

THE CYANIDE PROCESS FOR THE EXTRACTION OF GOLD FROM LOW GRADE GOLD ORES.

BY T. GRAHAM YOUNG, F.R.S.E., AND WATSON SMITH, LECTURER ON CHEMICAL TECHNOLOGY IN UNIVERSITY COLLEGE, LONDON.

In the Journal of our Society for the past year, 1890, pages 267 to 270, a very able paper is published containing an account by Mr. J. S. MacArthur of the process patented by himself in conjunction with the Drs. Forrest. He there (*loc. cit.* page 269) defines a difficult case untouched by any other kind of treatment, viz., that of an ore consisting of a complex mixture of silica, and the various compounds of iron, copper, lead, zinc, antimony, arsenic and sulphur,

with gold in the proportion of 10,000 parts of silica and sulphides to one part of the precious metal. He adds that such an ore is very much richer than the average auriferous ore, and the question is, "How can we best separate the one from the ten thousand?" The problem was to find some solvent which, unlike chlorine and mercury, would have a stronger affinity for gold than for sulphides, and the author concludes that the use of the alkaline or alkaline earthy cyanides solves the problem.

After small trials successfully performed, large trials also became successful in the author's experience. The first physical condition is stated as being that of a fine state of division of the ore to be extracted. In the case of tailings from the amalgamation process, these would not need re-grinding and might be treated as delivered.

The next condition, a physical one involving great chemical activity, was that of the zinc used for precipitating the gold from solution. It was used in a filiform condition, of minute and very thin parings of the bright metal. On and amongst this the gold is deposited as a very fine powder. The mass of zinc with gold powder is to be vigorously shaken in water, when the gold falls off, and the fibrous zinc particles are to be collected on a sieve.

From such sulphide ore as that above referred to, the author extracted 93 per cent. of the gold present by his cyanide process, whilst the bromine methods, he states, only extract from 40 to 50 per cent.

It is pointed out, finally, that whereas chlorination will only extract the gold and leave behind the silver, the cyanide method extracts both gold and silver, and the most of the silver in fact.

In the experiments we have to record, we have had the advantage of operating upon such ore as is actually treated by the MacArthur-Forrest process, and with cyanide and the zinc gossamer-like material as used in actual practice in the Cyanide Company's works, and the method has been put to as searching an examination as we could inflict in a chemical laboratory, following methods as likely as possible to be adopted in large scale practice.

The ground ore, as supplied, was agitated in one of the forms of milk agitating apparatus sold by Messrs. Kent in Holborn, for the production of butter. It is a simple revolving apparatus, in which glass jars are fixed, the caps secured by sheet india-rubber preventing any escape of liquid. Slow and continuous revolution was secured by the aid of suitable gearing and a gas engine.

The first thing to do was to determine the amounts of gold and silver in an average sample of the ore to be treated by the process.

It was found that in this ground ore were contained gold and silver in the proportions of—

Gold..... 0·95 oz. (troy) per ton of ore.
Silver..... 37·5 oz. (troy) per ton of ore.

Having thus determined the quantities of gold and silver in the ore to be extracted, by ordinary dry assay, it was now necessary to determine the strength of the cyanide of potassium. It was a dark-looking product and specially made for the purpose on a commercial scale. The stated strength was "from 60 to 70 per cent. of potassium cyanide." The strength found was 70 per cent.

It was now thought best to determine the degree of solubility of the gold and silver in the cyanide solution under the conditions obtaining in the ore. In other words, to ascertain what the relative amounts of gold and silver are which can be extracted from the ore in the ground state by solutions of the cyanide.

For the above purpose 1,000 parts of the ground ore were taken and 6 parts of crude 70 per cent. cyanide (= 4 parts of real cyanide). The cyanide was dissolved in 500 parts (all parts by weight) of water.

The mixture of ore and cyanide liquor was let stand for 20 hours, and then vigorously agitated for 6 hours and again let stand 16 hours. It was then filtered. The residue was not washed, but drained as thoroughly as possible by the filter pump.

To find how much was extracted by this treatment from the above filtered liquor, which we will call the *1st extraction*, it was first passed through a divided box containing in the first and last of its compartments granulated zinc, and in the middle compartment fine zinc turnings. This being unsatisfactory, the solution was further passed through a long funnel-shaped glass vessel containing fine zinc turnings and granulated zinc at top and bottom, exactly as used on the large scale. It was repeatedly passed through until colourless. As much as possible of the zinc was then distilled off from the mixed metallic gold, silver, and zinc, and the residue was examined for gold as to quantity.

It contained a quantity representing of—

Gold..... 0·121 oz. (troy) per ton of ore (1st extraction).

(The foregoing test does not represent all the gold actually extracted, since the attempt to use the divided zinc-box for precipitation of the metals failed, and lost some of the gold in the process. The box was then discarded in favour of the zinc funnel tube above mentioned.)

Now the residue left behind by the liquor, drained off to form the *1st extraction*, was treated as in the previous case with a further 6 parts by weight of 70 per cent. cyanide, dissolved in 500 of water. The mixture was agitated well for 4 hours and then filtered as before. The liquid obtained formed the *2nd extraction*. It was evaporated and the dry residue tested. It yielded amounts of gold and silver corresponding to—

Gold..... 0·157 oz. (troy) per ton of ore
Silver..... 8·155 oz. (troy) per ton of ore } 2nd extraction.

The residue left behind by the liquor drained off on the second extraction, was once more treated with 6 parts of cyanide (70 per cent.) and 500 of water, and the mixture was agitated for 4 hours. The liquor, filtered and drained off just as in the previous cases, was evaporated, and the residue quantitatively determined as to gold and silver. The amounts of these metals yielded corresponded to—

Gold .... 0·016 oz. (troy) per ton on the ore
Silver ... 1·864 oz. (troy) per ton on the ore } 3rd extraction.

No further extraction was made.

Under the circumstances given then, it was found that from 1,000 parts of ground ore the following amounts of gold and silver could be extracted by the use of 1,500 parts of a cyanide liquor containing 18 parts of solid crude cyanide of 70 per cent. strength (KCy) used. This was carried out in three extractions, for each 500 parts of cyanide liquor containing six of solid cyanide being used.

The progress of the solution and its extent are seen below:—

	1st Extraction.	2nd Extraction.	3rd Extraction.
	Oz. per Ton.	Oz. per Ton.	Oz. per Ton.
Gold.....	0·121*	0·157	0·016
Silver.....	..	8·155	1·864

* As pointed out above, gold was lost here, and so no calculation as to total gold extracted could be made in this experiment.

It is thus plain that the cyanide at once attacks gold and rapidly extracts it, whilst the attack on silver is slow and gradual. This will be seen better under Experiment 2, now to follow, in which the funnel tube is *uniformly* used instead of the box.

Experiment No. 2.

Another experimental trial was next made. In this 500 parts of ore were taken, 1 part of the 70 per cent. cyanide and 250 of water. After mixing, the substances were allowed to stand in mixture for 20 hours, and the mixture was then agitated for 6 hours and then let stand for 17 hours. Filtering with washing of the residue then followed.

Thus, extract (*a*) was obtained, and in it were found—

Gold..... 0·31 oz. (troy) to the ton of ore.
Silver..... 5·81 oz. (troy) to the ton of ore.

Extract (*b*).

The residue left by Extract (*a*) was again treated with 1 part of the cyanide in 250 parts of water, with four hours agitation, and filtered. Thus Extract (*b*) was obtained, and from it were gained—

Gold..... 0·23 oz. (troy) per ton of ore.
Silver..... 7·78 oz. (troy) per ton of ore.

Extract (*c*).

The residue left by Extract (*b*) was now treated with 2 parts of the cyanide in 500 parts of water, with four hours agitation.

Filtering and washing yielded Extract (*c*); from this were gained—

Gold..... 0·67 oz. (troy) per ton of ore.
Silver..... 8·15 oz. (troy) per ton of ore.

By the three Extractions (*a*), (*b*), and (*c*), 21·74 oz. of silver and 0·81 oz. of gold were thus extracted, and since the ore contains 37½ oz. of silver and 0·95 oz. of gold per ton, the above dilute cyanide has extracted—

Gold.	Silver.
Per Cent. 85·26	Per Cent. 57·98

The details of these extracts may be instructively tabulated thus:—500 grms. of ore yielded—

Water.	——	Silver.	Oz. per Ton.	Gold.	Oz. per Ton.
250	KCy. + 1 grm., stood 20 hours, agitated 6 hours, stood 17 hours	Grm. = 0·0888	5·81	Grm. 0·0079	0·51
250	+ 1 grm., agitated 4 hours.	= 0·1190	7·78	0·0035	0·23
500	+ 2 grms., agitated 4 hours.	= 0·1246	8·15	0·0011	0·07
	By the three extractions—totals		21·74	..	0·81

Final Experiment.

The last experiment was one made for the purpose of ascertaining on a larger quantity of ore, if the precipitation of the precious metals by the zinc in fine turnings and granulated, is practicable, and under what circumstances.

For this, 2,000 grms. of ore, 30 grms. of the cyanide, and 1,000 cc. of water were taken. The mixture was agitated for 5½ hours, and let stand all night. (Agitating all night would be better, and would be adopted in practice. Moreover, washing and filter-pressing, in combination, would undoubtedly give very much better yields.)

It was found that the precipitated metals adhered rather tenaciously to the zinc. However, a process combining washing with agitation of the zinc would separate the precipitate tolerably completely.

Thus it was found that the amount of gold that could be separated from such zinc by washing and shaking = 0·560 oz. per ton, whilst the amount retained by the zinc after washing and shaking = 0·038.

At the same time, the amount of silver that could be separated from this zinc by washing and shaking = 21·42 oz. per ton, whilst that retained by the zinc after washing and shaking = 1·37; silver retained in solution after washing and shaking = 0·34, including a trace of gold.

Hence, supposing that the zinc can be used over and over again, and reckoning the amount of silver retained by the zinc as constant, then the amount of silver which can be extracted from the ore by a solution of such a strength as this latter, would be 61·6 per cent. of that contained in the ore; whilst 63·09 per cent. of the gold contained in the ore would be extracted. However, this only represents the work of *one extraction*; no doubt repeated extraction would raise the amount for the gold to fully 85·4 per cent. (the figure obtained in earlier experiments). As the work of only one extraction 63·09 per cent. is unquestionably indicative of powerful, and hence valuable, solvent action.

With regard to the zinc treatment and cyanide left in the spent liquors, these, on evaporation, lost much cyanogen, but still left a residue which contained 18 per cent. on the total weight of the 70 per cent. cyanide taken. These liquors could hence be used again with further replenishment with cyanide.

We have much pleasure in thanking Mr. Oswald Hamilton for valuable assistance in the experiments recorded in this paper.

Experiments by Bertram Blount.

In the early part of last year I was requested to ascertain the applicability of the cyanide process to the extraction of certain gold ores which had proved somewhat troublesome to treat by other methods.

Three ores were dealt with; they were from an Australian mine and had yielded unsatisfactory results when subjected to the ordinary process of amalgamation. Their assay values were—

——	I.	II.	III.
Gold, per ton ...	Oz. dwt. gr. 0 8 11	Oz. dwt. gr. 0 19 14	Oz. dwt. gr. 1 0 22

In the first place a solution of potassium cyanide was made, containing 2·5 per cent. of the commercial salt, and 200 grms. of each ore treated with 200 cc. of this solution by shaking by hand in a stoppered bottle at intervals for several days. The extract was then filtered off, evaporated to dryness and the residue assayed. The figures obtained were—

I.	II.	III.
5·21	6·12	9·3

An attempt was then made to ascertain whether this indifferent result could be bettered by the use of a higher temperature and a larger proportion of cyanide in the following manner:—

100 grms. of ore No. III. were extracted with 200 cc. of the same strength cyanide solution, the extraction being conducted at the temperature of the water-bath.

The quantity of gold obtained was 3 dwt. 6 gr., a somewhat discouraging result.

Further experiments were instituted to determine the effect of more thorough agitation of the ore with the extracting liquor, and in these the strength of the cyanide solution was reduced to some extent.

In order to subject the experimental vessel to sufficient shaking, the following simple mechanical means was adopted: an old anemometer wheel was mounted in an oak block, the bearing being bushed with a bit of glass tubing and placed so that a stream of water from an ordinary tap on the water supply of the laboratory impinged upon the cups causing the rotation of the wheel. The bottle containing the ore and cyanide solution was slung to the wheel in such a manner that its centre of gravity approximately coincided with the centre of rotation and the whole arrangement was very fairly balanced and would remain in nearly neutral equilibrium in whatever position it was placed. Under these conditions a comparatively slight stream of water sufficed to

set the whole in vigorous rotation. The contents of the bottle were therefore agitated most efficiently. The stopper was, of course, secured by a piece of rag tied tightly down.

Carrying out an experiment with this apparatus, I treated 400 grms. of ore III. with 900 cc. of a solution containing 1 per cent. of commercial KCy with 12 hours' agitation and 15 hours' rest, and extracted gold to the extent of 9 dwt. 11 gr. per ton.

In order to ascertain whether extraction (as far as the cyanide process could carry it) was complete, the same portion of ore was then treated again in exactly the same manner with the result that 1 dwt. 7 gr. was extracted.

The total amount of gold therefore obtained from an ore with an assay value of 1 oz. 0 dwt. 22 gr. per ton, was 10 dwt. 18 gr. per ton, or rather over 50 per cent. of the total gold.

This, though far from an ideal state of things, compares favourably with extractions by means of chlorine under pressure which I had previously executed on the same ore.

The comparatively high cost of the cyanide forms a cogent reason for endeavouring to utilise it to the utmost extent, and experiments were therefore undertaken to determine how far the liquors that had been used for the extraction of one batch of ore were available for the treatment of a second portion.

In these a sample of ore No. II., which had already been extracted with chlorine under pressure, and which had had its assay value thereby reduced to 6 dwt. 3 gr. per ton, was used.

Three portions of 500 grs. each were extracted successively with the same 400 cc. of cyanide solution, the liquor being in each case separated from the extracted ore by reverse filtration. The total extract was evaporated to dryness and assayed. It gave 3 dwt. 6 gr., or rather more than 50 per cent. of the total gold present. Assays of the tailings of each portion of ore showed that the extraction had proceeded to nearly the same extent in each, the third portion alone giving indications that the solvent action of the cyanide was becoming exhausted.

The conclusions that I draw from the experience thus gained are:—

1. A most important factor in the successful operation of the cyanide process is the amount of agitation to which the ore is submitted.

2. A strength of 1 per cent. is as efficient in securing extraction as one of 2·5 per cent.

3. To obtain 90—95 per cent. of the gold present in a refractory ore is rather too much to expect.

4. The efficiency is quite comparable with that of a good chlorine extracting process and the means considerably simpler.

5. Considering the high price of potassium cyanide, one of three conditions must be fulfilled to make any process depending on its use a commercial success. These are:—

(*a*) The same solution must be used repeatedly until its solvent powers are completely exhausted.

(*b*) A cheap and efficient method of recovering the cyanide from the liquors from which the extracted gold has been removed must be devised; or

(*c*) A greatly improved and cheapened method of producing cyanides must be invented.

The last is perhaps the way of achieving the object in view which is of the most general utility.

In conclusion I must record my acknowledgments to my assistant, Mr. S. Dickson, who has carried out these experiments under my direction.

Discussion.

Mr. W. Trubshawe said that he was interested in a syndicate which had taken up this process for the treatment of gold ores on the large scale in South Africa. The syndicate had purchased 10,000 tons from one mine for treatment by the process, and he had a cablegram in his hand which stated that at a cost of less than 15*s.* a ton they were extracting over 80 per cent. of the gold from an ore assaying about 16 dwt. In one case they were challenged to publicly treat almost pure pyrites. They did treat 1¼ ton of it, and obtained a certificate from the challenger's expert that they readily took out 98·25 per cent. of the assay value. There were a few details in connexion with the process that were not yet published. When chemists were aware of these details they would acknowledge that the extraction of gold by cyanide was an almost perfect method. As to the question of the cost of the cyanide, when he mentioned that he had shipped over 7,000*l.* worth during the last four months at a cost of 1*s.* a pound, and that they were treating ore with only 2½ lbs. weight of cyanide per ton, he thought they would admit that it was not too expensive. He did not know of any other process that could compare with the cyanide process on the question of cost. Was there any other process which could effectually deal with refractory ores at a cost of under 15*s.* a ton?

Mr. W. F. Anderson wished to point out that the use of the word "ore" was not satisfactory in the case under notice. According to the statement on the blackboard, silver was present with the gold. If that were got out of quartz he would not call it an ore. Quartz required mechanically breaking up, and the two things therefore were very different. Chemists often spoke of gold ores; but there was no such thing, though there were plenty of silver ores. But gold was gold, even if in the heart of stone. Looking at the figures before them he would say that they represented a silver "reef," and that amalgamation was the proper process for it. He wished, however, that chemists would remember that quartz could not be called an ore; if it carried gold it was metallic gold. On the other hand, when iron pyrites carried gold, it required chemically splitting up to get the gold out.

Mr. Clay of Vautin said that there was a great deal of truth in the remarks of each of the previous speakers; but at the same time Mr. Smith and Mr. Blount, and even Mr. Trubshawe, had spoken only of their experience of the process in connexion with the one class of ore that they had dealt with. He himself had carried out experiments on about 325 different classes of gold and silver ore and quartz, and had found that he had been able to classify the results under six different heads. The gold and silver existed under six different conditions, giving varying results as regarded treatment by cyanide. In its application to the tailings of the Johannesburg ores, the cyanide process seemed to leave but little to desire. The actual condition of the gold in the samples treated had not been referred to by either of the gentlemen who had spoken; but before one could investigate the result of any reagent on gold or silver contained in an ore one must ascertain how the gold existed in that particular ore. The word "refractory" was often used improperly. When he first went to Africa, he was led away by statements that a considerable portion of the gold was locked up in pyrites, and that it could be extracted only by converting the pyrites into ferric oxide and treating by amalgamation or chemical methods. On returning to England he had made microscopic examinations of the Johannesburg ores, and found that they were not truly refractory. That was to say, he had not found any gold encased in pyrites after they were reduced so as to pass through a 60-mesh sieve. Therefore the condition of the grains of gold was practically metallic and free, in the sense that they were not embedded in the crystals of the pyrites or the quartz matrix. He doubted whether any system of amalgamation could deal with the gold to the bitter end; and if one could get a solvent to convert the gold into a soluble salt without materially taking up the sulphide of iron, then that was the best way of dealing with that particular class of ore. One part of the process was open to improvement, namely, the recovery of the gold from solution. It could be recovered by zinc, but an alloy of 99 of zinc and 1 of sodium gave far less trouble and almost a perfect precipitation. Speaking of the ore described by the author, he did not think the experiments were sufficiently practical. The ore was ground in such a way as no machine could produce it in large quantities, and on a large practical scale they would never get through the process, as leaching would be impossible. Properly worked, and with cheaper cyanide, the process would provide a

means of successfully treating enormous quantities of low-grade pyritic ores. Such ores existed all over the world, but were too highly pyritic to concentrate, too poor to smelt, and would not pay to amalgamate. He hoped therefore that chemists would do their part of the work by producing cheaper cyanide of potassium, and leave the application to metallurgists who had had actual experience on gold-fields and knew the real requirements.

Mr. J. S. MacArthur wished to thank his friend Mr. Trubshawe for going so fully into the matter from the commercial aspect, and for his particulars relating not to experiments on a small scale but to actual practical working, every word of which he could corroborate. The gentleman who had followed Mr. Smith had gone into some experiments that did not seem to be of much value, because of the insufficient agitation. That was a point that must be taken fully into consideration. Intermittent agitation would not do when the ore was very hard and non-absorbent. Wherever the gold was it was pretty far in, and the solution must have time to get at it, or be coaxed into contact with it. Before passing on, he would like to ask Mr. Smith why he did not in his experiments wash the cyanide solution out with water. He had given results on about 1,000 parts of ore and 500 of water, the whole thing being filtered. Naturally, the ore would contain about 20 per cent. of its weight of moisture, and with that the proportionate amount of gold. He thought that the experiments might have shown the working of the cyanide better if at the end of each stage there had been a complete washing. Mr. Blount had thrown some doubt on the statements as to the extraction of more than 90 per cent. of gold by the process; but he thought that Mr. Trubshawe had settled that point completely. With regard to the remarks that had been made as to the use of the terms "ore" and "quartz," he was not aware that the former term was limited to minerals containing metals in chemical combination, but thought it included free minerals also. But if a distinction were drawn between gold in the free state in quartz and gold in the pyritous state, it mattered not, for cyanide of potassium attacked the one as easily and with as much effect as the other. Mr. Vautin, too, appeared to have some trouble with the word "refractory." For his own part he adopted the simple plan of applying the term to any ore which, for whatever reason, would not yield its gold to the ordinary method of amalgamation. Mr. Vautin had also raised the question as to whether gold was chemically combined or mechanically held in pyrites.

Mr. Vautin: No, I meant that it was mechanically combined or encased in a crystal of the pyrites. It is still metallic, of course, but if you reduce the crystals so that they will pass through a 60-mesh sieve, that is sufficient to allow the metallic gold to pass out. What I inferred was that if a particle of metallic gold was still encased, the cyanide not being able to get at it, could not convert it into a soluble salt.

Mr. MacArthur, continuing, said that, however the gold might exist, the cyanide got at the great bulk of it. In one case it had done its work so thoroughly that they had extracted 98½ per cent. from an ore that was almost a pure pyrites—80 per cent. pyrites at least. That ore did not show gold even after being ground fine enough to pass through a 60-mesh sieve. He knew that many ores which on the most careful examination showed no free gold, did yield 90 per cent. at least to the cyanide method. Mr. Vautin had also spoken about the recovery of the gold from solution, and seemed to infer that that gave trouble. But it gave no trouble whatever. It went on with perfect smoothness and regularity, and they had no wish to improve it.

Mr. Trubshawe wished to mention one other important fact, namely, that in some of their big trials of the process they had found simple percolation to be as effective as agitation. A lot of 500 tons just put through from one mine in that way had shown almost complete extraction.

With the view of demonstrating the value of the MacArthur-Forrest process, a public trial had been lately conducted at the Salisbury Company's works near Johannesburg, on auriferous ores, tailings, and concentrates submitted for treatment. These trials, which were made on working quantities, and without preliminary roasting, gave the following results:—

Name of Company.	Dry Weight Treated.	Assay Gold per Ton.	Gold Extracted.
		oz. dwt. gr.	Per Cent.
Salisbury	102 tons Buddle Head tailings.	1 14 9	82·6
Do.	18,802 lb. concentrates ..	6 3 11	93·2
Do.	10 tons pan residues.....	2 7 9	80·2
City and Suburban.	13,440 lb. tailings.....	0 17 4	85·0
Robinson	3,278 lb. ore	1 17 13	92·6
Do.	3,678 lb. tailings.....	0 14 16	84·5
Do.	2,744 lb. free milling concentrates.	3 18 9	89·6
Ginsburg Syndicate.	5,760 lb. pyritic ore.....	1 7 0	90·0
Nooitgedacht Klerksdorp.	6,216 lb. do.	0 19 14	90·8
Wilkinson Klerksdorp.	1,763 lb. do.	0 8 1	85·0

Concentrates containing 80 per cent. of pyrites and assaying over 26 oz. of gold per ton, also proved amenable to treatment, over 98 per cent. of assay value being recovered by this process under special supervision.

——	Assay per Ton.	Gold Extracted.
	Oz. dwt.	Per Cent.
Results of 25 cwt. treated	26 6	98·25

Trials had also been made at the Cassel Company's works in Glasgow of the following refractory South African ores, which yielded the following results without roasting:—

"Edwin Bray," 95 per cent. extraction; "May Consolidated," 84 per cent.; "North Star," 94 per cent.; "Black Reef," 100 per cent.; "Klerksdorp," 100 per cent. (full extraction); "Nigel," 96 per cent.

The following results had also been obtained by this process at the Glasgow works in dealing with 22 tons of ore from the New Zealand Crown mines:—

——	Gold.	Silver.
	Oz. dwt. gr.	Oz. dwt. gr.
Weight of ore treated, 21.5.1.5 tons..... Assay contents	30 12 12	256 9 18
Actually extracted and recovered	26 14 11	219 7 11
Total average extraction	87·25 %	85·72 %

Dr. S. Rideal regretted that no systematic experiments had as yet been published, showing the relative chemical and economical values of the cyanide and older chlorine extraction processes. If different grades of ore were treated by the several processes no comparison was possible, but he thought that although apparently the cyanide process gave the best result with all kinds of ore, some of the old chlorine processes would be more economical under certain conditions.

The Chairman having suggested that Mr. Vautin might explain this point—

Mr. Vautin said that the advantage of having a solvent that would convert gold into a soluble salt without taking the sulphide of iron was of immense value. The difference

between the cyanide process and a chlorination process was that in the latter, before the chlorine could be applied, the sulphide of iron had to be converted into some form in which the chlorine had but little affinity for it. That necessitated furnaces, which on a gold-field entailed great expense, and limited the output of the mine to the roasting capacity of the furnaces. On the other hand, if the cyanide cost more than the actual cost of roasting, he would always advocate chlorination. It was easy, so long as one could banish the roasting when not actually necessary for removing the gold.

Mr. Bertram Blount wished to say a few words in reply to the criticisms of his own portion of the work. It might be quite right to say that, working on the small scale he had employed placed him at a disadvantage; but frequently it was the only means one had of investigating a process, and valuable results had been obtained in that way. He was afraid that until they all had big plants, they would have to go on with small experiments and modify their deductions accordingly. There was a good deal of variety in the accusations brought against him, one speaker having found fault with him for obtaining too much gold by grinding the ore too fine, while another thought that he had found too little in consequence of not agitating the ore sufficiently. It seemed to him, in fact, that the criticisms of one side went far to neutralise those of the other. A great deal of heavy artillery had been brought to bear upon a very simple communication. He did not suppose that his results or the general conclusions that he had drawn from them would be accepted as final; at the same time he had no reason to doubt the accuracy of his work. As to the complete washing of the ore after treatment with the cyanide, of course that took place. With regard to the degree of extraction claimed by the inventors of the cyanide process—while he did not wish to suggest that it was arrived at by the method he was about to speak of—he would mention that method in order to warn the unwary against placing too much confidence in the glowing statements that were not uncommonly met with. Some time ago a gold ore was treated by a certain process, and the extracted ore, together with the liquors resulting from the treatment, were sent to him. He assayed both, as well as the ore before treatment, and compared his results with the return made to him by the company owning the process. The quantity claimed to be extracted was 9 dwt. per ton, and the assay value of the ore was given as 10 dwt. per ton, the excellent yield of 90 per cent. of the total gold being thus apparently obtained. It was perfectly true that there was that quantity of gold extracted, but it was also true that the assay value of the ore was in reality nearly 20 dwt. instead of 10 dwt., thus reducing the percentage of gold extracted from 90 per cent. to about 45 per cent.—a vastly different result. On assaying the tailings the balance of the gold was found, thus confirming these figures. By conveniently understating the assay value of the ore the apparent *efficiency* of any process of gold extraction might be increased to any desired extent without committing the folly of overstating the *absolute quantity* of gold that could be extracted, and thereby courting detection.

Mr. Watson Smith having been called upon to reply, said that his friend Mr. F. Graham Young had a considerable interest in the matter, and but for severe illness would have been present to take part in the discussion. He had left to him the selection of the ore, which he believed to be a thoroughly representative one. In order to test the action of the weak cyanide solution on metallic gold, they had procured some pure gold leaf from Johnson, Matthey, & Co., and had found that the action was a surprisingly easy one. He knew that the price of cyanide was an important element in the practicability of the process, and had lately been told that it could not be produced under 2*s.* per lb. of 70 per cent. strength. Now that it seemed clear that brands of potassium cyanide could be obtained at half that rate and less, one of the principal difficulties of the process would be removed providing those brands whilst of diminished price were not also *pari passu* of diminished strength. The use of an alloy of zinc with a little sodium had been recommended as likely to produce good results in the precipitation of the gold. The action of zinc under ordinary conditions was extremely slow; but in the gossamer condition its precipitating power was much increased though still slow, until some deposit had taken place. In reply to Mr. MacArthur, he would say that they did wash the specimen finally to get out the cyanide last remaining in the material before testing for gold and silver; and for a test of that kind he thought that the amount of gold and silver spoke very favourably for the process. Some processes could be carried out far better in the works than in the laboratory, for in the latter they could scarcely imitate the mechanical appliances used and so achieve the mechanical advantages obtained on the larger and practical scale. In conclusion, Mr. Smith alluded to a criticism of the process which had recently appeared in a letter to the "Engineering and Mining Journal," written by a gentleman who whilst claiming to have been the originator of the cyanide process, now appeared to dissent so bitterly from the method of which he was at first enamoured that he stated that he would now prefer to recommend extractors to employ an *aqua regia* process in preference to the cyanide process. If any argument could be based on this, it would be probably one of which the reagent recommended served as a reminder, *viz.*, one based on the fable of the "sour grapes."

Liverpool Section.

University College, Brownlow Street.

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Hon. Treasurer: W. P. Thompson.
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Dr. Chas. A. Kohn, University College, Liverpool.

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

Meeting held on Wednesday, January 14th, 1891.

MR. A. NORMAN TATE IN THE CHAIR.

THE SECTOR AND GREASE SPOT PHOTOMETERS, AND THEIR RESULTS.

(This Journal, 1891, pp. 18—20.)

BY J. HURTER, PH.D., AND V. C. DRIFFIELD.

(*a.*)—Reply to Captain Abney.

Since the last meeting we have constructed a photometer on the principle of Captain Abney's, and we are happy to be able to confirm every word he has said in his paper regarding the differences which result when one and the same negative is measured by his instrument and by our own. The density of the "fog," as we term it, is considerably smaller when measured by his instrument than when measured by ours, and we fully recognise that, although the higher densities measure only about 20 per cent. less by Captain Abney's photometer than by our instrument, his transparencies are much greater than ours.

The fact is, Captain Abney's transparencies are much too great and his densities too small. He can easily convince himself of this by measuring in his instrument the transparency of a piece of white paper, such as Rives, when he will find that it allows nearly 40 per cent. of the light to pass. We need not point out to him that this is far wide of the truth.

Such marked differences between the readings of Captain Abney's and our photometer must arise from causes which he ought to have had no difficulty in finding. He, no doubt, thought that these differences were entirely due to the scattering of the light, but, as we have shown, this is so trifling that it would never account for such discrepancies.

Whilst we measure the ratio of the amount of light which a given point (the grease spot) receives, first from the naked light and then through the negative, Captain Abney measures something entirely different. He measures the alteration in the transparency of a piece of paper which is brought about by placing a negative in front of it. This alteration he takes to be the measure of the transparency of the negative, but herein he is entirely mistaken. Had we thoroughly understood the construction of his instrument at the last meeting, we could at once have pointed out the cause of the differences, and could also have clearly shown his error.

We pointed out in our first paper that the laws of absorption, as we there stated them, hold good only for such substances as reflect but little light, and do not apply at all for other substances. One substance, for which the law does not hold good, is white paper. Now Captain Abney's method of measuring actually assumes that these laws do hold good for white paper, and that the density of a combination consisting of a piece of white paper and a negative is the sum of the densities of the paper and the negative taken singly. He assumes the density of the paper as a constant, and takes the alteration produced by placing a negative in contact with it as due to the density of the negative only; whereas, in reality, it is due to the density of the negative diminished by another very important factor, namely, the alteration in the transparency of the paper consequent upon the negative preventing reflection from its surface.

This law, which we have long known and which applies to all bodies we have so far tested, black as well as white, is the following: If O is the opacity of one and O_1 of another substance, and if R and R_1 are their coefficients of reflection respectively, then the opacity of the combination of the two is—

$$O \times O_1 \times (1 - RR_1).$$

It is the last factor, the existence of which Captain Abney did not recognise, which has led to the great differences in our results. It is a very important factor, and it wholly accounts for these differences.

If we measure, in our instrument, combinations of paper and negative, these differences vanish absolutely, and our readings are in complete accord with Captain Abney's. The order in which paper and negative are placed in our instrument is perfectly immaterial; whether the light passes first through the paper and then through the negative, or *vice versâ*, the density of the combination is exactly the same, and the formula given indicates this.

But when we combine *three* things, say two pieces of paper and a negative, the opacity of the combination differs according to the order in which the three are used. Suppose, for example, we use two pieces of paper and a negative. Let O be the opacity of the paper (as measured in our instrument) and O_1 that of the negative. Let R be the coefficient of reflection of the paper, and R_1 that of the negative. The opacities of the three possible combinations will then be—

(1) Paper—paper—negative $= O^2 \times O_1 \times (1-R^2) \times (1 - RR_1)$
(2) Paper—negative—paper $= O^2 \times O_1 \times (1 - RR_1)^2$
(3) Negative—paper—paper $= O^2 \times O_1 \times (1 - RR_1) \times (1 - R^2)$

The first and the third are alike, but the second opacity is different. The reflective power of the negative being small compared with that of the paper, $1 - RR_1$ is greater than $1 - R^2$, and the opacity of the second combination is greater than that of the other two. The influence of mutual reflection can thus be readily shown without measurements by combining, in different ways, two pieces of paper and a negative.

If, on a half-plate negative of uniform density, we place two pieces of paper on one side (1), two pieces on the other side (3), and, between these, one piece on either side (2), we then, in each case, look through two pieces of paper and a negative, but you will readily see that the combination (2), paper—negative—paper, is very much darker than the other two combinations (1 and 3), the reason being that the powerful mutual reflection between two papers is absent in the second combination.

Captain Abney is therefore entirely mistaken when he thinks that his figures represent the true transparencies of the negative; they represent, in fact, the transparency increased by the mutual reflection between the paper and the negative.

But Captain Abney says that his experiment on platinotype paper shows that his figures are more nearly correct than are ours. To this we answer: that is a mere coincidence. If he had made as many experiments in this direction as ourselves, he would have found that neither his nor our figures would suit all printing operations. Let the Captain, for instance, use the negative in an enlarging apparatus where it does not come into contact with the sensitive surface, and where mutual reflection is excluded, and he will find that the densities, as measured by his instrument, are absolutely useless and wrong by much more than 100 per cent.; whereas ours are very nearly correct—not quite, because even the densities of negatives as given by our instrument are too small; a ferrous oxalate developed plate even offering more resistance to the blue rays than to the others.

Captain Abney has evidently not studied the question as carefully as we have done, and he has not considered the mutual reflection at all. The principle of his apparatus is wrong, and in attempting to avoid the trifling difficulty of "scattered light," he has fallen into the error of disregarding the much more important factor "reflected light."

We are certain that our instrument gives, as nearly as it can be measured, the correct density of a negative free from all other complications, and, so far, it is the only one which has proved itself a reliable and handy substitute for a chemical balance in photographic researches.

(*b.*)—Reply by Chapman Jones.

I have to thank Messrs. Hurter and Driffield for giving me this opportunity of replying to the section of their paper that has an immediate reference to me. I do not consider that they have correctly represented my position in the matter, nor the proper bearing of the particular experiment which they deem of so much importance.

In a paper by Messrs. Hurter and Driffield, published in the May number of the Journal of the Society of Chemical Industry, 1890, p. 455, the authors made several assertions concerning the development of photographic sensitive surfaces which are at variance with every-day experience. Some of these I combated in a paper read before the Photographic Society of Great Britain, and published in the November number of that Society's journal. To this paper and Messrs. Hurter and Driffield's accompanying reply I must refer those who are interested in the matter. It is sufficient to state here that I showed evidence against Messrs. Hurter and Driffield's assertions, and demonstrated that every experiment made by these gentlemen that I knew of either confirmed or was agreeable with the views I upheld. The particular experiment that they have just criticised is a comparatively unimportant item in the argument. I have dealt with this experiment in my paper, and have there met the hypothesis about the inequalities of the coating of the plate, and quoted

from Messrs. Hurter and Driffield's correspondence what is practically an admission that there is such a difference between the two plates as a partial remedying of over-exposure would effect. The only new point now raised is the objection to my method of averaging, based on the statement that all the highest ratios lie on one side of the plate. I would point out that the group that has been indicated as not including any of the high marginal ratios, gives the same average as the adjacent group, which includes two of these high ratios. Messrs. Hurter and Driffield appear to have no objection to averaging in groups of four instead of five, as this gives one high marginal ratio to each group, and they state that the figures so obtained fail altogether to support my claim. I had rejected this method as less impartial than the other. Both series of figures show that the ratios rise as the densities increase:—

Averages.

In Groups of Five.	In Groups of Four.
1·48	1·47
1·51	1·51
1·54	1·57
1·60	1·58
..	1·59

(c.)—Reply to Mr. Chapman Jones by F. Hurter, Ph.D., and V. C. Driffield.

In reply to Mr. Chapman Jones' remarks, we much regret if we have in any degree misrepresented him; but we are completely at a loss to understand in what way. The growth of the density ratios, with which he is so deeply impressed, is fully accounted for by a thin place in one of the plates. This place is marked by the lowest density ratio in square No. 3, from which point it will be seen the density ratios increase in all directions. We have previously pointed out to Mr. Chapman Jones that a *thickly* coated plate does not, by any means, imply an *evenly* coated plate.

He has throughout professed to regard our results from the point of view of the practical photographer, and granting that he has, in his experiment, remedied over-exposure to the full extent he claims, he has brought about a degree of improvement which the eye alone could never discover, and which, therefore, to the practical photographer would count for nothing.

RELATION BETWEEN PHOTOGRAPHIC NEGATIVES AND THEIR POSITIVES.

By F. Hurter, Ph.D., and V. C. Driffield.

The photo-chemical investigations which we had the honour to bring before this Section were undertaken with a view to render photographic operations more certain and reliable than they are at present, and by this communication we wish to direct the attention of photographers to the advantages of scientific procedure over rule of thumb manipulation. We propose to produce, by contact printing, a negative from a transparent positive, and from a negative two positives; the three being produced upon three entirely different plates. We hope to prove that we can produce the best possible result upon these plates with certainty, without making any calculations, and that, although a knowledge of logarithms is necessary for the appreciation of our theory, no such knowledge is required to carry out our practice, which indeed is simplicity itself.

In order to be successful in photographic operations it is essential to know exactly the properties of the plates we intend to use. We must know their sensitiveness to light, their behaviour during development, and their behaviour to negatives, if transparencies and secondary negatives are to be produced.

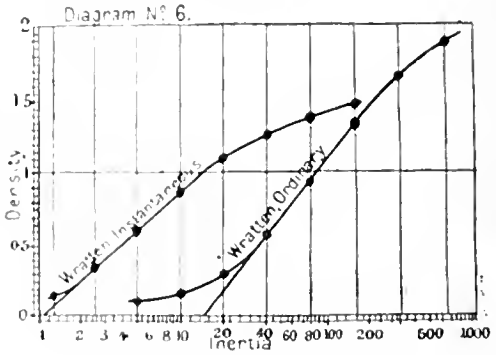
We think it well shortly to recapitulate as much as is necessary of what we have already published, so that the principles on which our operations depend may be properly understood.

We have shown that when light acts upon a sensitive film, the growth of the density of the resulting image (*i.e.*, the amount of reduced silver) is at first proportional to the intensity of the light, but that, owing to the decreasing amount of unaltered silver salt, the density grows less rapidly with prolonged exposure; a period now supervenes when it ceases to grow at all, and at last it decreases if the exposure be unduly prolonged. We have shown that for every plate there exists a range of exposures during which the growth of the density is proportional to the logarithm of the exposure, and this range we termed the "period of correct representation."

Now, what we aim at, in studying our plates, is to ascertain this range of exposures. The method of doing so is simple. We expose different portions of a plate to the light of a standard candle placed at a distance of one metre from the plate for various periods of time, every successive exposure being double the previous one. After development we measure the amount of silver reduced by our photometric method.

The densities thus obtained, when plotted on a diagram, furnish the "characteristic curve" of the plate. We refer you to diagram No. 6, which shows the characteristic curves of the Wratten "ordinary" and "instantaneous" plates, which we intend to use to-night.

Relation between Photo-Negatives and their Positives.



The lower horizontal scale is a scale of exposures, the vertical scale the scale of densities. The divisions of the exposure scale are similar to those of an ordinary slide rule. The divisions of the vertical scale are all equal, and the distance between 0·0 and 1·00 on this scale is exactly equal to the distance between 1 and 10 on the exposure scale.

In order to save trouble we have had skeleton diagrams with these scales lithographed, and members are welcome to copies. They are exceedingly convenient for plotting characteristic curves and making other memoranda of experiments.

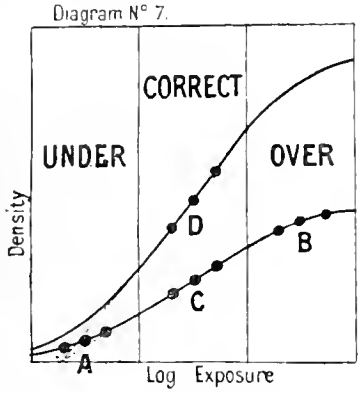
It will be seen that the two curves on this diagram are very similar, but they are situated on different portions of the exposure scale. The one plate requires much shorter exposures for the production of the same density than the other. The more to the left of the exposure scale the curve is situated, the faster is the plate.

The curve itself consists of three distinct portions. The lower strongly curved portion is the period of under-exposure; the middle portion, almost a straight line, is the period of correct representation; the upper curved end is the period of over-exposure.

The middle or straight line portion of this curve embraces the only useful range of exposures, and the only one which interests us to-night. If we produce this straight line until it intersects the scale of exposures, the point of intersection marks a particular exposure, viz., the shortest, which will produce a density very nearly at the beginning of the period of correct representation. We have shown that this point of intersection is practically independent of the length of time of development.

Diagram No. 7 shows the divisions of the characteristic curve into three periods more clearly. The curves on this diagram are two of the infinite number which are all characteristic of the same plate, and which result from differences in the length of time of development. The shorter the time of development the less inclined is the straight line, and as development is prolonged, the more inclined does the straight line become, but, whatever the inclination, it would still intersect the exposure scale at the same point.

Diagram N° 7.



It is important to know what length of time development must last in order to reach any particular inclination of this straight line. We therefore develop the plate, when determining its speed, for an exact time at a specified temperature, and note the inclination of the line by drawing through the point 1,000 on the exposure scale, a line parallel to the straight part of the characteristic, noting its point of intersection with the density scale. This gives us the value of the tangent of the angle of inclination, which value we term the "development constant." Knowing the value of this constant for one time of development, we can approximately determine the time it would take to reach any other constant, but our results in this respect are not yet sufficiently complete for publication.

We may here say that, in our first paper (**9**, 467), we gave a formula for the calculation of the development factor γ, which, we regret to say, was accidentally inverted.

It should stand—

$$\gamma = \frac{D_2 - D_1}{\log. E_2 - \log. E_1}.$$

In our former publication we have shown how we utilise the information obtained by the simple experiment with a candle for the production of negatives in the camera; we now proceed to show how we utilise it for the production of positive transparencies and secondary negatives.

The production of secondary negatives may not be considered by many as of importance, but other researches we have made have clearly shown to us that one and the same negative is not equally suitable for all printing processes, and that a negative yielding a good ordinary silver print is generally incapable of giving a first-class enlargement on bromide paper. There are therefore cases in which the production of secondary negatives of special qualities is most desirable.

Let us now imagine a sensitive plate behind a negative illuminated by a light of known intensity. For simplicity's sake let the negative have only one or two different opacities. Let the opacities of the negative be 40, 20, and 10, then we should expect the plate to be illuminated behind the negative with $\frac{1}{40}$, $\frac{1}{20}$, and $\frac{1}{10}$, the original intensity of the light. Experiment reveals, however, that this is not so, but that the results of exposures to the light behind the negatives are greater than those which would be produced by $\frac{1}{40}$, $\frac{1}{20}$, and $\frac{1}{10}$ of the original light intensity. The reason for this is not far to seek. When the light shines on the plate directly, say about 70 to 80 per cent. of the light is reflected by the plate into space. When a negative is placed in front of the plate the light is similarly reflected by the sensitive surface, but a considerable portion of it is at once reflected back again by the two reflecting surfaces of the negative, so that behind a negative less of the light transmitted by it is lost by reflection from the sensitive film, and consequently more work is done on the film than would be the case if the same intensity of the light were to act upon a film free to reflect.

Suppose the naked film were exposed to light of unit intensity. It would reflect into space the fraction R of light. Of the rest $(1 - R)$, some would be absorbed and some would pass through the plate. If, however, a negative be placed in front of the sensitive film, then the fraction R of the light cannot be reflected wholly into space; a portion of it is reflected back again upon the film, and if the coefficient of reflection of the negative be r, the amount of light which is thus returned to the film is $R\,r$. Secondary, tertiary, &c. reflections add small amounts $R^2 r^2$, $R^3 r^3$, &c. to this. The result is that the effect of unit light coming through a negative is greater than the effect of unit light when the film can reflect freely, and is represented by the amount—

$$1 + R\,r + R^2 r^2 + R^3 r^3 + \ldots = \frac{1}{1 - R\,r}.$$

or, what is the same thing, the opacity of the negative appears to be reduced by a fraction $(1 - R\,r)$. It will therefore be seen that the same negative will give different results upon different printing surfaces, according to the amount of light which these surfaces reflect.

There is still another point to be considered. When we measure the opacity of the negative, we measure it chiefly to the yellow rays of the lamp, whilst those rays are least active upon the plate. The opacity of the negative to the blue rays is in all cases we have tested greater than the opacity to the yellow rays.

These considerations will explain why, when a negative is used for contact printing, its opacity must be considered as less than that indicated by our instrument; and when it is used for enlargement the opacity must be considered as greater than that measured in our instrument, because, in the one case, the sensitive surface cannot reflect freely, whilst in the other it does do so.

The exact amount, therefore, by which we have to increase or decrease the value of the opacity of the negative depends upon the reflection of the film, upon its sensitiveness to different portions of the spectrum, and upon the colour of the negative.

If it were not for these corrections the relation between a negative and its positive could be at once deduced from the formula we gave in our paper for the calculation of the amount of silver deposited for a given exposure. This formula was, for the period of correct representation—

$$D = \gamma \log. \left(\frac{I\,t}{i}\right).$$

We should have to consider that in this formula the intensity of the light I is reduced by the negative, and we should have to divide I by the opacity of the negative, which in logarithmic calculation means deducting the logarithm of the opacity from the logarithm of the intensity of the light. But the logarithm of the opacity is the density as measured by our instrument, which density we simply subtract, and, in order to prevent confusion, we mark the densities of negatives, including the fog, by N, and the densities of positives by P. The equation which results, if we introduce at the same time the correction α of the negative density for the reasons just explained, stands thus:—

$$P = \gamma \left[\log. \frac{I\,t}{i} - \alpha\,N\right]$$

and this equation represents the general relation between a negative and its positive. P is the density of the positive

produced behind the negative of density N upon a plate of inertia i by means of the light intensity I in the time t.

The coefficient α which converts the density, as measured, into the printing density is, for negatives, developed by ferrous oxalate, usually a fraction; for pyro-developed negatives it is generally nearly 1, if the negative be used for contact printing; but when the negative is used for enlarging, the factor α, which changes the usual density of the negative into printing density, is always greater than 1, even for negatives developed with ferrous oxalate.

The method we have adopted as the simplest for finding the printing factor α is as follows, and is illustrated by diagram No. 9. We must assume that we have already made a speed determination of the plate of which we wish to determine the printing factor, and that we consequently know the extent and position of the straight line which indicates the period of correct representation. We proceed to make two more exposures which, so long as they fall within the correct period, should lie as widely apart as possible. In our example we have given exposures of 5 and 40 C.M.S. We next take a negative of a uniform density of, say, about 1·0. Our object is, through this negative, to produce upon the plate under examination a density which shall lie somewhere between the densities which will result from the two direct exposures already given. The geometrical mean of 5 and 40 is, roughly, 15, and we therefore aim to produce a density behind the

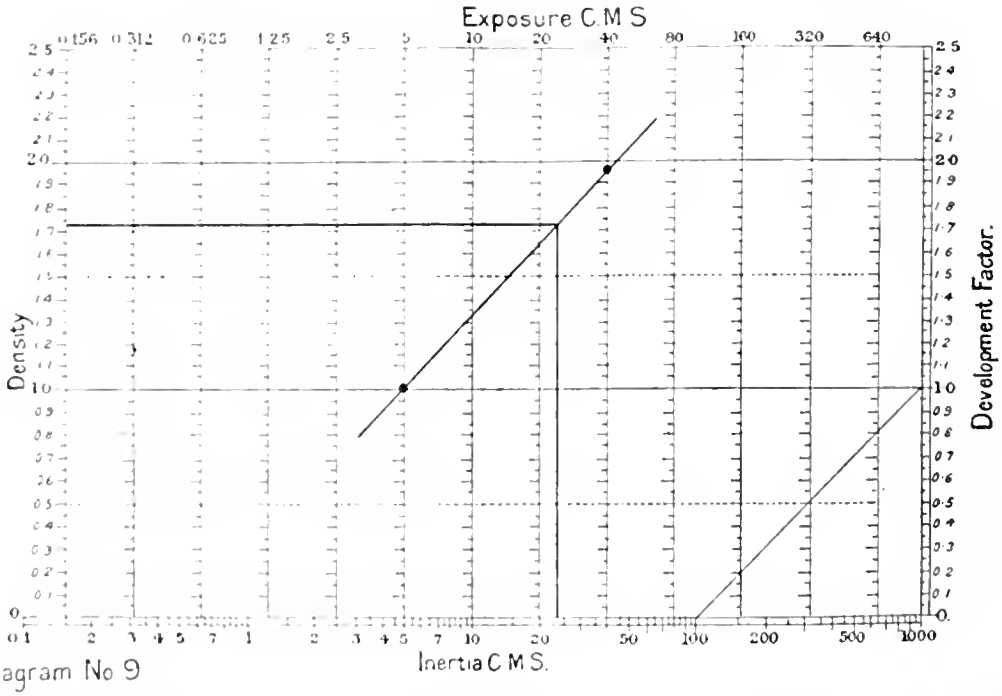


Diagram No. 9

negative (the total density of which is, in our example, 0·985) equivalent to a direct exposure of 15 C.M.S. We calculate the necessary exposure thus:—

$$\log. T = \log. 15 + 0{\cdot}985$$

$$T = 145.$$

We now give this exposure of 145 C.M.S. through the negative and proceed to develop the resulting plate, together with that produced by the direct exposures of 5 and 40 C.M.S. Having measured the resulting densities, we mark upon the exposure lines 5 and 40 of one of our skeleton diagrams those densities (exclusive of fog) which result from the two direct exposures, in our example 1·010 and 1·965 respectively. Through these two densities we draw a straight line which coincides with the correct period of the plate. In our example the density produced through the negative is 1·730, exclusive of fog; this we mark on the density scale, and draw through it a horizontal line intersecting the straight line we have already drawn. Through this point of intersection we draw a perpendicular and mark the point of its intersection with the inertia scale. This point of intersection gives the direct exposure to which an exposure of 145 C.M.S. through the negative is equivalent, in this example 24 C.M.S. We have now merely to deduct log. 24 from log. 145 and divide the result by the density of the negative used, and we obtain the printing factor α —

$$\frac{\log. 145 - \log. 24}{.985} = 0{\cdot}79$$

That this mode of converting the visual density into the printing density is correct practically, even for the errors caused by mutual reflection, is best proved by experiment.

Having measured in our instrument the densities of a negative with a number of different but uniform tints, and found the densities to be N_1, N_2, N_3, &c., we can calculate the time of exposure necessary to produce, behind each tint, exactly the same positive density if once we know the factor α.

The times of exposure are given by the equation—

$$\log. t - \alpha N = \text{constant}.$$

We have made many such experiments, of which we quote one as an example. Behind the negative densities N it was proposed to produce positive densities corresponding to 15 C.M.S. direct exposure upon a plate known as "Barnet ordinary," the printing factor for which is $\alpha = 0{\cdot}665$. The following table shows the calculations and results, the time of exposure being calculated by the formula—

$$\log. T = \log. 15 + 0{\cdot}665\ N.$$

N.	α N.	log. T.	T.	P.
			Seconds.	
1·230	·8179	1·9939	98·6	1·300
·985	·6417	1·8177	65·7	1·310
·750	·4389	1·6149	41·2	1·330
·380	·2503	1·4353	27·2	1·285
		Mean.....		1·306

It will be seen that the densities of the resulting positive were as nearly equal as they could possibly be made. Such experiments, of course, require an exact knowledge of the factor α.

The mode of correcting the visual density for mutual reflection and colour can, however, be proved correct in another way, which does not involve a previous knowledge of the factor α.

The formula $P = \gamma (\log. \frac{I t}{i} - \alpha N)$ becomes by transposition $P + \alpha\gamma N = \gamma \log. \frac{I t}{i}$. Since when exposing a sensitive plate behind a negative, the intensity of the light I in front of the negative, the time of exposure, and the inertia of the sensitive plate are all the same, the sum $P + \alpha\gamma N$ must be the same for any corresponding points of the negative and positive. If, therefore, we print a positive from a negative, ensuring such exposures as fall within the period of correct representation, measure the resulting densities, and then form the sum $P + \alpha\gamma N$, this sum must be constant. Since $P + \alpha\gamma N = c$ is the equation of a straight line, we can show this property graphically without knowing $\alpha\gamma$. We simply choose the densities of the negative as abscissæ, the densities of the positive as ordinates, and join the points which should form a straight line if the proposition is correct. We give a few experiments of this description.

Experiments made in 1887. $P + 1{\cdot}6\,N = 3{\cdot}083$.

Negative Density, N.	Positive Density, P.	P + 1·6 N.	Error.
0·700	1·960	3·080	− ·003
0·900	1·680	3·120	+ ·047
1·010	1·480	3·096	+ ·013
1·223	1·113	3·096	+ ·013
1·285	1·010	3·060	− ·023
1·360	·850	3·020	− ·063
1·550	·530	3·010	− ·073
1·660	·417	3·073	− ·010

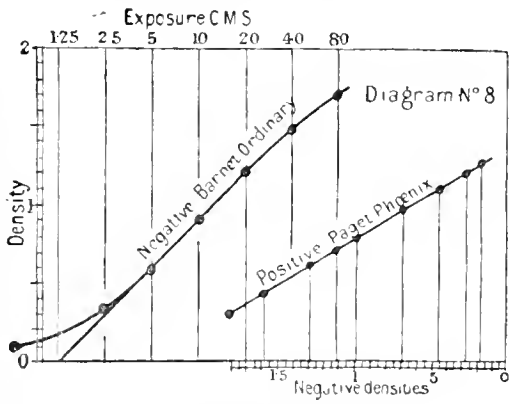
Experiment No. 2. $P + 1{\cdot}5\,N = 2{\cdot}530$.

Negative Density, N.	Positive Density, P.	P + 1·5 N.	Error.
0·700	1·470	2·520	− ·010
0·900	1·140	2·490	− ·040
1·010	1·007	2·562	+ ·032
1·223	·657	2·491	− ·039
1·285	·547	2·474	− ·056
1·360	·410	2·430	− ·100
1·550	·270	2·595	+ ·065
1·660	·190	2·680	+ ·150

This experiment being made with a slow plate the last few positive densities fell into the period of under-exposure. It must not be forgotten that all the formulæ so far given only apply to the period of correct representation.

The following more recent and and more complete experiment has been made the subject of a diagram to illustrate the graphic mode of proving that the actual exposures a plate receives behind a negative are accurately represented by our formulæ.

To diagram No. 8 the abscissæ are the densities of the negative, the ordinates the densities of the positive, and it will be seen that all the points can be joined by a straight line, which proves that the printing densities of the negative were absolutely proportional to the densities as measured by our grease-spot photometer; were it otherwise the points would have been situated on a curve. The plate used for the positive was a Paget "Phœnix;" its constants had all been determined by special experiments, so as to make it possible to calculate beforehand the densities which



ought to result. These constants were: Inertia = 6·11 C.M.S., printing factor $\alpha = 0{\cdot}577$, development factor, for 4½ minutes at 60° F., $\gamma = 1{\cdot}03$. Behind a measured negative one of these plates was exposed for 134 seconds to a standard candle at 1 metre distance. The table shows the numerical results. The calculated densities are obtained by the formula—

$$P = 1{\cdot}03\ [\log. \tfrac{134}{6{\cdot}11} - 0{\cdot}577\ N]$$

Negative Density (observed).	Positive Density (observed).	Positive Density (calculated).
0·165	1·270	1·285
0·255	1·225	1·230
0·440	1·120	1·120
0·670	·990	·982
0·98	·805	·800
1·28	·625	·620
1·57	·445	·450
1·81	·315	·300

These experiments clearly demonstrate the general relation between the negative and its positive, and show the truth of our formulæ for correct exposures.

But nothing will be so convincing of the truth of these formulæ and measurements than an ocular demonstration. If, by carefully timing both the exposure and the development, we succeed in making the value of the product $\alpha\gamma$ numerically equal to 1, then the formula becomes—

$$P + N = \text{constant}.$$

Since P and N represent the visual densities of the negative and positive, this formula really tells us that, if such a positive is placed in juxtaposition with its negative, the picture should vanish totally; we ought to perceive nothing but a uniform tint all over the plate, since on every spot the sums of the positive and negative densities are alike. We show here a negative and positive, at present fastened together, which will prove this special case of our formulæ, the only one which can be proved so readily. But it must not be supposed that every positive and every

negative will do this; it is only when exposure and development have been carefully timed that this result is obtained.

We must now refer you again to diagram 8. If, on this diagram we produce the straight line until it intersects the scale of negative densities, the point of intersection would indicate the smallest negative density through which the standard candle, at one metre distance, would have been just unable to affect the plate in the 131 seconds given.

This leads us to the rule by which we ascertain the exposure necessary to produce with certainty a good positive transparency upon a given plate.

We first of all measure the highest density of the negative which we then correct with the factor a for the particular sensitive plate, and, knowing the inertia of the plate, we take care that the exposure shall be such that, behind the highest density of the negative, the plate shall receive an exposure at least equal to the inertia. By our formula the necessary exposure would be—

$$\log. T = \log. i + a N.$$

But we do not need to make the calculation at all. Thanks to the arrangement of our diagrams, we need only take into a pair of compasses the printing density of the negative measured on the density scale, and measure from the inertia of the plate the same distance to the right on the exposure scale, and we read off at once the necessary exposure.

If the positive is to serve for the reproduction of a negative, it is absolutely necessary to continue development until the difference between two densities, say the extremes, is equal to the difference of the corresponding extremes in the negative. If the development is too short the resulting positive may look better, but it will not yield a good secondary negative.

By variations in the time of development it is possible to produce secondary negatives in which the scale of tones is either contracted or extended, and this function of development is of the utmost value in the production of special negatives for special printing processes.

It is undoubtedly a difficulty that, with one and the same negative, we have to multiply its densities as measured photometrically with different factors according to the plates we use with it. For negatives developed with ferrous oxalate the factor varies from about 0·6 to 1·0. We find it, however, sufficient for practical purposes to use the factor 0·8, but, of course, it is always better to ascertain the correct factor by experiment.

All this appears to be very complicated, but in actual practice it is very simple, as we shall now proceed to show. At the last meeting we produced, from a positive, a secondary negative, and we ascertained the necessary exposure as follows.—The highest density of the positive, as measured in our instrument, was 2·70, the printing factor a for the plate we used (Barnet) was 0·65, so that the highest printing density was 0·65 × 2·70 = 1·7955. We measured the amount, 1·795, or practically 1·800, with the compasses on the density scale, and carried this distance off on the exposure scale from the point 1·3 (the inertia of the Barnet plate). This indicated an exposure of 81 seconds, and this exposure we gave, the result proving it to have been correct.

To-night we propose to conclude our paper by producing two positive transparencies by contact printing on two plates of considerably different sensitiveness. The plates we shall use are Wratten "Ordinary" and "Instantaneous." The highest density of the negative we shall use is 2·385, and if you will refer to diagram No. 6, you will see how, from this density, we arrive at the exposure necessary for the two transparencies. We first of all multiply the density 2·385 by 0·8, and this gives the effective printing density 1·90 for the Wratten plates. We measure with compasses 1·9 on the density scale, and applying the compasses to the inertia of each plate, we read off, on the inertia scale, exposures of 87 and 1,200 C.M.S. for the "instantaneous" and "ordinary" plates respectively.

We will expose the "instantaneous" plate first, but instead of giving an exposure of 87 seconds at a distance of 1 metre from the candle, we will, to save time, give 43½ seconds at a distance of 0·707 of a metre. Having made this exposure, we will proceed to expose the "ordinary" plate. The exposure indicated is 1,200 C.M.S., which amounts to 20 minutes, and, as we do not wish to tax your patience to this extent, we will show you how we curtail a too lengthy exposure. Instead of using a candle, we will take a paraffin lamp, and we will find the distance at which it must be placed from the plate to be equal to 100 candles at 1 metre distance. To do this we hold a piece of white cardboard in the place of the sensitive plate, and, by means of a simple shadow photometer, we adjust the position of the lamp until its light is equal in intensity to that of 100 candles at a distance of 1 metre. We view the shadows through a piece of green grass in order to obviate the colour difficulty. We have now increased our light one hundredfold, and the exposure we must give is consequently 12 seconds.

(The resulting positives showed that these widely different exposures were perfectly timed, and there was nothing whatever to distinguish one from the other.)

In the discussion that followed Mr. A. Watt remarked that he was glad to be able to confirm the experiment by which the authors of the paper had shown that the production of a perfect negative is possible. Believing that this proved the general accuracy of their researches, he had repeated the experiment, and had succeeded in obtaining a negative which, when placed in contact with its positive (transparency), and viewed by transmitted light, showed a nearly uniform density all over the plate, and only a faint trace of an image. The combined positive and negative was shown to the meeting.

Meeting held Wednesday, 4th February 1891.

MR. A. NORMAN TATE IN THE CHAIR.

THE DECOMPOSITION OF STRONTIUM CARBONATE BY HEAT.

BY JAMES L. CONROY, B.SC., SHERIDAN MUSPRATT SCHOLAR, UNIVERSITY COLLEGE, LIVERPOOL.

The accounts to be found in our text-books and other works with regard to the decomposition of strontium carbonate into strontia and carbonic anhydride when heated vary so widely that I thought it would be of interest to study the conditions of decomposition especially in reference to the quantitative determination of strontium as the carbonate.

That there was room for such an investigation will be readily admitted when such contradictory statements as the following are to be found:—

$SrCO_3$ heated in a platinum crucible over a gas blowpipe is almost completely converted into oxide after about 20 minutes (Valentine).

$SrCO_3$ ignited with access of air is infusible, but when exposed to a most intense heat it fuses and gradually loses CO_2 (Fresenius).

For the purpose of examination pure (so-called) strontium carbonate was obtained, which on analysis, however, was found to contain 1·5 per cent. of calcium carbonate.

To purify this the carbonate was converted into the nitrate, and the crystals of nitrate, after powdering, extracted with warm alcohol in which calcium nitrate is soluble.

The insoluble strontium nitrate, after washing with alcohol, was drained at the pump. The product, which, when examined in the spectroscope, showed none of the calcium lines, was dissolved in water and strontium carbonate precipitated by the addition of ammonium carbonate The precipitated carbonate was washed by decantation and finally on the filter until the filtrate ceased to give a reaction with Nessler's reagent, and the product dried at 150°—170° C. The carbonate thus obtained, after heating to dull redness over the Bunsen to remove any moisture still remaining, was analysed, the carbonic anhydride being estimated by absorption and the strontium oxide (1) by direct conversion of the carbonate into the sulphate in a platinum crucible, and (2) by precipitation as strontium sulphate in presence of alcohol.

—	Percentages.	Mean.	Theory.
SrO (by direct conversion)..	70·35	70·32	70·17
(by precipitation)	70·29		
CO_2	..	29·72	29·83
		100·04	100·00

[Sr = 87·5, O = 16, C = 12.]

From this it appears that the precipitated carbonate was very slightly basic.

Behaviour on Heating.—The carbonate was heated, in quantities varying from 1·25 to 0·25 grms., in a platinum crucible over the Bunsen, in the muffle and over the blast with the following results:—

Table I.—Behaviour over the Bunsen Flame (Temperature about 800° C.).

Experiment I.			Experiment II.			Experiment III.			Experiment IV.			Experiment V.		
Weight of $SrCO_3$ taken (in Grms.).														
1·2770			·8435			·7380			·4120			·2426		
Total Time of Heat in Hours.	Total Loss of CO_2 in Grms.	Loss per Cent.	Time in Hours.	Loss CO_2	Loss per Cent.	Time in Hours.	Loss CO_2	Loss per Cent.	Time in Hours.	Loss CO_2	Loss per Cent.	Time in Hours.	Loss CO_2	Loss per Cent.
¼	·016	..	¼	·0125	..	¼	·0108	..	¼	·0055	..	¼	·0035	..
½	·0165	..	½	·0125	1·48	½	·0108	1·46	½	·0055	..	½	·0035	..
6½	·017	1·41							3	·0055	..	3½	·0033	1·44
									4	·0055	1·33			

That the loss in these cases is constant, notwitstanding the varying lengths of time during which the crucibles were heated and the different sized flames employed, show that the loss (1·45 per cent.) is entirely due to moisture in the precipitated carbonate,

Table II.—Behaviour over the Blast (Temperature 1050°—1100° C.).

I.			II.			III.		
·831 Grm. Dry $SrCO_3$			·630 Grm. Dry $SrCO_3$			·2391 Grm. Dry $SrCO_3$		
Total Time of Heat in Hours.	Total Loss of CO_2 in Grms.	Per Cent., Loss, CO_2	Time in Hours.	Loss CO_2	Per Cent. Loss.	Time in Hours.	Loss CO_2	Per Cent. Loss.
½	·026	3·13	⅓	·0367	5·8	½	·0433	18·2
			½	·0467	7·36	¾	·0463	19·3
			¾	·0587	9·3	1	·0413	..
			1	·0637	10·1			

On the blast, therefore, 0·24 grm. strontium carbonate only loses 19·3 per cent. of CO_2 in three-quarters of an hour, while larger amounts of carbonate lose much less. This clearly disproves the statement to be found in Valentine, and previously referred to, that "strontium carbonate heated in a platinum crucible over a gas blowpipe is almost completely converted into oxide after about 20 minutes," and also the statement in Roscoe and Schlorlemmer that "$SrCO_3$ when gently ignited loses all its CO_2, and is converted into strontia."

TABLE III.—BEHAVIOUR IN THE MUFFLE (TEMPERATURE ABOUT 1050° C., COPPER MELTING WITH DIFFICULTY).

I.			II.			III.			IV.		
1·26 Grm. Dry $SrCO_3$			·7272 Grm. Dry $SrCO_3$			·4065 Grm. $SrCO_3$			·2391 Grm. $SrCO_3$		
Time in Hours.	Loss of CO_2 in Grms.	Loss per Cent.	Time in Hours.	Loss of CO_2 in Grms.	Loss per Cent.	Time in Hours.	Loss of CO_2 in Grms.	Loss per Cent.	Time in Hours.	Loss of CO_2 in Grms.	Loss per Cent.
6	·349	27·7	2½	·202	27·8	6	·118	29·07	1½	·0588	24·5*
9	·359	29·25	7½	·215	29·6	9	·1205	29·64	6½	·0703	29·7
Per Cent. loss CO_2 = 29·25			29·6			29·64			29·7		

* The 0·2391 grm. had previously lost 19·3 per cent. over the blast.

In all these experiments the residue in the crucible had formed a cake which gave no effervescence with hydrochloric acid (the cake had been previously carefully moistened with a few drops of water) and therefore contained no appreciable amount of CO_2.

An analysis of the residue in experiment II. showed that it contained 100·18 per cent. of strontia (estimated as carbonate), *i.e.*, pure strontia is left on igniting strontium carbonate.

Summary:—

Loss over Bunsen.....	Nil.
Loss over blast in 1 hour	From 19·1 per cent. on ·6307 grm. $SrCO_3$ To 19·3 per cent. on ·2391 grm. $SrCO_3$.
Loss in muffle	From 29·25 per cent. on 1·26 grm. $SrCO_3$ To 29·70 per cent. on ·2391 grm. $SrCO_3$.
CO_2 (found by analysis)	29·72 per cent.
CO_2 (theoretical)	29·83 per cent.

From these results it is evident that over the Bunsen there is absolutely no decomposition, whilst at a temperature of 1050° C. the strontium carbonate is slowly but completely decomposed into strontia and carbonic anhydride, the time required for complete decomposition varying with the mass of strontium carbonate taken.

The above work has been carried out in the laboratories of University College, Liverpool, and I have to thank Dr. Kohn for several suggestions with regard to it, and for the interest he took in it during its progress.

CONCENTRATED ESSENTIAL OILS OF LEMONS, LIMES, &c.

BY ARTHUR A. BARRETT.

In bringing under your notice this evening the subject of concentrated essential oils, I think it will be well to pass in rapid review the state of our knowledge of essential oils, and more particularly its recent development.

As the subject is rather an extensive one I have limited myself to the oils of lemon and limes. These oils are of considerable commercial importance, and though our friends from Widnes and St. Helens whom I see here to-night may think the subject far less interesting than sulphuretted hydrogen and hydrochloric acid, and beneath their notice, yet the total value imported of the two oils together is very considerable.

Until quite recently it was laid down in our manuals of chemistry that many essential oils were identical in composition with oil of turpentine and chemically indistinguishable from it. Gmelin, without attempting completeness, enumerates no fewer than 28 terpenes, all of which are represented as being compounds with the formula $C_{10}H_{16}$, yet differing from one another in some way not explained.

When the benzene nucleus theory came into vogue and the laws of isomerism began to be understood, these differences were attributed to isomerism or the position of the grouping in the molecule, but it was soon perceived that if this were so, the number of isomers was still strictly limited, and attempts were made to reduce Gmelin's 28 to more modest proportions.

One of the first of the modern school of chemists to investigate the subject was Dr. Tilden of Birmingham. He succeeded in proving the identity of several of the terpenes, and was the first to point out that in the cases of oils of lemon and orange the terpenes did not contain much flavour. Owing, however, to the high temperature employed in his method of fractionation, he unfortunately or fortunately seems to have come to wrong conclusions as to the properties of the high boiling portions of the oil.

Dr. Tilden was the first to point out that in the case of oil of lemon the terpene does not contain much flavour. My object to-night is to prove to you that it really contains none. Dr. Tilden says: "Of the various constituents of volatile oils the terpenes which are present in so many of them contribute less than any other to the peculiar odour of the oil."

In the case of oil of lemon he finds, in addition to terpenes, a compound ether $C_{10}H_{17}(C_2H_3O)O$, which is decomposed by heat into a hydrocarbon ($C_{10}H_{16}$) and acetic acid. I have not been able to obtain any evidence of the presence of this body, and coupling this fact with the guarded words of Dr. Tilden, I have come to the conclusion that it does not exist.

About the same time—1877—79—that Dr. Tilden was at work, Dr. Gladstone and Mr. Kingzett made independent researches which confirmed Dr. Tilden's results as to the identity of the terpenes.

I have great pleasure in knowing that our countrymen led the way in the study of this important class of bodies, as at the present moment the classic research of Professor Wallach, Professor of Pharmacy at the University of Bonn, threatens to obscure entirely all that had previously been done.

Professor Wallach has devoted several years to the study of the terpenes, and his papers published in the "Annalen" relate the particulars of what may be described as a model research.

Without going into detail I may say that generally Professor Wallach has succeeded in classifying the terpenes and bringing them into some sort of order. At the same time a large number which were thought to be distinct from one another have been proved to be identical.

Thus—

Cinene,	the terpene of	oil of	Worm seed.
Cajeputene,	„	„	Cajeput.
Hesperidene,	„	„	Orange peel.
Citrene,	one of the	„	Lemon peel.
Carvene,	„	„	Carraway.
Menthene	„	„	Peppermint.

are all identical and may be termed limonene. This terpene is also present in oil of camphor, oil of dill seed, oil of erigeron, oil of pine needles. Naturally, it having been proved that the terpenes of lemon, carraway, and peppermint were identical, it at once became probable that in the same way that as the flavour of oil of carraway is due to carvol, peppermint to menthol and menthon, so oil of lemon would prove to owe its flavour to some quasi impurity of the terpene.

Chemists were not long in trying to isolate this, the characteristic constituent, and it is now possible to prepare it in an almost pure form. I am pleased to be able to lay before the meeting a sample of this body and also the body to which oil of limes owes its characteristic flavour. I have also samples of the terpenes from which these bodies have been separated.

If oil of lemon be distilled in a glass retort in the ordinary way over a gas burner or otherwise, and the distillation is not carried too far, the distillate will be found to be weaker than the original oil, whilst the residue in the retort is considerably stronger. This is the body, prepared in a more scientific way and completely freed from terpene, which I designate concentrated oil, and samples of which I now exhibit.

I term it concentrated oil because up to the present I cannot say with certainty what is its exact chemical composition. I hope to continue my investigations in this direction, and will meanwhile give you particulars of its properties.

Concentrated oil of lemon is neutral to litmus paper and has a pure lemon smell. It has a specific gravity of 901, never less than 900, at 15° C., and boils at 220° to 240° C., at which temperature it is partly decomposed.

Treated with bisulphite of soda it forms a magma and it is probably an aldehyde. With oxidising agents it yields a fatty acid. Warmed with metallic sodium it yields a brown mass.

A similar article to the one I am now showing was examined by Dr. Schweissinger, who published his results in the Pharmaceutishe Centralhalle, and my results agree with his.

The terpene from which the concentrated oil has been separated retains a pleasant but weak odour, but is practically free from all flavour of lemon. The specific gravity is ·850. It boils between 168° and 178°, and consists of pinene and limonene.

Concentrated oil of limes made from the fruit has not been previously prepared that I am aware of, though some work has been done in this direction by Mr. Francis Watt, chemist to the Montserrat Company. The oil which he examined and reported on to the Chemical Society of London was made from the leaves and young fruit of the lime fruit tree, *Limus limetta*. This is not a commercial article.

In this oil of lime leaves, Mr. Watt found a body boiling between 220° and 230° C., which he believes to be methyl-nonyl-ketone, $CH_3COC_9H_{19}$. This is possibly the same body which I am about to describe as concentrated oil of limes, made from the fruit.

Concentrated oil of limes as prepared by myself has a specific gravity of 920 to 923, is neutral to litmus paper and boils from 220° to 230° C. With bisulphite of soda it forms a magma. Warmed with metallic sodium it becomes very viscid, but not solid. With oxidising agents it forms a fatty acid.

The terpene from which the concentrated oil has been separated, contains a small quantity of a substance with a low boiling point, having a very objectionable smell, to which in a considerable degree the rankness of oil of limes is due. This is present in such small quantities that at present I have not been able to isolate it. The terpene when freed from this impurity has very similar properties to the terpene from oil of lemon. It retains a slight smell of limes, but is quite free from flavour. It boils at 176° to 180° C., and is probably nearly pure citrene.

Now as to the practical application.

Up to the present time the chief employment of these concentrated oils has been in the manufacture of liqueurs and syrups, and the improved flavour obtained by the absence of the objectionable greasiness of the terpene makes them specially suitable for this purpose. A great point in their use is that they dissolve at once to a clear solution, and in spirit of a much lower strength than has to be employed when using crude oils. In this country, where the high duty on alcohol makes spirit such a very expensive article, this is a very important advantage.

In using them it is a good plan to dilute the oils to about the same strength as the oils from which they have been prepared with strong spirit, say, 56 per cent. over proof; 1 part to 29 parts of spirit. You then have a solution which can be used in old receipts without making any calculation. It is rather remarkable that this solution in strong spirit has but little smell, the odour being only developed when the solution is largely diluted with water. The same thing is noticed, but to a smaller extent, when ordinary oil of lemon is dissolved in spirit, but the terpene seems to aid the diffusibility of the odorous principle.

Having diluted the concentrated oil with strong spirit to the strength of the ordinary oils, they may be further diluted with weaker spirit or added to the bulk of the cordial or liqueur to be flavoured.

The following table represents in a convenient form the solubility of the concentrated oils in various strengths of spirit :—

Strength of Spirit.	Concentrated Oil of Lemon.	Concentrated Oil of Limes.
Rectified Spirit, sp. gr. 838	All proportions.	All proportions.
900	1 in 150	1 in 100
905	1 in 800	1 in 400
920	1 in 500	1 in 600
935	1 in 3,000	1 in 4,000

In confectionery uses have been found where the employment of concentrated oils is advantageous, and in articles where sugar or other dry powders are required to be flavoured with lemon, and where oxidation is very rapid, the use of concentrated oil is an improvement. As the boiling point is so much higher than that of the crude oils, it may be advantageous to use concentrated oils where high temperatures are employed in this department.

I do not doubt also that in perfumery concentrated oil of lemon will to a large extent displace the crude oil, owing, amongst other reasons, to the fact that it is quite free from the fixed fat and resin which is contained in ordinary oil.

How nasty this residue is, contaminated as it is with dirt from the hands of the none too cleanly Italian workmen who prepare the oil, you will have an opportunity of judging for yourselves from the sample on the table.

For perfumery I have to acknowledge one disadvantage, and that is, that in an alcoholic solution the odour is only developed when the spirit has entirely evaporated; when the perfume has evaporated on the handkerchief the purity of the odour becomes evident. I think that by using a small quantity of terpene in addition to the concentrated oil, this difficulty would be got over, and the advantages of being able to use a weak spirit retained.

An important point is: Do the concentrated oils keep? The answer is: Yes, much better than the crude oils. They should be carefully stored and the same precautions taken as are usual with valuable essences, and they keep well. It is quite impossible for them to become "turpentiney" as they contain no terpene, $C_{10}H_{16}$, whatever.

The deterioration of oil of lemon by keeping is due, in my opinion, to the production of nascent peroxide of hydrogen by the action of air and moisture on the limonene and pinene. This reaction, which has been so ably utilised by Mr. Kingzett in his Sanitas process, is highly objectionable in oil of lemon, rapidly destroying the aldehyde to which the flavour is due.

The best method therefore of preserving the flavouring principle of oil of lemon is to remove the terpene. It can then be kept, if excluded from the air, in the same way as any other aldehyde.

In conclusion, I have to thank the proprietors of the Lion Still chemical works for permission to read this paper and for the loan of the samples on the table.

Discussion.

The Chairman invited discussion, remarking that although some members might consider the subject more suitable for a society of pharmaceutical chemists, yet it dealt with an important branch of chemical industry, and was well worth following up by experiments in the direction in which Mr. Barrett had worked.

Mr. M. Conway was obliged to the Chairman for an opportunity to speak on the matter under consideration. He had recently before him a small quantity of concentrated oil of lemon from a German firm, which, on careful examination, he found to be from 9 to 10 times stronger than the best oil of lemon, although it was said by the maker to be 30 times as strong, and at the time was fully 30 times dearer. It was a very fine specimen possessing the aroma of the best oil in perfection, and soluble in a weaker alcohol than ordinary oil. For this reason and also on account of its better keeping properties, it was well adapted for the manufacture of perfumery, cordials, and mineral waters. He had not as yet given sufficient attention to the chemistry of these concentrated oils to enable him to discuss it on this occasion.

Dr. Symes stated that he had had considerable experience in the treatment of essential oils, and referred to papers he had published on the subject. There was much in Mr. Barrett's paper that was in accordance with his own work, but he regretted that the author of the paper had given no attention to the refractive indices of the concentrated oils he had described.

In replying, Mr. Barrett was sorry to tell Mr. Conway that the yield was considerably under 10 per cent. If so large a yield be obtained, the commercial possibilities would be much greater than they were. The treatment of a considerable bulk of oil during last season had resulted in a yield of a little over 3 per cent. The strength might therefore be fairly estimated at 30 times, but if purity of flavour were taken into account there could be no comparison between the two.

Dr. Symes was an old worker on the subject of essential oils, and had long advocated the use of a distilled oil of lemon which was superior for some purposes to the ordinary oil. In answer to his expression of regret that the refractive indices had not been given, he did not think the refractive index of materials like essential oils, consisting as they did of varying mixtures of bodies with different properties, was likely to be of any value. The same objection applied to the concentrated oils which had not been prepared up to the present with a constant boiling point. It was not his experience that concentrated oils, containing oxygen, would not deteriorate by further oxidation; and the surmise put forward in the paper that the chief constituent was an aldehyde would support this theory. The change, however, was less rapid with concentrated oils owing to the absence of the terpene, &c.

Notes on the Conversion of the Nitrogen contained in Acid Sludge of Oil Works into Ammonia.

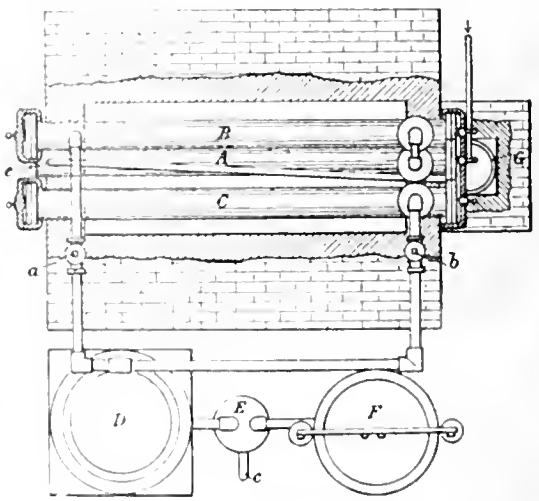
By L. J. Redwood.

Some idea of the great importance of utilising the by-product "acid sludge" or "acid tar" of the Scotch oil works to better advantage than as fuel, can be obtained from the fact that from the estimated total production of about 37,000 tons of acid sludge per annum, a theoretical yield of over 6,100 tons of sulphate of ammonia should be obtained; and this amount, at 11*l.* 5*s.* per ton, would realise 68,625*l.*, against (at 3*s.* 6*d.* per ton for acid sludge) 6,484*l.* as fuel.

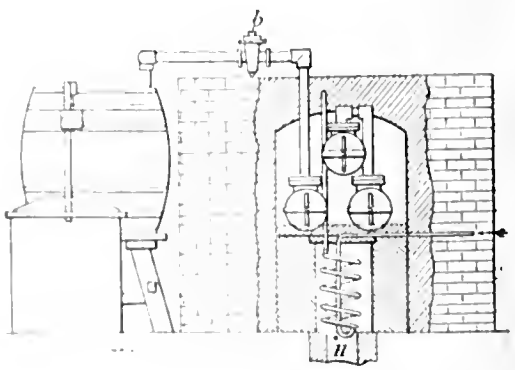
It is therefore hoped that the publication of the results of experiments made by the author at the Addiewell works of Young's Company on the conversion of the nitrogen of the oily bases of this acid sludge into ammonia may be of material value to those who are in a position to carry on the experiments and make the process a commercial success.

The mixed tars resulting from the treatment of shale oils with sulphuric acid are of a thick treacly consistency, and contain about 50 per cent. of crude oily bases of the leucoline series, which, it was thought, might be decomposed by superheated steam, and the nitrogen thus set free made to combine with the hydrogen of the steam to form ammonia.

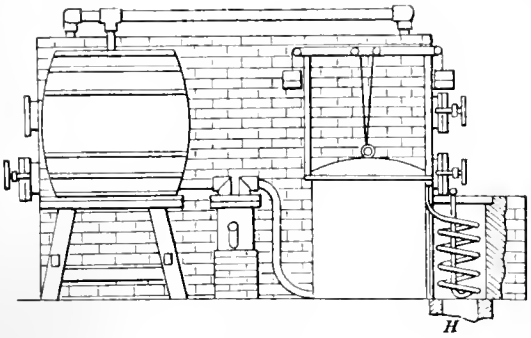
Numerous experiments on a miniature scale, after many failures, at last gave sufficiently encouraging results to justify the erection of a large experimental plant, a sketch of which is shown. The retort A was a cast-iron cylinder, 9 feet long by 6 inches internal diameter. The two cast-iron cylinders B and C, which were filled with pieces of coarsely broken brick, were used as contact chambers, and were so connected that by closing cock *a* and opening cock *b*, the gases passed through contact chamber B only. Whereas if cock *a* were closed and cock *b* opened, the gases passed through both contact chambers. D served as a condenser for the products of decomposition, which were separated in E, the gases passing on to the gas-holder F, while the water and neutral tars flowed out at *c*. G was the superheater, through which the steam passed before it entered the front end of the retort at *e*. H was the furnace connected with an underground flue.



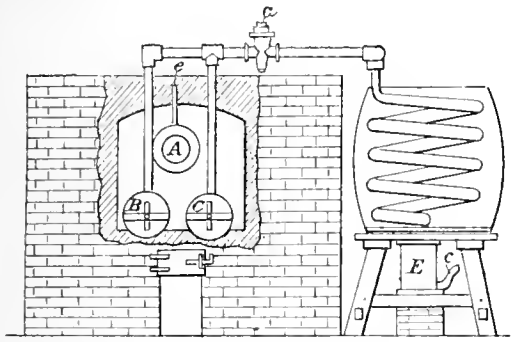
Plan.



Back End Elevation.



Side Elevation.



Front End Elevation.

As it was evident that the acid sludge would soon destroy the iron retort, it was first neutralised with "lime waste" (*i.e.*, lime after it had been used to causticise recovered soda) and equal weights of acid sludge and lime waste were found to make a very satisfactory mixture to work with. In all the experiments the retort was charged with 10 lb. of this mixture at a time, and after the lapse of about 50 minutes the charge was drawn and a fresh one introduced.

In the first set of experiments, the gases were passed through one contact chamber only, and the apparatus was worked at a bright red heat. The average yield of products from 100 lb. of the above compound were :—

700 cub. ft. of gas.
25 galls. of ammonia water (yielding 385 grs. of sulphate per gallon).
2·45 lb. of neutral tar.

In the second set of experiments, the gases were passed through two contact chambers, and the apparatus was worked at a visible red heat. The average yields were :—

830 cub. ft. of gas.
18¾ galls. of ammonia water (yielding 575 grs. of sulphate per gallon).
8·47 lb. of neutral tar.

The third set of experiments, using two contact chambers and employing a bright red heat, yielded the following results :—

816 cub. ft. of gas.
16¼ galls. of ammonia water (yielding 670 grs. sulphate per gallon).
1·44 lb. of neutral tar.

The gas obtained was found to be sufficient to supply about one-half of the total heat required to run the apparatus.

The resulting neutral tar was found to be soluble in naphtha to the extent of about 65 per cent., but other characteristics will be referred to later.

The results of the above experiments when calculated on 100 lb. acid sludge are shown in Table I.

Table I.

Product.	Experiments.		
	1st Set.	2nd Set.	3rd Set.
Sulphate ammonia (at 25·76 per cent. NH_3).	Lb. 2·95	Lb. 3·05	Lb. 3·03
Tar { soluble in naphtha	3·00	11·80	2·05
Tar { insoluble in naphtha	1·90	5·14	0·81
Gas	1,400 cub. ft.	1,660 cub. ft.	1,632 cub. ft.

In determining the yield of sulphate of ammonia, the titration test only was not relied upon, but the sulphate of ammonia was crystallised out, dried, and its strength determined.

Table I. shows plainly that both a high heat and ample contact surface are necessary for the complete decomposition of the neutral tars, and it also shows that double the contact surface with a lower heat is not so effective as a higher heat and half the contact surface, thus making it clear that a high heat is essential to the successful decomposition of the neutral tar. But when the heat is the same in both cases, the yield of neutral tar is halved by the doubling of the contact surface as is seen by comparing the results of the first and third sets of experiments.

As the sulphate of ammonia obtained from those experiments only represented about 16 per cent. of the total nitrogen contained in the acid sludge, and as an accurate knowledge of the distribution of the remaining 84 per cent. of nitrogen was indispensable for the successful conduct of future experiments, analyses of the various products were made in triplicate and the average results are shown in Table II.

Table III. shows the distribution of nitrogen calculated on acid sludge.

Table II.

Product.	Percentage of Nitrogen. Experiments.		
	1st Set.	2nd Set.	3rd Set.
Sulphate ammonia	21·212	21·212	21·212
Tar { soluble in naphtha	5·093	5·532	4·875
Tar { insoluble in naphtha	5·793	5·673	4·840
Residues from retort	0·274	0·457	0·249

Table III.

Product.	Percentage of Nitrogen calculated on Acid Sludge. Experiments.		
	1st Set.	2nd Set.	3rd Set.
Sulphate ammonia	0·5641	0·6469	0·6490
Tar { soluble in naphtha	0·1798	0·6528	0·0999
Tar { insoluble in naphtha	0·1100	0·2916	0·0392
Residues from retort	0·1644	0·2742	0·1494
Gas (by difference)	2·4797	1·6325	2·5605
Total	3·4980	3·4980	3·4980

Nitrogen determined in acid sludge = 3·4980 per cent.

It is rather discouraging to note in Table III., that, on an average, 2·2242 parts of nitrogen (= about 63·5 per cent. of the total nitrogen contained in acid sludge) passes away in the gas without combining with the hydrogen of the steam to form ammonia, and that additional contact surface does not appear to promote in any way the chemical union of the gases. It was thought that the use of soda lime might tend to bring about the desired union, and the contact chambers were therefore filled with balls made of soda lime in place of the broken brick, but the results were unsatisfactory in the sense that the improvement was not sufficient to justify the additional expense. The particulars of the results of these last experiments have been unfortunately mislaid and therefore cannot be tabulated with the rest.

The specific gravity of the neutral tar from the above experiments was 1·129. The tar was wholly soluble in carbon disulphide; naphtha dissolved about 65 per cent., and when the naphtha solution was evaporated in the steam-bath, a black oily residue was left which had a specific gravity of 1·1 and yielded on distillation 65·92 per cent. of a thick dark tarry oil of 1·045 sp. gr. This distillate had a boiling point of 190° C., and when redistilled, 50 per cent. came over under 230° C. Thus redistillation could not be carried to dryness owing to the delivery tube becoming choked with a crystalline substance that on further examination proved to be an anthracene.

The portion of the neutral tar that was insoluble in naphtha was nearly as solid, but not so brittle, as pitch, and its specific gravity was 1·184. It was only slightly soluble in ether, and the ethereal solution on evaporation left a thick sticky residue. It was soluble in coal-tar benzol to the extent of about 60 per cent., and on evaporating the benzol, a nearly solid, black, sticky residue was left. It was wholly soluble in carbon disulphide. On distillation it yielded 15·3 per cent. of a black oily tar of 1·077 sp. gr.

For the past four years or so, two or three of the Scotch oil companies have been in the habit of recovering the acid from the acid sludge, and using the recovered acid for the manufacture of sulphate of ammonia. Recovered acid is of a very dark red colour, owing to its containing nearly the whole of the oily bases in solution, but as soon as it is neutralised with ammonia in the "cracker-boxes," those bases rise to the surface, and are now separated for use as fuel.

These oily bases could doubtlessly be obtained in quantity from any of the works where they are thus produced; and in the event of any of the members of this Society being inclined to carry on these experiments, they would find that experimenting with oily bases presents less difficulty than dealing with acid sludge, which latter, besides having to be neutralised with lime-waste, also has to be introduced into the retort by hand, whereas the retort could easily be fed with the bases by means of an injector worked by the superheated steam; a continuous and more satisfactory process of decomposition could thus be carried on.

As it is evident that a fire-clay retort, and contact chambers made of the same material, if maintained at a nearly white heat, will effect the complete decomposition of oily bases, the aim of future experiments should be the discovery of a contact substance capable of promoting the union of the free hydrogen and nitrogen, and sufficiently cheap to make the process of commercial value.

Discussion.

The CHAIRMAN said that petroleum sludge had always been a difficulty with petroleum refiners, and if anything could be done to utilise its constituents to fuller advantage, it would be very advantageous to the refiners of petroleum and of shale oils. As far as he was able to judge Mr. Redwood's process, it did not appear to him that he had gone very far towards the solution of the problem.

Dr. KOHN said that he had written to Mr. Redwood asking him a few questions relative to his process, the answers to which he thought might be of interest to members.

In the first place he (Dr. Kohn) wished to know whether any analyses or determinations of the illuminating power of the gas obtained in the decomposition of the acid sludge had been made, and if so, whether the results confirmed the large quantity of nitrogen which, according to Table III., occurred in the gas, as these results, which were taken by difference, had to account for the greater proportion of the total nitrogen?

Also had Mr. Redwood any direct evidence that the ammonia he obtained really was derived from the quinoline bases contained in the sludge, for one would hardly imagine that such a stable body as quinoline would be decomposed by superheated steam with the formation of ammonia?

Further, had the author made any detailed examination of the tar obtained in the decomposition, as this could throw much light on the actual nature of the process?

Mr. REDWOOD replied that no analyses of the gases resulting from the decomposition of the sludge were made, neither was the illuminating power of the gas determined photometrically, but close observation of the gas as it was burning in the furnace showed that it was highly luminous when the retort was newly charged, but gradually fell off in luminosity as the charge became spent, and during about 10 minutes before the charge was drawn only a blue flame was visible.

In regard to the decomposition of the leucoline bases by the superheated steam, having purified the crude bases by fractional distillations until products of the required constant boiling points were obtained, and having, in so doing, only met with a loss of about 15 per cent. (due to precipitation of coke and loss by adhesion of the bases to the bottles, &c.), it was evident that the loss shown to have taken place by decomposing the sludge in the retorts was due to the decomposition of the leucoline bases.

Considering the nature and sources of the acid sludge experimented with, he did not think it either possible or probable that the nitrogen obtained as ammonia was derived from any nitrogenous substance other than the leucoline bases.

Owing to pressure of other work, no examination of the nature of the distillates obtained from the distillation of the soluble and insoluble (in naphtha) tars resulting from the decomposition of the sludge were made, other than to determine that the crystalline substance that choked the delivery tube was anthracene.

Manchester Section.

Chairman: Ivan Levinstein.
Vice-Chairman: Edw. Schunck.
Committee:

J. Angell.	J. Grossmann.
G. H. Bailey.	P. Hart.
R. F. Carpenter.	A. Lachmann.
G. E. Davis.	Sir H. E. Roscoe, M.P.
H. Grimshaw.	C. Ruby.
Harold B. Dixon.	D. Watson.

Hon. Local Secretary:
J. Carter Bell,
Bank House, The Cliff, Higher Broughton, Manchester.

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

Meeting held on Friday, 7th November 1890.

MR. IVAN LEVINSTEIN IN THE CHAIR.

SOME UNDEVELOPED INDUSTRIES.

BY PETER HART.

(ABSTRACT.)

MR. PETER HART gave a communication on "some undeveloped industries." He more especially referred to a species of cannel coal he had observed, which was to be found pretty plentifully in the neighbourhood of Worsley, near Manchester. On comparison with some Wigan cannel of similar appearance, by distillation and other tests, he found great resemblance to subsist between the cannels, both as to chemical character and also as to yield of products.

He suggested the utilisation of the cannel and shale for the production of oils, as practised in Scotland.

The other suggestion related to the possible propriety of the cultivation of the potato in Ireland not only for food, but also for the production of starch, farina, &c., so largely used by Lancashire calico printers and others.

Meeting held on Friday, 6th February 1891.

MR. IVAN LEVINSTEIN IN THE CHAIR.

THE PRACTICAL APPLICATION OF MAGNESIA CEMENT.

BY CARL OTTO WEBER, PH.D.

THE name of cement is applied to a certain class of chemical compounds, which, when in the form of a fine powder mixed with water, within a certain time form a solid homogeneous mass of stonelike appearance and great hardness. One class of these cements, which we may roughly term alumina-lime silicates, has developed into an industry of the highest importance producing millions of tons every year, although it is hardly 70 years since the beginning of the manufacture of these products on a large scale. The literature, scientific and technical, of this branch of chemical manufacturing is of extraordinary dimensions, which is, however, not very astonishing if we consider on the one hand the commercial importance of the article, on the other hand the very great complexity of this matter from a scientific point of view.

There exists however, besides the silicate of lime cements, a very great variety of other cements, some of which are used in workshops every day, but offering, neither commercially nor scientifically, much to interest us. As competitors with the alumina-lime silicates they are altogether out of the question. But there is a class of cements, the magnesia cements, which certainly are deserving of more attention than has been paid to them up to now, although I do not mean to say that they will ever rival ordinary cement in any considerable degree. But on the other hand there can be no doubt that these cements might easily find a considerable sale, so soon as the means are found to overcome certain unwelcome properties of them, which are the main impediment to their use.

The hydraulic properties of magnesium oxide have been discovered by Vical, the same man who may be considered the founder of the silicate of lime cement industry. Vical observed that freshly calcined magnesia hardens in contact with water, an observation which was confirmed by Macleod, but neither of the two seems to have followed up this experiment any further. The matter rested for more than forty years, when Deville discovered that magnesia, obtained from chloride of magnesium by calcination, and carbonate of lime formed a cement, which under water sets to a mass in its outer appearance very much like marble, but considerably surpassing this material in hardness. Deville found that the hardness these cements attain depends largely upon the density of the magnesia used. Magnesia salts precipitated with alkalis yield a magnesia of great hardness, forming cements of a very poor quality, whereas the magnesia obtained from chloride of magnesium by calcination is of great density. To use Deville's method for the production of this cement on a commercial scale is out of the question for economical reasons. But considering the composition of Deville's cement, magnesia and carbonate of lime, it is not surprising that experiments have been made with a view to utilise dolomite, a natural magnesia-lime carbonate, for the manufacture of the product in question. If dolomite is heated to a temperature below red heat the carbonic acid of the magnesia carbonate, but not of the lime carbonate, is given off and the resulting product is Deville's cement. On further investigation of this matter, Crace Calvert found that the hydraulic properties of this cement increase with the proportion of magnesia which it contains, and that in strength and durability it is equal to a good average Portland cement. This standard, however, was subsequently contradicted by Erdmenger, who found these dolomite cements very much inferior to the average Portland cements.

The interest which this class of magnesia cement at one time attracted by-and-by subsided, and to-day the question of dolomite cements has sunk nearly into oblivion. If we take into consideration that dolomite cements could be profitably produced at about two-thirds of the price of Portland cements, it is obvious that their qualities must be of such an unsatisfactory kind as to render them unfit for successful competition with the silicate of lime cements.

At about the same time Deville made his researches on the magnesia-lime carbonate cements, Sorel discovered his magnesia cement, which he described as magnesium oxychloride. He produced it by forming a paste from a finely-ground magnesium oxide and a solution of magnesium chloride from 30 to 70 per cent. strong. This cement, which sets tolerably quickly, forming a very hard mass considerably harder than marble, gives extraordinary high figures in the crushing test, and possesses a tensile strength equal to nearly one ton per square inch, which is about three or four times the tensile strength of a good Portland cement. It has the further advantages of being fairly cheap, producing splendid concretes with as much as 10 times its own weight of indifferent materials, and having a beautiful white colour, so that it appears scarcely doubtful that if magnesia is going to win a place amongst the important cements, it will be in the form of Sorel's cement or some improvement thereon.

One of the most important items to be observed with magnesia cement is to use a magnesia of great density and as free as possible from carbonic acid. A few per cent. of carbonic acid absorbed by the burnt and powdered magnesia are sufficient to so considerably interfere with its action as to render it absolutely useless. The reason of this is, not that the magnesium carbonate formed, by its chemical properties, prevents the formation of a cement from the unchanged magnesia on the interaction of the solution of chloride of magnesium, but that the magnesium carbonate envelopes each particle with a film entirely indifferent against magnesium chloride, and although, in the centre of each such particle, the cementation takes place, that outside film of carbonate prevents the action from particle to particle, *i.e.*, the agglomeration of the whole mass. A few days' exposure of the magnesia to the atmosphere are quite sufficient to make this substance unfit for use.

The magnesium chloride used for Sorel's cement is the ordinary product as it is used largely in textile industries. It is sold in casks, in which it forms a solid block of white colour and crystalline texture, containing about 48 per cent. of pure $MgCl_2$. Of this salt Sorel recommends the use of a solution from 30 to 70 per cent. strong, but I found the

results obtained are the more satisfactory the stronger the solutions used, and consequently I always use solutions about 80 per cent. strong.

If from magnesia and such an 80 per cent. solution of magnesium chloride a paste is formed, it sets within a few hours to a solid white mass, the hardness of which still increases for some days. The time of setting to a great extend depends upon the temperature and the moisture of the air at the time the experiment is made, high temperature and little moisture considerably accelerating the setting, whereas low temperature and moist atmosphere show a decidedly restraining influence.

The proportions of magnesia and magnesium chloride are of the greatest influence upon the qualities of the cement. I stated before that the cement produced was the harder the stronger the solution of magnesium chloride used, and this fact was already pointed out by Sorel himself. This might seem to imply that the hardness of this cement could be improved by increasing the proportion of magnesium chloride which enters in the composition. But this is not so. The fact is that in working the cement with an 80 per cent. solution of magnesium chloride, the strength of the cement decreases with increasing proportions of the chloride. The following series of experiments show this very clearly:—

No.	MgO	$MgCl_2$ 6 aq. 30 per Cent. Sol.	Tensile Strength per Inch Square.
1*	10	6	1,518
2	10	8	1,300
3	10	10	1,150
4	10	12	1,028
5	10	14	860

* Besides the above proportion of magnesia and magnesium chloride 1 part of water was used, as without this the mixture appeared quite dry and had no plasticity.

This shows distinctly enough that a mere increase in the proportion of the magnesium chloride is detrimental to the cement, a fact which becomes still more prominent some time after the experiment, when first hair-cracks appear on No. 5 sample, which in due time develop into gaping fissures, owing to a swelling of the cement after setting. Samples 3 and 4 show the same phenomenon, only in a somewhat smaller degree, the amount of swelling being distinctly in proportion to the amount of magnesium chloride the samples contain. Samples 1 and 2 remain perfect for any length of time. Considering these facts, we must come to the conclusion that if the stronger chloride solution produces stronger cements than a weaker chloride solution, this not due to the relative increase in magnesium chloride, but to the decrease of the water of the solution. The correctness of this conclusion is borne out by another series of experiments. Sample No. 1 of the previous series showed the highest tensile strength and stability, and to find out the influence of water, or what comes to the same, of solutions of magnesium chloride less than 80 per cent. strong, I added to the various cement mixtures varying quantities of water:—

No.	MgO	$MgCl_2$ 6 aq. 80 per Cent. Sol.	Water.	Tensile Strength per Inch Square.
6	10	7	0	1,468
7	10	6	1	1,784
8	10	6	2	780
9	10	6	3	700

Nos. 6 and 7 test were only made to check the correctness of the tests Nos. 1 to 5, and are in perfect accordance with them. Test No. 8 contains the same proportions of magnesia and magnesium chloride as test No. 7, but double the quantity of water, and the result is a cement not half as strong as the latter; and still worse is No. 9 with 3 parts of water, notwithstanding the fact that the quantity of magnesium chloride is the same in each of the three samples. Sample No. 7 never shows any swelling or hair-cracks, but the samples No. 8 and No. 9 are in this respect as bad if not worse than samples No. 4 and No. 5.

These results show that the water of the solution of magnesium chloride plays a very important part in these cements, and acts not simply as a solvent. This is further shown by the fact that a solution of magnesium chloride in absolute alcohol does not form any cement with magnesia, no matter how long it is in contact with it, as long as the moisture of the air is excluded. Sorel considered his cement simply as an oxychloride of magnesium, but this compound very probably does not exist at all. All the samples I described contain a very considerable quantity of water, of which only a very small part is given off at 100° C.; and even at 200° C. not more than 70 per cent. of the total water the cement contains expelled. From this we have to conclude that the setting of Sorel's magnesia cement is one and the same process as the setting of the Portland cements, *i.e.*, assimilation of water, this process of assimilation evidently being facilitated by the presence of magnesium chloride. According to this, we shall have to describe this cement as hydroxychloride of magnesium. Bender, to my knowledge, was the first to point this out. Bender evidently used a magnesium chloride solution containing about 50 per cent. $MgCl_2$ 6 aq., as the composition answered the formula $MgCl_2 + 5\ MgO + 17\ H_2O$. This cement lost 3 H_2O in the desiccator at ordinary temperature, 9 H_2O at 100° C., 11 H_2O at 180° C. On treating the cement with cold water, it lost $MgCl_2$, and the composition of the remainder answered the formula $MgCl_2 + 9\ MgO + 24\ H_2O$. Boiling water removes the magnesium chloride entirely, resulting in a cement of the formula 2 MgO, 3 H_2O, and Bender further adds that neither the treatment with cold nor with hot water has any destructive effect upon the agglomerated cement. My experiments do not corroborate this statement, nor is it in accordance with the results of the experiments made on a large scale with Sorel's cement. It is perfectly correct that water extracts $MgCl_2$ from the cement, which assimilates a proportionate amount of water, but this reaction invariably destroys the agglomeration of the cement; still more so if boiling water be used. This effect, produced by the action of water, makes Sorel's cement utterly useless for outdoor purposes, where it would be exposed to the influence of atmospheric moisture, and on that score failed all experiments on a large scale. The Union Stone Company in Boston, U.S.A., used Sorel's cement for the manufacture of artificial stones and emery wheels, and, as far as I am aware, the artificial stones were a failure. How the emery wheels turned out is not stated, but I am afraid the results were not very gratifying, as my own experience showed that emery wheels made from Sorel's cement are rather dangerous in use. They may for some time run right enough, and work extremely well, but they suddenly burst without any apparent cause. These very serious drawbacks are sufficient explanation that Sorel's cement, in spite of its cheap price and other advantages, is very little used.

If, instead of the magnesium chloride, a substance could be found which would form an insoluble compound with magnesia and at the same time have the same active properties with regard to the hydration of the magnesia, all these drawbacks could at once cease to exist and no doubt the magnesia cement would forthwith take its place as a cement of the first order, admirably adapted for the manufacture of artificial stones for building, ornamental, and a number of other purposes. Already Sorel hinted that magnesium chloride might be dispensed with and other compounds used instead, but at the same time he did not mention any compound better suited to the purpose than magnesium chloride. I experimented with chloride of potassium and chloride of sodium, both of which act in a similar way as the chloride of magnesium, but certainly with no better results. The chlorides of the alkaline earths do not answer at all, nor do any of the sulphates of the alkalis or alkaline earths. But there is a decided action by silicic acid, or such of the silicates which, being treated with hydrochloric acid,

produce gelatinous silicic acid. I experimented with powdered flint, infusorial earth, hydrated silicic acid, and anhydrous silicic acid, the two last-named produced from a solution of silicate of soda by addition of hydrochloric acid. The silicates I used were silicate of soda, silicate of magnesia, and silicate of lime. Powdered flint, as will be expected, showed extremely little, if any, action, although it had been most carefully incorporated to the magnesia; the cement it produced took a considerable time in setting, and was only moderately strong. Infusorial earth gave considerably better results, the cement setting very quickly and showing considerable hardness and strength. Hydrosilicic acid acted so suddenly that it was past the maximum of its action before it was properly mixed with the magnesia. Precipitated anhydrous silicic acid proved the best of the series, producing after 10 hours' setting a very hard and in every respect very strong cement of perfectly white colour. Silicate of soda forms with magnesia a paste which very soon hardens, without, however, producing a cement of any remarkable properties. The silicates of magnesia and lime behave very much like the soda silicate, but take a longer time to set than the latter. Of the whole series the precipitated anhydrous silicic acid showed to best effect, and was further proceeded with. A series of experiments was made to ascertain the best proportion of magnesia and silicic acid:—

No.	MgO	SiO_2	Time for Setting, in Hours.	Tensile Strength per Inch Square.
10	100	5	32	211
11	100	7	24	313
12	100	10	15	780
13	100	15	14	1,300
14	100	22·5	12	992
15	100	30	19	510

To get reliable results it is necessary to incorporate the silicic acid with the magnesia as carefully as possible, otherwise the repetitions of one and the same test may nearly as widely differ in the figure representing the tensile strength, as any of two of the above tests differ from each other.

This shows that about 15 per cent. of silicic acid are required to give the best result as regards the strength of the cement. Test No. 14 was quicker in setting, but considerably weaker. But even No. 15, the strongest of the series, remains considerably behind the figures we found for the magnesium chloride cements; but on the other hand, these cements made with silicic acid are perfectly indifferent against water, cold or hot, and under no circumstances begin to swell after setting. But a difficulty in the practical use of these cements would be their very great liability to become inert so very soon after exposure to the atmosphere. Two or three hours' exposure I found quite sufficient to nearly annihilate the hydraulic properties of this cement mixture. This is certainly a very serious drawback, as in practical use it would mean a great deal of waste; but it can be overcome simply by mixing the silica-magnesia cement with a solution of magnesium chloride instead of water. The cement thus formed sets in about 10 hours, and forms an extremely hard mass, which in strength even surpasses Sorel's cement without sharing the unwelcome properties of the latter. Water takes up magnesium chloride from this cement as from Sorel's, but no expansion is noticeable. Treatment with cold water is quite sufficient to extract all the magnesium chloride, the place of which in the cement is taken by water hydrating the magnesia.

The admixture of silicic acid with Sorel's magnesia cement makes the latter closely related to the hydraulic mortars as well as the Portland and Roman cement, as the formation of a hydraulic magnesium silicate in that mixture is beyond doubt. On treatment of this new cement, after setting, with hydrochloric acid, it slowly decomposes. The whole of the magnesia and about 30 per cent. of the total silicic acid contained in such a cement are in solution, the rest of the silicic acid appearing in the gelatinous state. The best proportions for the preparation of this new cement I found to be—

100 magnesia.
15 silicic acid.
90 magnesium chloride solution, 80 per cent.

This cement is of a tensile strength equal to 1,788 lb. per inch square, the most important part being the mixing of the magnesia and silicic acid, which must be done as carefully as possible. Absorption of carbonic acid previous to use to the extent of about 2 per cent. has scarcely any effect upon it, a larger proportion acts in precisely the same manner as in the other magnesia cements, and must be avoided.

The practical application of a magnesia cement free from the defects pointed out above will be very great indeed, owing to its cheapness, remarkably fine colour and great agglomerating capacity, many times surpassing that of Portland cement. As far as my personal experience goes magnesia cement is a material of the first order for the manufacture of artifical stones for ordinary building and ornamental purposes, for the manufacture of emery wheels, and for the production of artificial lithographic stones. Only in the first of these applications named it can be said to enter into competition with Portland cement, the other applications being altogether beyond the scope of the latter. Whether magnesia cement will ever be capable of competing with Portland cement in general concreting work and constructions under water I am hardly able to give an opinion yet, but it may interest you to hear that I employed it successfully for the construction of engine beds, the results also from an economical point of view being highly satisfactory.

The materials which can be utilised for the manufacture of artificial stones from magnesia cement are preferably such containing silica or silicates. Sand, crushed granite, porphyry, glass, Yorkshire and Cheshire sandstones, and the like answering very well. The quantity of cement to be used depends very little on the chemical nature of the filling-up material, but is very considerably influenced by the coarser or finer granulation of the materials used. The strengths such mixtures attain is, however, quite independent of the degree of granulation, as under all circumstances we are able to produce from any of the above filling-up materials with magnesia cement a composition very much stronger than the cement itself. This seems a very remarkable fact, and a few examples may serve to illustrate it. I used in the following series of experiments emery simply because this material is readily obtainable crushed to a number of standard sizes, the grains varying in size from $\frac{1}{4}$ of an inch (emery No. 6) to $\frac{1}{220}$ of an inch (emery No. 200 or emery flour). The samples were always tested one week after they had been made, as it was found that after this time they gain in four months about 5 per cent. only in strength.

This series clearly shows the remarkable fact above referred to, *i.e.*, that mixtures of magnesia cement and indifferent mineral materials produce compositions at least as strong as the cement itself, and eventually twice as strong. But this result is subject to certain conditions, the most important of which is, that the cement mixture used must be such as to allow each particle of the filling-up material to be got perfectly coated with it, after which the mixture must remain of a rather moist, not dry and sticky, appearance. There are, of course, two ways of arriving at this end, the one being to use a rather thin flowing cement mixture to start with, or to use a larger quantity of a dryer cement mixture. Of these two ways, I found the first to give the better result. The strongest cement mixture I produced is No. 1, viz., 10 parts of magnesia and 6 of magnesium chloride solution: these proportions produce a very dry mixture, and you will see that in combination with emery it yields a composition very much inferior in tensile strength to a similar combination made with No. 3 cement, although the latter in its pure state is very much weaker than No. 1. Experiments Nos. 16, 17, and 18 all contain the same cement mixture, but you see how the strength is increased simply by using larger proportions of it, that is

making the combined mixture of cement and emery moister. The importance of this point is still better illustrated by using the finer emery, 24 or 36. You will notice that the 20 per cent. compositions, Nos. 16, 20, and 23, show a great falling off in strength corresponding to the finer granulation of the emery, but in every instance the 40 per cent. compositions, Nos. 18, 22, and 25, show the same strength. By using more than 40 per cent. of the cement mixture no further increase in strength is obtained; on the contrary it begins to decrease, and at about 80 per cent. the combined mixtures show the same strength as the corresponding pure cement. Emery flour, however, forms the exception of the rule, as it reaches its maximum strength with 60 per cent cement. It never attains the strength we could obtain with coarser material, but on the other hand we reach the minimum strength, that is the strength of the pure cement only in using equal parts of cement and emery flour.

Cement No. 1 forming an exceedingly stiff paste, it is quite clear that, although it is about the strongest magnesia cement which can be produced, it will never give satisfactory results in combination with indifferent materials. Of course it might appear that its excessive stickiness by addition of water could be so reduced as to give it the required fluidity, but if you look at experiment No. 28, which represents the strongest compound I could obtain under these conditions, you will see that, although it is much stronger than the corresponding experiment No. 19, still it remains considerably behind the strength of the pure cement. This might still be accounted for by deficient fluidity, and no doubt it is; but by adding more water, as in experiment No. 29, you see that the result shows the contrary of an improvement. This is evidently due to the detrimental influence of the water, shown by the experiments 8 and 9, and also by No. 30, which otherwise corresponds to No. 18.

No.	MgO	$MgCl_2$ 6 aq. 50 per Cent. Sol.	Water.	Emery 16.	Emery 24.	Emery 36.	Emery Flour.	Tensile Strength, Lb. per Inch Square.
16	10	10	..	100	..	..	..	1,100
17	15	15	..	100	..	..	..	1,428
18	20	20	..	100	..	..	..	2,236
19	10	6	..	100	..	..	..	868
20	10	10	..	..	100	..	..	901
21	15	15	..	..	100	..	..	1,541
22	20	20	..	..	100	..	..	2,236
23	10	10	..	..	..	100	..	610
24	15	15	..	..	..	100	..	1,680
25	20	20	..	..	..	100	..	2,230
26	30	30	..	..	..	..	100	1,870
27	50	50	..	..	..	..	100	1,108
28	10	6	1	100	..	..	..	1,203
29	10	6	2	100	..	..	..	940
30	20	20	2	100	..	..	..	1,360

Considering the great strength of compounds of magnesia cement, it will appear that it is very well adapted for the manufacture of emery wheels, and indeed it has been used for this purpose for some time; but such an emery wheel is scarcely safe enough in use for reasons I pointed out before. If, however, to Sorel's magnesia cement the silica magnesia cement be substituted, the wheels produced are of remarkable toughness, and perhaps as safe as the emery wheels considered the safest of all, namely, those made with india rubber as cohesive matter. The proportion of cement in the magnesia emery wheels ought not to be less than 20 per cent. of the emery; it never exceeds 50 per cent. Of a somewhat similar nature is the use of this cement for the manufacture of millstones. The face of these stones can be made from emery with a backing of crushed flint. Such millstones are, in hardness, lasting quality, and general efficiency very much superior to natural stones, especially for the grinding of very hard material. For corn grinding they are not so well adapted, though they are used very extensively for the shelling of rice.

The future of the magnesia cement seems, however, to lie in its application for the manufacture of artificial building stones, as very small percentages of the cement are required to form remarkably strong stones. Nearly any mineral material can be used for this purpose, and especially good results can be obtained with mixtures of sand and not too coarse pebble or gravel. The stones may be coloured, or given an ornamental face backed by ordinary material; in this way stones are obtained which at very moderate cost resemble in appearance polished marble or granite. The most important question with regard to these stones is of course whether they will resist the influence of the atmosphere as well as a good natural building stone. As far as artificial stones from Sorel cement are concerned, this question must be answered in the negative; but stones made from the silica magnesia cement withstood the influence of the atmosphere for over 12 months without showing the slightest sign of deterioration. Amongst the specimens I brought here to-night you will find some which have been exposed for a considerable period without in any way looking the worse for it.

A few experiments which I made with a view to produce artificial lithographic stones proved very successful, in so far as the stone I obtained behaved in practical use in every respect like the natural lithographic stones from the Bavarian quarries, but it did not yield the same number of impressions as the latter. This difficulty, however, I consider not very difficult to overcome, as it merely seems to be a question of the absorbing qualities of the stone. The artificial production of these stones would be a matter of no small commercial importance, as up to now the trade in lithographic stones is monopolised by the Bavarian quarry owners.

Discussion.

Mr. J. Carter Bell asked if the author was aware of recent statements widely circulated in the continental and English papers, with regard to the great danger of magnesia in Portland cement. If magnesia cement possesses the excellent properties which the author claims for it, why should its presence be objectionable in Portland cement?

Dr. Weber, in reply to several questions raised in the discussion, said with regard to Mr. Hart's remarks he did not think magnesia cement would enter into competition with ordinary cements, as in the first instance it was a

little more expensive than Portland cement, and it applied to quite a different class of uses, such as the manufacture of building stones, emery wheels, ornamental stones, and similar articles for which ordinary cement was rather unsuitable. He had seen the article referred to by Mr. Carter Bell in some of the English technical papers on the subject of magnesia in cement, but this had no bearing on the magnesia cement in question. The detrimental effect of magnesia on Portland cement was due to the fact that the hydration of the Portland cement had come to a standstill when the hydration of the magnesia was taking place, and as this was accompanied by a swelling of the magnesia the result was a destruction of the hardened Portland cement. With regard to the composition of the magnesia cement, the prevailing idea was that magnesia cement was oxychloride of magnesium. This, however, was not the case, as pointed out in the paper. The presence of magnesium chloride in the cement after setting appears to be only accidental, and the composition of the set cement was simply that of hydroxide magnesia. With regard to the action of sea-water on ordinary cement, he found it to have a very detrimental influence, whereas magnesia cement was not affected by it. After the extraction by water of the magnesium chloride from the cement, the cement showed if anything a slight increase in strength, and, further, for the amount of magnesium chloride extracted from the cement, a proportionate amount of water is assimilated.

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SESSION 1890-91.

March 2nd (Glasgow) :—
Dr. E. J. Mills. "Destructive Distillation: Part II."
Messrs. R. T. Thomson and H. Ballantyne. "On the Revision of Constants Employed in the Analysis of Fats and Oils: Part II."

April 6th (Glasgow) :—
Election of Office bearers.
Mr. F. J. Rowan. "Notes on the Physical Conditions existing in Shale-Distilling Retorts."
Mr. J. S. Thomson. "The Determination of Impurities in Paraffin Scale, &c."
Mr. J. Gray. "An Apparatus for determining Flash-Points of Heavy Mineral Oils."

May 4th (Edinburgh) :—
Dr. J. B. Readman. "The Manufacture of Phosphorus: Part III."
Dr. J. Clark. "The Direct Estimation of Arsenic in Minerals and Metals."

Meeting held at the Societies' Rooms, 207, Bath Street, Glasgow, on Monday, 5th January 1891.

MR. W. J. CHRYSTAL IN THE CHAIR.

THE COMPOSITION AND DIGESTIBILITY OF GREEN FODDER AND OF ENSILAGE, WITH NOTES UPON ARTIFICIAL DIGESTION AS AN ANALYTICAL METHOD.

BY DAVID WILSON, JUN., M.A., F.C.S., AND P. R. HARPER.

Through the kindness of Mr. Speir, Newton Farm, Cambuslang, we received, in September 1889, nine samples of clover, representing the produce of separate plots, and one sample of ryegrass. These plots had all borne the same rotation of crops, and farmyard manure had been applied to none of them since 1875, but each had been dressed annually with a mixture made up on Ville's principle of omitting the constituents in turn from a complete artificial manure. The produce of each plot was also kept instinct in the silo at Newton, and samples of the ensilage from each sent us.

After weighing, the samples were air-dried, ground in a mill to a fine powder, and bottled for analysis. In the air-dried samples, moisture was determined by heating at 110° C. in a current of dried air; total nitrogen by a soda-lime combustion; and the albuminoid nitrogen by the copper hydroxide method, using, however, twice the amount of that precipitant recommended by Stützer. The fibre was obtained by Henneberg and Stohmann's method. The numbers in Table I. are the means of at least two, and in some cases of four and six, determinations. Duplicate results are given for total nitrogen and albuminoid nitrogen to show the limit of error.

It is evident that the composition of clover does not vary greatly with manure. In the above table the plots are arranged in the order of weight of crop, and it will be seen generally, as the crop increases the fibre and ash in the dry matter increase slightly, but the percentage of albuminoids decreases.

The composition of clover varies greatly with the stage of maturity at which it is cut, as is seen from Table II. The results of which these are the average were obtained by us from clovers grown at Carbeth.

That the composition also varies with the soil and climate is evident from the average albuminoids in 13 samples cut in bloom at Carbeth being lower than any of the nine samples grown at Newton, all cut at the blooming stage. As formerly shown by one of us,* the influence of manures on the composition of crops can generally be traced to their action in increasing succulence and reducing maturity. Such action is always most evident with soluble nitrogenous manures, and it was therefore to be expected that a leguminous crop like clover, which is not dependent on such a supply, nor materially increased thereby, would show very little difference in composition with varying manurial treatment. Differences of climate, soil, and subsoil, as affecting the conditions of maturity in clover to a greater extent than differences of manure, have also a much greater effect on its quality. Weight of produce, therefore, is the only end that need be considered in manuring clover, and the feeding value of the crop per ton will depend on the stage of development at which it is cut.

The ensilage made from these plots had been 90 days in the silo. It was scarcely of the best quality, being rather soft and sour. The pressure applied was 1 cwt. per square foot area of the silo, but owing apparently to the succulence of the clover the temperature did not rise above 125° F. Mr. Speir's experience is that 130° F. is necessary as a minimum to secure sweet silage.

* Trans. Highland and Agricultural Society for 1886, pp. 221—239 and 154—187; also for 1889, pp. 1—45.

TABLE I.

ANALYSES OF CLOVERS FROM EACH PLOT AND OF ONE SAMPLE RYEGRASS.

Number of plot	2.	7.	19.	10.	18.	20.	17.	8.	9.		
Manure	No Manure	Full Manure less Potash.	Full Manure less Potash.	Full Manure	Full Manure less Phosphoric Acid.	Full Manure	Full Manure less Nitrogen.	Full Manure less Phosphoric Acid.	Full Manure less Nitrogen.	Mean of Clovers.	Ryegrass.
Weight of crop per acre	t. c. q. 3 6 0	t. c. q. 4 5 0	t. c. q. 4 8 2	t. c. q. 3 12 0	t. c. q. 5 15 0	t. c. q. 6 0 3	t. c. q. 6 18 2	t. c. q. 7 0 0	t. c. q. 7 8 2		
Water	79·31	75·63	77·84	80·66	81·77	79·41	81·19	80·28	79·75	79·51	47·12
Solids	20·69	24·37	22·16	19·34	18·23	20·59	18·81	19·72	20·25	20·49	52·88
	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00
Solids dried at 110° C.:											
True albuminoids	18·06	16·28	18·23	17·09	16·78	15·66	15·40	15·01	15·08	16·47	8·46
Non-albuminoid nitrogen × 6·25	4·68	3·39	3·88	1·50	4·02	3·79	4·04	4·07	3·25	3·91	3·64
Carbohydrates, &c. (by difference)	47·24	47·00	47·93	48·51	46·15	49·02	45·51	44·44	47·15	46·33	48·84
Fibre	21·21	23·47	20·69	23·20	23·35	26·07	25·03	26·29	24·14	23·79	30·50
Ash	8·78	9·16	9·28	9·70	9·22	9·46	10·02	9·49	10·38	9·50	8·56
	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00
Total nitrogen (1)	3·649	3·263	3·532	2·970	3·127	3·132	3·131	3·039	2·915	3·261	1·914
Total nitrogen (2)	3·640	3·254	3·541	2·978	3·387	3·132	3·090	3·067	2·948		1·957
Albuminoid nitrogen (1)	2·890	2·726	2·914	2·724	2·677	2·500	2·463	2·397	2·436	2·634	1·337
Albuminoid nitrogen (2)	2·877	2·709	2·929	2·738	2·651	2·508	2·463	2·406	2·389		1·370
Percentage of total nitrogen, non-albuminoid	20·6	16·6	17·5	8·1	21·7	27·0	20·8	21·3	17·7	19·0	30·1

TABLE II.

Clover.	Number of Analyses Averaged.	Percentage of Water in Green Clover.	Composition of 100 Parts Dry Matter.					Percentage of Total Nitrogen, Non-Albuminoid.
			True Albuminoids	Non-Albuminoid Nitrogen × 6·25.	Carbohydrates, &c. (by difference).	Ash.	Fibre.	
Very young leafy growth	1	80·78	23·75	4·02	45·28	11·07	15·88	14·5
Young growth before bloom	6	81·92	15·70	4·76	51·34	11·41	17·19	21·7
In full bloom	13	79·71	13·46	3·87	50·14	10·93	21·60	22·3
After bloom	2	81·51	10·66	.. ..	.. ..	.. ..	29·86	.. ..

TABLE III.

ANALYSES OF ENSILAGE MADE FROM EACH PLOT OF CLOVER AND FROM RYEGRASS.

Number of plot	2.	7.	19.	10.	18.	17.	8.	9.	Mean of Clover.	Ryegrass.
Water	80·20	79·22	77·92	79·92	81·30	78·51	81·93	81·68	80·12	74·33
Solids	19·80	20·78	22·08	20·08	18·70	21·49	18·07	18·32	19·88	25·67
	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00

(*continued.*)

TABLE III—*continued.*

ANALYSES OF ENSILAGE MADE FROM EACH PLOT OF CLOVER AND FROM RYEGRASS—*continued.*

Number of plot	2.	7.	19.	10.	18.	17.	8.	9.	Mean of Clover.	Rye-grass.
Solids dried at 110° C.:										
True albuminoids	19·71	21·44	17·51	19·39	18·54	16·08	13·17	12·99	17·38	7·08
Non-albuminoid nitrogen × 6·25	3·29	3·07	5·65	5·27	5·92	3·91	5·83	2·78	4·46	2·88
Carbohydrates, &c. (by difference)	40·59	34·90	40·52	36·43	35·96	36·21	39·33	35·83	37·18	45·73
Fibre	26·91	28·72	25·91	29·05	29·35	33·13	30·83	37·63	30·19	36·81
Ash	9·50	11·87	10·41	9·66	10·23	10·67	10·84	10·77	10·49	7·50
	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00
Total nitrogen { 1	3·648	3·801	3·730	3·934	3·941	3·209	3·052	2·534	3·494	1·582
Total nitrogen { 2	3·710	3·954	3·681	4·021	3·886	3·187	3·029	2·512		1·606
Non-albuminoid nitrogen { 1	3·125	3·410	2·803	3·129	2·926	2·610	2·142	2·079	2·780	1·128
Non-albuminoid nitrogen { 2	3·181	3·440	2·797	3·139	3·006	2·534	2·072	2·079		1·136
Percentage of total nitrogen, non-albuminoid	14·3	12·5	24·4	21·2	24·2	19·6	30·7	17·6	20·6	28·9
Total acid reckoned as acetic	·58	·50	·54	·85	·63	·54	·62	·78	·63	·43

The composition of the clover silage from the different plots varies in the same direction as the clover before ensilage. The sample of ryegrass was stemmy, somewhat yellow at the bottom, and appeared partially dried when received. The ryegrass silage, on the other hand, being compact, had retained its moisture during transference.

The ash or mineral matter is not liable to change in the silo except so far as its soluble portion may be removed in the juice expressed by the pressure. The produce of the experimental plots was in the middle of the silo. Assuming therefore that the small amount of soluble ash lost in expressed juice would be balanced by that gained, as 100 lb. of the dry matter of the clover contained on the average 9·50 lb. ash, the average amount of the various constituents in the ensilage corresponding with this amount of ash, and therefore with 100 lb. of clover put into the silo may be calculated thus :—

——	True Albuminoids.	Non-Albuminoid Nitrogen × 6·25.	Carbohydrates, &c. (by difference).	Fibre.	Ash.	Total.	Total Nitrogen.
100 lb. dry matter of clovers, average	16·47	3·91	46·33	23·79	9·50	100·00	3·261
Ditto, when taken out of silo	15·74	4·04	33·94	27·35	9·50	90·57	3·164

The loss, due to fermentation in the silo, on these samples seems to have fallen almost entirely on the carbohydrates. Roughly, of 46 lb. of "carbohydrates" put into the silo only 34 lb. were taken out. The greater part of this has been entirely lost, but a small quantity, which was when put into the silo soluble in dilute acid and alkali, has become insoluble during the fermentation, and goes to increase the "fibre." The loss of nitrogenous food material has not been great in the ensilage process as conducted at Newton. There appears to have been a slight loss of total nitrogen, but this may be due to dissociation of some organic salts of ammonia—such as ammonia acetate and lactate—during the preparatory air-drying of the samples of ensilage. The process of ensilage, so far as already investigated, has frequently been accompanied by a change of the albuminoids of the fodder into non-albuminoid forms, some of which, ammonia for example, are of no feeding value, and the others (amides and amido-acids), are at least inferior to albuminoids in this respect. It will be seen, however, that the amount of non-albuminoid nitrogen is but very little higher in the ensilage from Newton than in the clover before it was put into the silo. Though, therefore, considerable decrease in feeding value often does occur by the degrading of the albuminoids in the silo, it is evident that this loss is not inseparable from ensilage, but is dependent on the substance ensiled, and on the conditions of the process.

Our main object in publishing these analyses is to point out another kind of deterioration to which albuminoids seem to be subject in the ensilage process, viz., decrease in their digestibility. Though much work has been done in Germany and America in determining the digestibility of albuminoids in different feeding stuffs, both by experiments upon living animals, and more recently by the artificial method, the experiments with ensilage in this direction have been few, and we are not aware of any upon silage made from clover or ryegrass. In experiments with living animals the quantity of each constituent supplied in the food and not recovered in the solid excrement is taken as the digested portion of that constituent; and the numbers so obtained have generally been entered in the tables of digestibility without correction for biliary compounds and mucus in the solid excrement. The method of artificial digestion as originally proposed by Stützer has been found by Ladd* and others, to give results agreeing well with these tables. We have examined the feeding stuffs used from time to time at Carbeth by this pepsin method. In Table IV. the average of the results obtained are compared with the maximum, minimum, and average results of experiments made in Germany upon living animals. Where no name is given these are on the authority of Julius Kühn (Mentzel and v. Lengerke's Landw. Kalender), and the others from the 1888 edition of Emil Wolff's Landwirtschaftliche Fütterungslehre.

* Report New York Agricultural Experiment Station for 1886, p. 372, and for 1888, p. 306.

TABLE IV.

PERCENTAGE OF CRUDE PROTEIN (= N × 6·25) DIGESTED.

	Where Grown.	By Artificial Digestion with Pepsin.		By Experiments upon Living Animals.		
		No. of Samples Examined.	Averages.	Maximum.	Minimum.	Average.
Young clover before bloom	Carbeth	6	71·4	74·3	70·5	73
Clover in bloom	"	7	71·4	70·2	64·7	67
	Newton	9	64·8			
Green vetches	"	2	76·0	80	73	76
Green lucerne	Carbeth	3	83·2	83·2	78·2	81
Young grasses	"	27	68·0	79	51	64 (Very good meadow hay (Kühn).
Older grasses	"	20	65·6			
Grass in seed	"	13	55·0	63	42	54 (Medium and inferior meadow hay (Kühn).
Oats	"	2	82·8	86	68	77·3 Wolff.
Beans	"	2	90·8	100	80·6	90
Maize	"	2	78·5	79·5	77·5	79
Linseed cake	"	3	86·5	89·9	86·2	87
Decorticated cotton cake	"	3	84·0	..	..	84·7 Wolff.
Undecorticated cotton cake	"	3	73·1	78	69·4	71
Decorticated nut cake	"	3	93·3	..	..	90·9 Wolff.

These results show that artificial digestion with pepsin affords a good criterion of the *relative* digestibility of the albuminoids in different feeding stuffs; and if a method could be found to measure as nearly the digestibility of the non-nitrogenous constituents, we believe it would revolutionise the analysis of fodders. We are at present engaged upon experiments in this direction. When practical men tell us that the market price of feeding stuffs is a better index of feeding value than chemical analysis it is time to revise our methods.

Stutzer prepared his pepsin solution directly from the inner membrane of a pig's stomach, but more constant and satisfactory results can be obtained by using "scale pepsin," as it can be preserved in the dry condition, and so a fresh solution made up for each digestion experiment. The results tabulated were got as follows: 2 grms. of substance, in the finest state of division, were repeatedly triturated with cold water in a mortar, the clear liquid being poured through a filter. When the substance was thoroughly reduced to paste, it was transferred to the filter and washed till the washings came through free from colour. The substance on the filter was then transferred to a bottle by means of 100 cc. of water and 1 cc. of 33 per cent. hydrochloric acid, and 0·1 grm. of scale pepsin added. The bottles thus prepared were loosely stoppered and immersed in a bath of water kept at 40 C. for 12 hours, with occasional shaking. The contents were then filtered, washed till free from acid, dried, and ignited with soda-lime. The result in nitrogen multiplied by 6·25 gives the indigestible albuminoids as usually tabulated.

The above method, however, cannot give the absolute digestibility of feeding stuffs, for in the animal system the albuminoids that have not been rendered soluble by gastric digestion are acted upon by the pancreatic juice in the intestines; and similarly it has been found artificially that a solution of pancreas dissolves a considerable proportion of the albuminoids which had resisted the action of pepsin. Accordingly Stutzer* now recommends that the residue from the pepsin digestion—his earlier process—should be further treated with an alkaline solution of pancreas. As has been shown, however, the pepsin alone gives for many foods at least as high results as the experiments on animals. It follows that either the successive actions of the artificial pepsin and pancreas solutions are more powerful in dissolving albuminoids than that of the digestive fluids in the animal, or that some considerable error is involved in the ordinary method of determining the digestibility of albuminoids by experiments on living animals. It was known, indeed, that the solid excrement of animals contains varying quantities of bile which has escaped resorption, and of mucus, and that the nitrogen of these was erroneously reckoned as indigestible albumen of the food; but, under the impression that the error thereby caused would be small, it was generally neglected in stating the results of digestion experiments. Further work has proved that this assumption was not justified, and Stützer,† Pieffer,‡ Jordan,§ and others, indeed all who have recently compared the artificial and natural methods of digestion on the same foods, agree in concluding from their investigations that the artificial pepsin-pancreas method gives the same result as digestion experiments with animals provided that the true correction be made in the latter for the nitrogen in the solid excrement due to biliary compounds and mucus. They differ to some extent as to the best method of estimating this correction, but, accepting their unanimous conclusion, the artificial method has the advantage not only of being much easier of execution, but also of eliminating the coefficient of the individual, which is a factor in all results got from living animals.

The pancreas solution was prepared by Stützer from the sweet-breads of oxen. Having tried this process, we prefer to use the prepared extract of pancreas sold as "pancreatine." The results given in Table V. were obtained as follows:—The residues from the pepsin digestion, conducted as before described, after being washed free from acid, and before drying, were transferred back to the bottles by means of 100 cc. of water. To each bottle 0·15 grm. Savory and Moore's pancreatine and 0·3 grm. sodic carbonate were added, and the whole heated for 12 hours at 40° C., as in the pepsin digestion; the residue filtered, washed, dried, and ignited with soda-lime. The nitrogen so obtained multiplied by 6·25 gives the indigestible albuminoids.

* Zeit. Phys. Chemie IX., p. 211.

† Zeit. Phys. Chemie X., pp. 153—162. ‡ Ibid., X., pp. 561—576.
§ Agricultural Science for 1888, pp. 293—299.

TABLE V.

DIGESTIBILITY OF GREEN FODDER, AND OF ENSILAGE MADE FROM IT.

No. of Plot.	Dried Herbage. In 100 parts Dry Matter. Crude Protein = N × 6·25.	True Albuminoids.	Albuminoids indigestible in Pepsin alone.	Albuminoids indigestible in Pepsin and Pancreatine.	In Pepsin alone. Percentage of Crude Protein digestible.	Percentage of True Albuminoids digestible.	In Pepsin and Pancreatine. Percentage of Crude Protein digestible.	Percentage of True Albuminoids digestible.	Ensilage. In 100 parts Dry Matter. Crude Protein = N × 6·25.	True Albuminoids.	Albuminoids indigestible in Pepsin alone.	Albuminoids indigestible in Pepsin and Pancreatine.	In Pepsin alone. Percentage of Crude Protein digestible.	Percentage of True Albuminoids digestible.	In Pepsin and Pancreatine. Percentage of Crude Protein digestible.	Percentage of True Albuminoids digestible.
2	22·77	18·09	7·62	3·56	66·53	57·87	84·37	80·32	23·00	19·71	15·42	8·80	32·95	21·77	61·74	55·35
7	20·37	16·98	7·35	3·30	63·92	56·72	83·80	80·57	24·51	21·44	15·24	8·66	37·84	28·92	64·67	59·61
19	22·11	18·23	8·63	3·05	60·97	52·66	86·21	83·27	23·16	17·51	15·38	7·77	33·60	12·16	66·45	55·62
10	18·59	17·09	7·68	3·14	58·69	55·05	83·11	81·62	24·86	19·59	14·20	6·90	42·89	27·51	72·26	64·78
18	21·30	16·68	6·33	2·57	70·28	62·05	87·94	84·60	24·16	18·54	13·47	6·96	44·93	27·34	71·55	62·46
17	19·44	15·40	6·41	3·09	67·02	58·37	84·10	79·94	19·99	16·08	13·37	8·16	33·12	16·82	59·18	49·25
8	19·08	15·01	6 37	2·81	66·62	57·57	85·28	81·27	19·00	13·17	10·61	6·55	44·16	19·44	65·54	50·27
9	18·33	15·08	6·51	2·98	64·49	56·82	83·74	80·24	15·77	12·99	9·76	5·96	38·13	24·89	62·21	54·14
Mean of Clovers	20·25	16·57	7·11	3·06	64·81	57·14	84·82	81·18	21·84	17·38	13·43	7·47	38·45	22·36	65·45	56·44
Rye-grass	12·10	8·46	4·01	1·84	66·87	52·60	84·79	78·25	9·96	7·08	6 04	3·24	39·37	14·69	67·47	54·24

Taking the average of these eight samples of clover, they contain 16·57 per cent. of true albuminoids, and of this 9·46 per cent. are digested with pepsin alone, but after passing through the fermentation of the silo only 3·95 per cent. are soluble in the pepsin solution. So notable was this difference, that additional experiments were made increasing the hydrochloric acid at regular intervals until the digestive solution contained 1 per cent. HCl, but this modification, adopted by several experiment stations in America, did not alter to an appreciable extent the results obtained. The re-digestion with pancreatine has dissolved about half of the albuminoids which resisted the action of pepsin both in the clover and in the ensilage. The difference in the digestibility is therefore not so noticeable with pepsin-pancreas digestion as with pepsin alone. It may be inferred, however, as the result of both methods, considering the former as a relative and the latter as our nearest approach to an absolute measure of digestibility, that the process of ensilage, as conducted at Newton upon these samples of clover and ryegrass, has to a very marked extent reduced the digestibility of the albuminoids they contain, and the value of the fodder proportionately.

We cannot chemically formulate this change. While the individual albuminoids—the pure nutrients—may be taken as wholly digestible, the group that goes under that name in fodder analyses, consisting of all the nitrogenous substances insoluble in water, as well as those that are precipitated by copper hydroxide, are admittedly only partially so; and the heat and acidity developed in the silo may affect the proportions in this complex group. Or, as it has been shown that the ensilage process in this case has increased the so-called "fibre," it may have so acted upon the walls of the individual cell as to render the contents less easily acted upon by the juices of the alimentary canal.

There are thus two ways in which the fermentation of the silo may practically destroy albuminoids; first, by changing them into amides and other less valuable compounds, as shown in samples of ensilage examined by Prof. Kinch, Mr. Clifford Richardson, Mr. W. H. Jordan, Sir J. Lawes, and Dr. Gilbert and others; and, secondly, as shown here by rendering them indigestible. The extent of the loss in both cases will depend on the nature of the substance ensiled, and on the conditions of the process. One way or the other there will be loss of those feeding constituents of which our farms produce too little, and which are the most expensive to buy in. It would seem advisable, therefore, in practice to reduce the risk of serious loss by pasturing, or making into hay-crops like clover and other leguminosæ, and to confine ensilage to those crops which are poorer in albuminoids. It is in providing succulent winter food, and as a substitute for roots, which contain but little true albuminoids, that ensilage has its place and value.

DISCUSSION.

Dr. G. G. HENDERSON said they were much indebted to Mr. Wilson for giving them another instance how the application of chemical knowledge to agriculture might be of the greatest possible value. Could Mr. Wilson inform them how certain of the "albuminoids" were rendered indigestible in the process of silage. One could easily enough understand how they were changed into amides and other compounds, but he wished to know if the change by which these albuminoids were rendered indigestible had been studied, and, if so, what was the explanation of the fact.

Mr. D. WILSON said he was not in a position to give a definite answer to Dr. Henderson's question.

Meeting held in the Philosophical Institution, Edinburgh, on Tuesday, February 3rd, 1891.

DR. J. B. READMAN IN THE CHAIR.

THE NITROGEN OF CRUDE PETROLEUMS AND PARAFFIN OILS.

BY GEORGE BEILBY.

In a former paper I have shown (J. III., 216) that the ordinary crude oil distillate from average Scotch oil shale contains from $\frac{1}{3}$ to $\frac{1}{4}$ of the nitrogen of the original shale. This oil contains from 1·16 per cent. to 1·45 per cent. of nitrogen in the form of basic tars which readily combine with, and are almost completely removed by, sulphuric acid of sp. gr. 1·220. These basic tars are the principal impurity of crude shale oil.

When crude shale oil is re-distilled it leaves a residue of pitchy coke which contains about 3 per cent. of nitrogen.

When the basic tars which have been separated by sulphuric acid are neutralised and distilled, the percentage of nitrogen in the various fractions is pretty constant, varying from 3·24 per cent. to 3·51 per cent., and the undistilled residue contains 4 per cent. of nitrogen. Therefore in the distillation of the basic tars as in the distillation of the crude oil, the nitrogen tends to concentrate in the undistilled residue.

In the same paper the following statement occurs :—

"In 'Watt's Dictionary' (I. 426) there is a table of analyses of certain natural bitumens, which are found to contain from 1 to 2·3 per cent. of nitrogen, thus indicating their probable organic origin. In this connexion it is interesting to note that while all crude oils or naphthas, artificially prepared by the destructive distillation of carbonaceous deposits, contain nitrogen in the form of alkaloidal tars, the natural American petroleums do not contain any nitrogen. This statement is based on the results of the examination of many ship loads of crude petroleum residuum which have passed through the refinery at Oakbank works during the last 12 years. If, therefore, these petroleums have been produced from organic deposits by a process of subterranean distillation, what has become of the organic nitrogen?"

In view of the possible value of this observation as a contribution to the study of the origin of natural petroleums, I decided to carefully re-examine American petroleum and to extend the examination so as to include various other natural petroleums. The results of this examination, which was made some years ago, are now published for the first time.

American Petroleum.

When crude petroleum is distilled the refiner takes off as distillate about 90 per cent., leaving in the still about 10 per cent. of residue, which contains the higher boiling oils and paraffin and most of the tarry impurities. This residue is commercially known as "residuum."

Unlike crude shale oil, petroleum residuum gives no separation of basic tar with dilute acids, but concentrated sulphuric acid separates a thick pitchy tar. This tar is quite free from the smell of pyridine bases which is so characteristic of shale tar.

All of the nitrogen determinations which follow were made by soda-lime in extra long tubes heated very slowly to give ample time for the complete decomposition of the basic tar vapours by red-hot soda-lime. If in any case sensible quantities of oily or tarry matter appeared in the condensation bulb, the experiment was rejected as likely to give too low a result. As the actual quantity of ammonia obtained was very small it was absorbed in HCl and weighed as platinum double chloride.

Analyses were made of the residuum, of the pitchy coke left by it on distillation and of the tar separated from the distillate by concentrated sulphuric acid. The following are the results :—

	Per Cent. Nitrogen.
Residuum	0·080
Coke ($\frac{1}{4}$ of residuum)	0·375
Tar ($\frac{1}{7}$ of residuum)	0·710

The nitrogen found in the coke and tar is equal to 0·078 per cent. on the residuum or practically the whole of the nitrogen originally present.

The residuum is about one-tenth of the original petroleum, so that the amount of nitrogen found is equal to 0·008 per cent. on the original oil. A part of the nitrogen of the original petroleum may have passed over with the 90 per cent. distillate, but there cannot have been much, as that distillate is almost a refined burning oil and does not contain more than a small percentage of tar.

I have now to correct the statement in my former paper as quoted above, as it is now found that crude American petroleum contains at least 0·008 per cent. of nitrogen.

Russian Crude Petroleum.

Mr. Boverton Redwood having kindly sent me samples of Baku petroleum and its residuum or "Astatki," these were analysed and gave the following results :—

	Per Cent. Nitrogen.
Baku crude petroleum	0·05
Baku crude petroleum residuum	0·05

Only a small part of the Baku crude is distilled off as burning oil, the larger part remaining as residuum, so that there is less apparent concentration of nitrogen in this case.

Galician Ozokerite.

A sample of crude earth wax or ozokerite from Galicia was analysed and gave 0·188 per cent. of nitrogen.

Scotch Petroleum or Ozokerite.

In 1885, in sinking a pit at Midcalder from the "Broxburn" seam of shale to the "Dunnet" seam (see diagram in Mr. Steuart's paper, J. Vol. VIII. 100) a seam of very hard crystalline limestone was cut through, in the crevices of which small quantities of a greenish-brown, translucent, semi-solid wax or ozokerite were found. From its situation, not far from a trap dyke which had disturbed the shale seams, it seemed most probable that this ozokerite was a distillate from one of the shale seams which had condensed in the cracks and crevices of the limestone. In view of its probable origin it was thought that a determination of its nitrogen would be of interest, and the following result was obtained :—

	Per Cent. Nitrogen.
Scotch petroleum or ozokerite	0·296

Only a small quantity of this petroleum could be obtained, so that it was not possible to assay it for oil and paraffin products, but its appearance suggested that it was a tolerably pure product rich in solid paraffin.

The "Broxburn petroleum" described and analysed by Mr. D. R. Steuart (J. VI. 128), must be very similar to the petroleum found in the Midcalder pit, and, from their situation with reference to the shale seams, it is probable that both were produced from the same seams. Mr. Steuart's experiments showed that this petroleum only suffered a loss of about 16 per cent. on refining, as compared with 27 per cent. lost by the best artificially distilled oil, and as most of this loss is due to basic tars, it may be taken as a rough index of the quantities of these tars, and therefore of the nitrogen in the oils.

Comparing the natural and the artificial distillates from the same shale seam at Midcalder we have :—

	Per Cent. Nitrogen.
Natural petroleum contains	0·296
Artificial (retort-distilled)	1·160

The natural distillation in the earth evidently produces a much purer distillate, containing a much smaller percentage of nitrogen and basic tars; so that the smallness of the percentage of nitrogen in American and Russian crude petroleums cannot be held to exclude them from classification as distillates from organic remains.

The actual percentage of nitrogen in any distillate must always be largely determined by the nature of the organic remains from which it was derived. We should never expect a coal, chiefly derived from the woody parts of large trees, to give a distillate containing as large a percentage of basic tars and nitrogen as we should from a shale derived from animal remains or from the seeds and more highly nitrogenous parts of plants.

From the results recorded in this, and in my former paper, it seems probable that an explanation of the much smaller percentage of nitrogen in natural as compared with artificial oils is to be found in the tendency of the nitrogenous bodies to concentrate in the residues of distillation. It is easy to picture a condition of subterranean distillation in which the oil is distilled out of the shale by the heat from intruding lava, and condenses in the immediate neighbourhood among the earthy particles, only to be again distilled and driven to a fresh condensing place when sufficient heat reaches it by conduction. A few such distillations and condensations would reduce the nitrogen of the final distillate to a mere fraction of its former amount. Any of the nitrogen which might be converted into ammonia or volatile bases would, of course, disappear, leaving no trace behind.

TABLE OF NITROGEN DETERMINATIONS.

	Nitrogen per Cent.
Scotch shale oil from retorts	1·160
Scotch petroleum or ozokerite	0·296
American petroleum residuum	0·080
Baku petroleum	0·050
Baku petroleum residuum	0·050
Galician ozokerite	0·188
Scotch basic tar	3·900
American residuum tar	0·710
Scotch crude still coke	3·200
American crude still coke	0·375

DISCUSSION.

The CHAIRMAN asked if Mr. Beilby would state the amount of nitrogen usually found in the Broxburn shale, and the proportions of that nitrogen recovered as ammonia, that is, how much went into the tar and the oil?

Dr. G. G. HENDERSON said it appeared from Mr. Beilby's results that in the distillation of shale, &c., there was a tendency towards accumulation of nitrogen in the residues of the distillation, and therefore that the smallness of the quantity of nitrogen found in petroleum could be accounted for by assuming that that substance was a product of some natural process of distillation of organic matter. He did not know whether any positive proof could be led in support of this supposition—whether, for example, there were any traces in oil-bearing districts of natural processes, such as irruption of volcanic rocks, by which distillation of organic matter could be brought about—but at any rate Mr. Beilby's results seemed to go against the view that petroleum and similar substances were formed by the action of steam on carbides of the metals in the interior of the earth at very high temperatures. He would be glad to know Mr. Beilby's opinion on this subject.

Mr. G. BEILBY, referring to Dr. Henderson's remarks, said they had certain facts before them which might lead themselves more or less to one or other theory of the origin of petroleum.

First.—The retort distillates from fossil deposits in peat, coal, or oil shale, contain nitrogen, generally as alkaloidal bases.

Second.—A number of petroleums which have been examined contain nitrogen probably in the form of bases, as it is all removable from the distillate by sulphuric acid.

Third.—The experiments on the concentration of nitrogen in the residues of distillation offer a possible answer to the question: Why do the natural petroleums contain so much less nitrogen than the retort distillates?

Fourth.—In the case of the Scotch petroleum or ozokerite, its character and its situation with reference to the seams of shale make it highly probable that it is a natural distillate from the shale.

In answer to Dr. Readman's question, he stated that in the retort distillation of an ordinery Scotch shale one-fifth to a quarter of its nitrogen appeared in the oil distillate.

Mr. W. HUME, philosophical instrument maker, Edinburgh, exhibited and explained a portable form of Mr. John Aitken's pocket dust counter, which he had prepared for that gentleman. He explained its details by means of lantern illustrations, pointing out its importance and value in determining the amount of dust particles present in the air.

Journal and Patent* Literature.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

The Production and Utilisation of Artificial Cold. G. Richard. Bull. Soc. d'Encouragement l'Industrie Nationale, 1889, 629—661 and 749—773.

THIS elaborate memoir was compiled by the author at the request of the organising committee of the *Congress Internationale de Mechanique appliquée*. The whole subject of the machinery employed for the production of artificial cold is exhaustively treated. The applications are less fully dealt with except in the case of the manufacture of ice. No less than 246 patents are referred to in the memoir. In addition the following sources of information have been largely drawn upon.

Ledoux.—*Theorie de Machines à froid* (*Annales des Mines*, July—August 1878).

Haton de la Goupillière.—*Cours de Machines.*

Armengaud.—*Étude sur la production mechanique de froid*, 1874.

Lightfoot.—*Machines for Producing Cold Air* (Inst. of Mech. Engineers, January 1881; see also this Journal, 1886, 133—142).

J. Coleman.—*Refrigerating Machinery* (Inst. of Civil Engineers, February 14, 1882; see also this Journal, 1884, 357—366 and 1887, 253—258).

Gottlieb Behrend.—*Eis und Kalteerzeugungs Maschinen.*

Also the work of Lezé on ice machines, papers by Kirk and by Kilbourn and other original matter.

Formerly the means principally employed for producing cold were:—

1. Saline solution.
2. Latent heat of evaporation.

The first is entirely restricted to domestic use.

The second principle is applied in the well-known apparatus of Carré (Eng. Pat. 4164 of 1876), in which the water to be frozen is cooled by evaporation in vacuo, the

* Any of these specifications may be obtained by post, by remitting the cost price, *plus* postage, to Mr. H. Reader Lack, Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C. The amount of postage may be calculated as follows:—

If the price does not exceed 8*d.*	½*d.*
Above 8*d.*, and not exceeding 1*s.* 6*d.*	1*d.*
„ 1*s.* 6*d.*, „ „ 2*s.* 4*d.*	1½*d.*
„ 2*s.* 4*d.*, „ „ 3*s.* 4*d.*	2*d.*

vapour being absorbed by sulphuric acid. Various patents were taken out in connexion with this method which was applied on the large scale. Difficulties with the pumps, and the necessity for continual renewal of the acid prevented their success. The employment of sulphuric acid, moreover, was a bar to their application for domestic use. The use of sulphuric acid was avoided in Atkinson's machine (Eng. Pat. 16,547 of 1886) in which the vapour was condensed, but at the expense of a loss of efficiency.

In the machinery used at the present time the source of cold is in every case *the latent heat of expansion*, aided in one of the two important classes of machines by *the latent heat of evaporation*.

There are two principal classes of refrigerating machines (1) in which the expanding body is the air; (2) in which the expanding body is the vapour from a condensable gas, generally ammonia, but sometimes sulphur dioxide or carbonic acid.

This second class may be sub-divided according as to whether—

(*a*) The vapour is liquefied by pressure.

(*b*.) The vapour is liquefied by absorption in a solvent.

The variety of machines in class (2) is very large. By far the most important, however, are those in which the working substance is *ammonia* and the means of liquefaction is *compression*. The bulk of the memoir is occupied with descriptions of different types of air machines and ammonia compression machines. The former enjoy at present a practical monopoly of the installations on board ship, being used for the preservation of meat. In the opinion of Diesel this monopoly is simply due to the fact that hitherto a type of ammonia machine suited to ship-board has been wanting. Such a type has been designed by Linde, for the White Star Line. In opposition to the views of Diesel, Richard points out, what is indeed sufficiently evident, that a principal objection to the employment of ammonia or other condensed-vapour machines on board ship is that if any accident occurs during the voyage, there is no means of replacing the working substance. Again, change of climate scarcely affects the working conditions of the air machines, which is far from being the case with ammonia machines. On the other hand, for permanent installations on land, the machines working with a liquefied gas (generally ammonia) are to be preferred. They are less cumbersome than air machines, owing to the greater specific heat per unit volume of the working substance, and they need no arrangement for the removal of moisture.

Theory of Air Machines.

In order that the air may be cooled, it is caused to do work by expansion in a cylinder of the steam-engine which drives the machine (see description of Fig. 1). The capacity of the expansion cylinder is defined by the formula—

$$d = r^{\frac{1}{n-1}} = r^{0.41}$$

where c = volume of compression cylinder, r = expansion, n = ratio (1·41) of the two specific heats of air. The refrigerating air machine being exactly the inverse of a hot-air engine, its maximum efficiency depends on the ratio—

$$\frac{T_2}{T_1 - T_2}$$

T_1 and T_2 being the absolute temperatures of the compression cylinder and of the freezing chamber. The efficiency, therefore, diminishes as the difference of temperature is greater, or, in other words, as the expansion of the air is greater. At the same time, with a smaller difference of temperature, the frigorific power of the machine diminishes. An expansion of 2·5 is found to be about the best value. The efficiency rarely exceeds 80 per cent. The highest result that one can expect to attain with a pressure of four atmospheres is 1,000 negative calories per horsepower per hour of the compression cylinder, and 25 calories per cubic metre of air passing through the machine. During compression the air should describe, as nearly as possible, an isothermal. The cooling is effected by cold water circulating round the compression cylinder, sometimes aided by an injection of water. The principle of the regenerator has been applied, in the case of machines which do not work in a closed cycle, by employing in the compression cylinder air drawn from the refrigerating chamber (Windhausen, Eng. Pat. 669 of 1869, and Bell-Coleman). Kirk's regenerator (Eng. Pat. 1218 of 1862), although ingenious and correct in principle, has not come into general use.

The principal parts of an air machine are:—

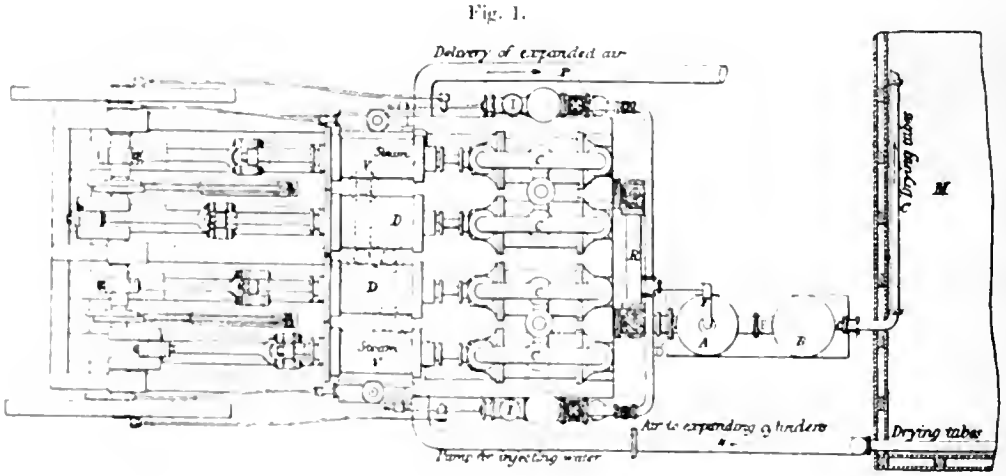
1. The compression cylinder.
2. The cooling and drying chamber.
3. The expansion cylinder.
4. The freezing chamber.

For the compression cylinder double action is almost universal on board ship. On land, single action is frequently used. Valves of various types are mentioned, those of Mathews (Eng. Pat. 5648 of 1886) being figured and more fully described.

Previous to 1877 the deposition of snow during the expansion and consequent cooling of the air had proved an insurmountable difficulty in the practical working of these machines. Bell and Coleman first showed how the aqueous vapour contained in the air can be satisfactorily removed. This they did by a further cooling of the air *after* compression and *before* expansion. In this way it is deposited not in the solid but in the liquid form, and, in Bell-Coleman's machine, is drawn off by means of sloping pipes furnished with bottom taps. The pipes may be placed in the freezing chamber, or cold air may be brought from this chamber to the pipes.

The details of the machine are shown in Figs. 1, 2, and 3. These machines are largely used on the Australian shipping lines.

Fig. 1.



The two steam cylinders V work four compression cylinders C^1 and two expansion cylinders D. The pumps I injecting water at the ends of the compression cylinders effect the first cooling. The compressed air from C^1 passes through R and D′ to the cooler A. This is a tower with horizontal perforated plates through which trickles water from F. The air enters at the bottom and passes out at the top by E, cooled and saturated with moisture into the drying tower B. This contains perforated plates on which a large part of the moisture deposits. From the bottom of B the air passes into the sloping tubes *c c* in the freezing chamber M. The moisture is here completely removed as already described, and the air passes by it to the expansion cylinders D D from which it is delivered by I to the freezing chamber M.

In Hall and Lightfoot's machines (Figs. 4, 5, and 6), the second cooling is effected in a small expander followed by a net-work drying arrangement (Inst. Mech. Eng. Jan. 4, 1881). This method is more compact than Bell and Coleman's. Hall and Lightfoot's machines are largely used in the foreign meat trade.

Fig. 2.

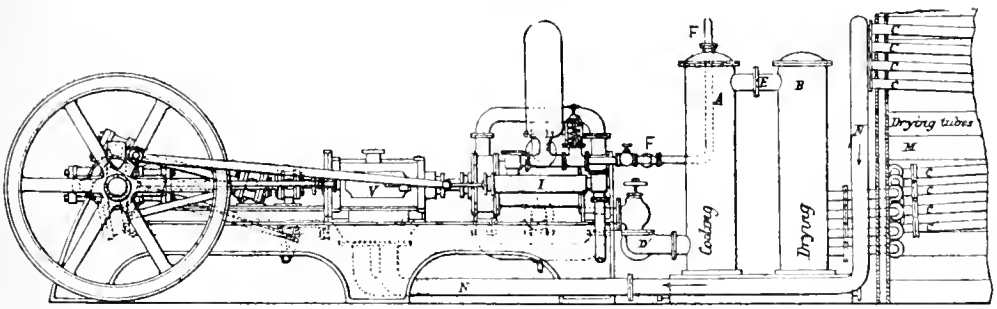
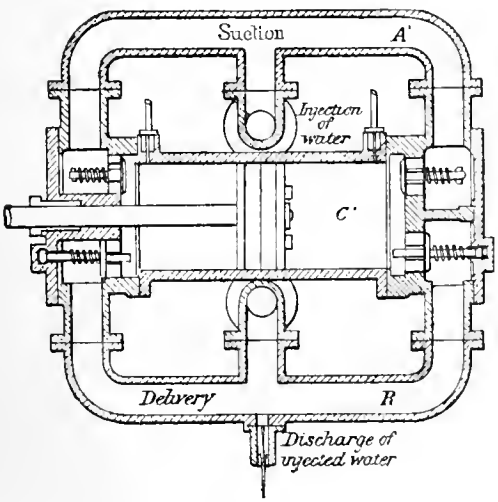


Fig. 3.



Compression Cylinder.

The double action compression cylinder C delivers the air at an absolute pressure of about 4·5 kilos. to the tubular cooler B, where it begins its expansion and is cooled to about 0° C. Thence it passes over the network G (Fig. 6) of the intermediate drying arrangement D (Fig. 4), where it deposits the greater part of its moisture before passing to the back of the expansion cylinder E. The steam cylinder A is coupled to the cylinder E in such a manner that the motion of the piston of A is assisted by the expansion of the air. Velocity, 63 revolutions per minute.

The Paul Giffard machine of 1877 (Eng. Pat. 627 of 1873, 2064 of 1875, and 3108 of 1877) has again a different drying arrangement. This is said not to work so well; nevertheless, these machines are in extensive use as, *e.g.*, on the P. and O. vessels.

Where a special cooling and drying arrangement is not employed a *snow box* is necessary. In this the air as it leaves the expansion cylinder deposits its snow or ice on a surface which has preferably the form of a network (Hargreaves and Inglis, Eng. Pat. 1747 of 1878).

Machines Worked by a Gas Liquefied by Compression.

In these machines the cycle is always a closed one. As has been already stated, ammonia prepared by heating commercial ammonia liquor, is the substance generally used. The theory of this class of machines is not known with the same exactness as that of air machines. The law, however, applies to both equally that the efficiency increases as the difference of temperature is less between the compression cylinder and the freezing chamber. The efficiency is sensibly independent of the nature of the working substance. It depends largely on working the compression with as little superheating of the vapour as possible. This necessitates an abundant circulation of cold water round the compression cylinder, and only a moderate piston velocity.

The following are the most important points in which the construction of these machines differs from that of the air machines. (1.) Absence of arrangement for condensing moisture. (2.) Absence of special cylinder of expansion, the expansion being generally effected simply by opening a cock placed near the freezing chamber, between this and the compression cylinder. In carbonic acid machines, however, an expansion cylinder is sometimes employed (Windhausen, Eng. Pat. 2549 of 1888; this Journal, 1889, 269). (3.) Special provisions on account of greater pressure. The forms of valve are different, and great attention has to be paid to the stuffing-boxes, &c. in order to avoid leakage. The pistons also are of special forms. (4.) Additional arrangements for keeping the compression cylinder cool. (5.) The vessel in which the working substance is liquefied.

Valves.—These are generally of iron or steel; conical and furnished with a spring. Their movement is in almost all cases regulated by the pressure of the gas itself. It is important that they should work without shock, and that they should be readily accessible. Among the devices by which these points are secured may be mentioned those of Fixary and of Wood (Eng. Pat. 16,558 of 1884, and 14,606 of 1886, *vide Engineer*, February 4, 1887).

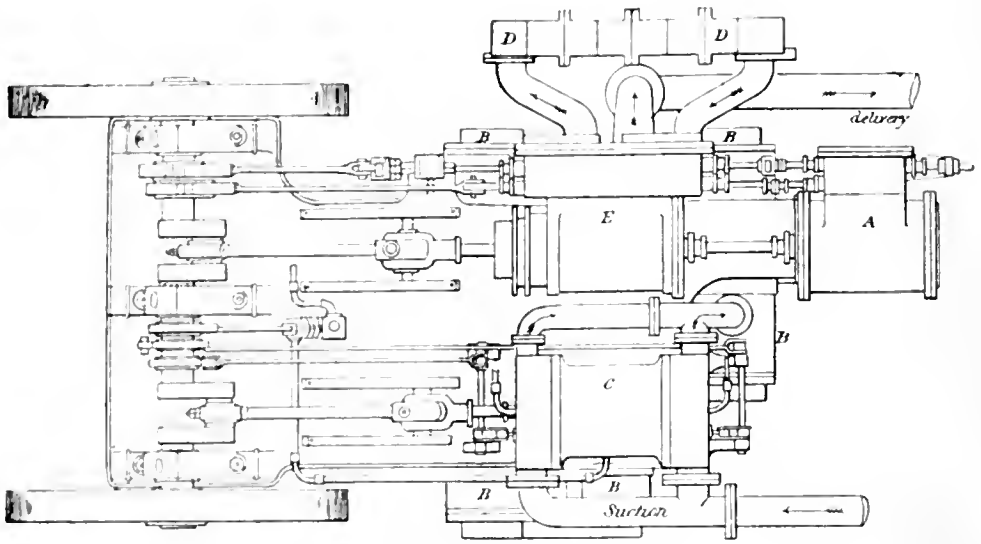
Stuffing-Box.—Much difficulty has been experienced in preventing leakage, especially with double-action compression cylinders. According to M. Richard this difficulty is completely overcome by the employment of Fixary's *joint pâteux*. The device consists in causing some of the cold expanded ammonia to circulate round the oil of the stuffing-

box so as partially to freeze it. In this semi-solid or highly viscous material the piston works without leakage and with little friction. The compression cylinders in which this joint is employed are shown in Fig. 7.

Cold, expanded ammonia is brought by *c* and circulates in *b b*, round the oil *a a*, through which the piston rod works. The gas then passes by *d* to the suction.

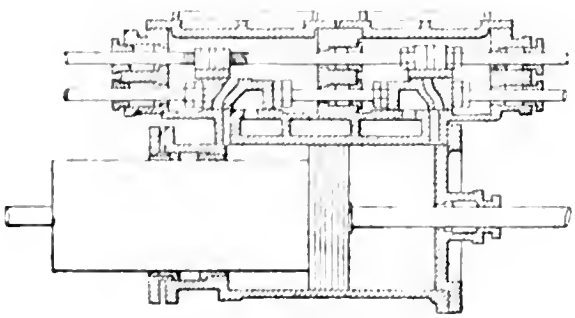
Pistons.—In most vertical machines there is a layer of oil above the piston which is said to do away with the clearance, and which at the same time lubricates the piston. In Lavargne's compression cylinder a deep layer of oil is used and the piston is so constructed that the greater part escapes during the ascent between the packing of the piston and the sides of the cylinder. The remainder passes

Fig. 4.



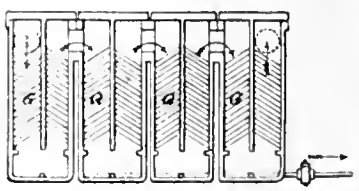
General Plan of the Machine.

Fig. 5



Expansion Cylinder.

Fig. 6.



Drying Arrangement.

through the delivery valves and serves for lubrication of other parts of the machine. This piston works tight and with reduced friction, and Richard's contention that it completely does away with the clearance appears to be correct. The oil is kept constantly renewed. Were this not done its action would be interfered with owing to its becoming saturated with ammonia. This supply of oil helps also in the cooling of the compression cylinder as does Fixary's *joint pâteux*.

Cooling of the Compression Cylinder.—It is possible to do this effectually (where ammonia is the working substance) simply by a circulation of water. This fact is proved by the indicator diagrams which have been taken with Linde's machines. Additional means of cooling are, however, frequently employed. The injection of a spray of the liquefied gas is used by Wood (Eng. Pat. 5798 of 1882 and 9547 of 1886) and also by Puplett (Eng. Pat. 12,543 of 1884). Raydt employs a hollow piston cooled inside by a current of water.

Liquefaction.—The liquefaction is effected in tubes kept cool either by being surrounded by water or by being exposed to a jet of water. In Lavergne's machines there is in addition an auxiliary condenser cooled by the return of the expanding gas. Some such arrangement is *necessary* in the case of machines in which the working substance is carbonic acid (*vide* Raydt's liquefying arrangement, Eng. Pat. 1352 of 1880). Considerable ingenuity has been exercised in securing the joints of the liquefying tubes. A figure of Kilbourn's arrangement is given in the memoir.

The refrigerating arrangement is of a form depending on the use to which the machine is put. Most frequently it is of a form which may be regarded as the inverse of the compression cylinder. The gas is expanded in tubes surrounded by an agitated liquid (generally brine), which is cooled by the gas.

The ammonia machines are manufactured by numerous firms. The position they hold is largely due to Linde,

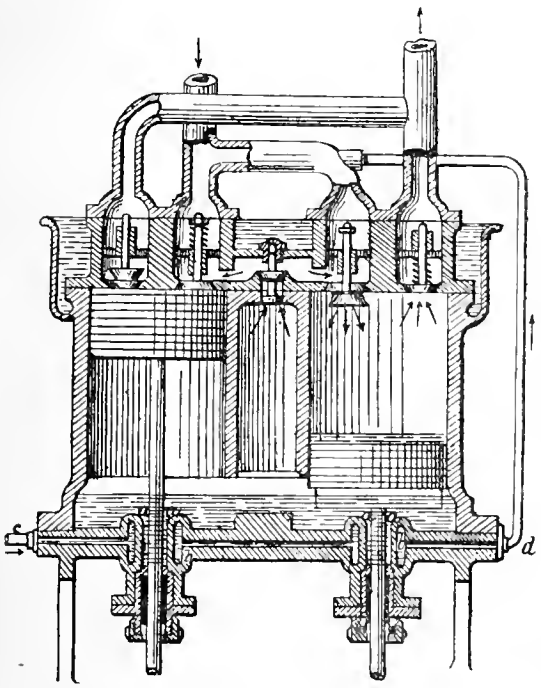
whose machines are in extensive use in Germany and elsewhere.

The Puplett machine (horizontal type) is also described (this Journal, 1889, 970, and 1890, 166).

Machines working with Liquefiable Gases other than Ammonia.

We may confine ourselves to the mention of those working with either sulphur dioxide or carbon dioxide. The former gas has less frigorific power than ammonia, and has the further disadvantage that the least trace of moisture getting in results in the rapid corrosion of the machinery.

Fig. 7.



Fixary's Joint Pâteux applied to single action Vertical Compression Cylinders.

Machines employing carbon dioxide have a special interest The frigorific power of the substance is much greater than that of ammonia, and by some authorities carbon dioxide is looked upon as the refrigerating agent of the future. It is certain that carbon dioxide machines even now have a practical value, and are capable of further development. Arguments are not wanting, on the other hand, in favour of the view that with the actual conditions under which engineers work in respect of strength of material and atmospheric temperature, ammonia will always be preferable to carbon dioxide. The question would be capable of a definite solution by the equations of thermodynamics, but that unfortunately the necessary knowledge of the physical constants of the gases is wanting. M. Richard advocates the establishment of a technical laboratory devoted to the investigation of problems such as this connected with the industry of refrigeration. In default of the information which such an institution might afford, the matter will probably have to be decided by trial on the large scale.

Pictet employs a mixture of carbon dioxide and sulphur dioxide. It appears premature as yet to pronounce on the likelihood of the success of this experiment.

Absorption Machines.

There is a class of machines in which ammonia gas is absorbed by water, instead of being condensed by pressure. The first absorption machines to be used on the industrial scale were those of Carré, now made in France by MM. Rouart. Similar machines are also produced by MM. Imbert. A special feature of absorption machines is the rectifying apparatus, for condensing and removing the aqueous vapour with which the ammonia is mixed. Among the most efficient of these arrangements are those of Reece and F. Stanley (Eng. Pat. 2891 of 1870, and 3907 of 1875) and of Pontifex and Wood (Eng. Pat. 15,064 of 1887). Notwithstanding the ingenuity expended upon them, absorption machines do not meet with general favour.

Applications of Refrigeration.

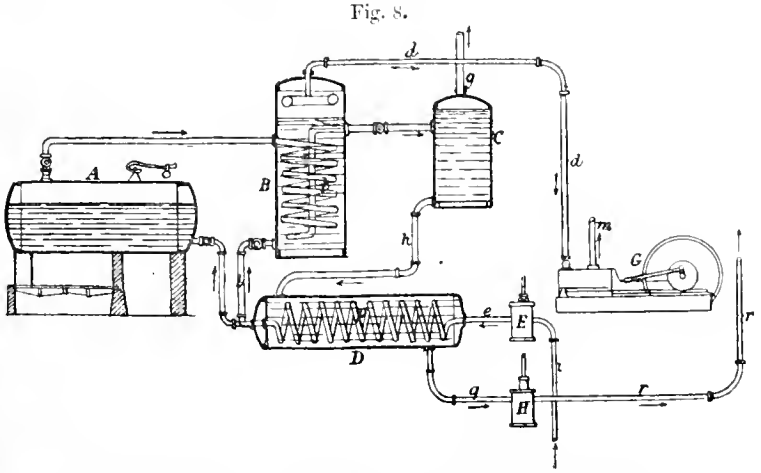
Of the numerous applications of refrigeration, only three are dealt with in the memoir, viz.:—

1. Manufacture of ice.
2. Cooling of buildings (theatres, &c.).
3. Preservation of meat.

Of these, only the first is treated at all fully.

In the manufacture of ice the chief difficulties are connected with obtaining the material transparent and sufficiently pure for consumption. This is best effected by distillation under high pressure, followed by ebullition under atmospheric pressure. The distilled water, freed from air, then passes through tubes surrounded by a liquid, such as brine, cooled by the circulation of expanded gas to moulds also surrounded by brine, and here the water is frozen. Fig 8 shows the arrangement adopted by Linde (Eng. Pat. 16,270 of 1886; see also this Journal, 1890, 481 and 594).

Fig. 8.



Manufacture of Transparent Ice by Linde's Process.

The steam from the high-pressure boiler A condenses in the worm *b* of the low-pressure boiler B. The steam from B works the driving engine G and escapes by *m* to a condenser. The hot water formed by the condensation of steam in *b* passes into the receiver C, where, being under atmospheric pressure only, it enters into ebullition, the dissolved air escaping, together with a little steam, by *g*. The water (pure and free from air) passes by *h* through the cooler D, and by *q*, H, and *r* to the moulds, where it is frozen. The boiler A is fed by the pump E, which draws water through *i* and delivers it by the worm *p*, where it is warmed by the hot water from C.

In M. de Stoppani's machine (Eng. Pat. 3363 of 1887; *vide* Revue Industr. Nov. 16, 1889) the steam from the driving engine is used for making the ice. Where this is done, special arrangements are necessary for removing grease. The cost of manufacture of transparent ice is stated at from 6 fr. to 10 fr. per ton with good machinery.

Cooling of Buildings (as Theatres).

(*Vide* Sir W. Thomson "On the Heating and Cooling of Buildings by Means of Currents of Air." Proc. Phil. Soc. of Glasgow, Dec. 1852.)

This application of refrigeration is still in its infancy The problem is, however, of considerable importance, and its importance will increase as European civilisation gains ground in tropical and semi-tropical countries.

Two methods have been tried: first, the direct method of disseminating small volumes of intensely cold air produced by machines in which air is the working substance. When ammonia machines are used, another principle is generally adopted, viz., that of cooling brine in tanks by the circulation of the gas through worms immersed in these tanks. The cold brine is then made to circulate through pipes in a manner similar to that employed for warming buildings by hot water. In connexion with this branch of the refrigerating industry should be cited Fixary's process (Eng. Pat. 3793 of 1887).

Preservation of Meat.

The meat chambers are best kept at a temperature of about 0° C., and not lower, since if the meat be actually frozen, it is liable to putrefaction when allowed to acquire the ordinary temperature. The cold air is distributed through the freezing chambers by means of wooden pipes furnished with *snow boxes* to collect the hoar frost formed from the moisture given off by the meat.

Although the air machines have a practical monopoly of the installations on board ship, the meat is often preserved at the *depôts* by ammonia machines (*e.g.* at the Victoria Docks, London, by one of Chambers' machines).

In the United States special railway waggons are employed for the transport of refrigerated meat. These are ice waggons with non-conducting walls and a ventilating arrangement (*vide* Lavoinne and Pontzen, *les Chemins de fer en Amerique*, 2, 83).—W. W. H. G.

On the Use of Galvanised Iron for Artesian Wells and for the Conveyance of Drinking Water. R. Haines. J. Franklin Inst. 1890, **100**, 393—401.

See under XVIII. *B., page* 155.

Fluorides as Agents for Softening Waters. C. A. Doremus. J. Amer. Chem. Soc. 1890, **12**, 303.

See under XVIII. *B., page* 155.

Corrosion of Lead and Zinc in Contact with Cement. Seger. Thonind. Zeit. 1890, **14**, 545.

See under IX., *page* 140.

The Amsterdam Exhibition of Appliances for the Prevention of Accidents in Factories. Van Vliet. Chem. Ind. 1890, **13**, 455—457.

In 1886 the Dutch House of Deputies appointed a committee to inquire into the state of the working classes of Holland. The outcome of this was the above-named exhibition, which comprised the following objects of importance for chemical factories:—To guard against danger in *spirit distilleries*, the still must be hermetically connected with the worm. The head of the still supports a globe by which the aqueous and alcoholic vapours are condensed, and a system of tubes is so arranged that a whistling noise is heard as soon as air mixes with these vapours. By this device leakage is easily discovered. In *varnish factories* the boilers are placed on wheels, that they may be quickly removed from the fire in case of danger. The *carboys used for acids* are protected with iron bands, and various arrangements for safely emptying them by means of air pumps, suction pipes, &c., are recommended.

Special attention was given to the subject of *ventilation*. Various systems were recommended for factories, *e.g.*, Blackman's, Wing's, and the Victoria ventilator.

Designs for *workmen's dwellings*, bathing establishments, &c., were numerous, and it was calculated that in Holland, lodgings consisting of two rooms, alcove and kitchen, can be provided for 3*s.* per week, and yet yield a profit of 4 per cent. to the building companies. The charge for a bath is equally cheap, viz. $1\frac{1}{2}d$.

Ladders of wire rope, coiled in boxes, placed between the windows of factories, would minimise, if not prevent, all danger from fire. Very numerous were the contrivances to prevent accidents from machinery, automatic lubricators being especially prominent.—H. S.

Accidents in Prussian Factories. Chem. Ind. 1890, **13**, 468—470.

Many and different reasons are stated as the causes of accidents, viz.: It is statistically proved that a great many accidents happen on Mondays. This is owing, in the majority of cases, to the notorious alcoholic excesses of the working classes on Sundays.—Moreover, men in charge of boilers and all kinds of machinery are especially liable to various kinds of accidents, and it is proposed to introduce a certain examination for these people, and to admit only trustworthy and able men. This rule should be strictly observed, and, if necessary, even legally enforced.

The danger from fire has, of late, been greatly reduced, by using only non-inflammable materials, such as stone, iron, &c., in the building of factories, by having fire-engines and hydrants in constant readiness and a good supply of water in all parts of the buildings. Highly to be recommended in this respect is the arrangement recently introduced into textile factories, viz., of erecting buildings consisting of ground floor and basement only. It is hardly necessary to remark that the employment of the electric light greatly diminishes the danger from fire. As a whole, great improvements are noticeable of late in the arrangements for the prevention of accidents from fire.

Ladders attached to machines, and employed chiefly in lubricating certain parts of them, are very often unsafe, and in conjunction with the bad conditions of the lifts, lend to many accidents which might easily be prevented.

Carbon bisulphide seems to be especially dangerous, as men who are engaged in filling carboys or bottles with this liquid may easily be poisoned. The dust of potassium chlorate is also a dangerous substance, on account of its inflammability. Those occupied in the manufacture of potassium chlorate should always be compelled to change their clothes before leaving the factory. Dyeing establishments should generally be better ventilated, as the various vapours often so fill the rooms as to make it almost impossible to see from one end to the other, thereby greatly increasing the probability of accidents. Glasses for the protection of the eyes are absolutely necessary in factories where acid or caustic liquids are used, and many accidents have happened from neglecting this simple precaution. Although great improvement for the prevention of accidents can be recorded, yet it must not be forgotten that the extreme carelessness and negligence of the workpeople themselves are the causes of the greatest and most constant danger and no remedy has yet been found against this.

—H. S.

PATENTS.

Improvements in Apparatus for Treating Fabrics, Paper, and other Materials with Gases, Steam, or Hot Air. E. Remy, Mülhausen, Germany. Eng. Pat. 20,905, December 30, 1889. 8*d*.

See under VI., *page* 135.

Improvements in Apparatus for the Evaporation of Liquids. W. Wild, London. Eng. Pat. 398, January 9, 1890. 11*d*.

The objeet of this invention is to ensure more perfect concentration of the liquid under treatment.

An outer chamber has fixed centrally within it an inner chamber, preferably of a cylindrical form, for heating the liquid before its entry into an evaporating coil, and is connected at its upper part to a suitable reservoir. In the space between the two chambers, and surrounding the inner one is a coil, formed of any suitable metal, but copper is preferred, tapering from its upper extremity, and increasing in diameter towards the lower end. The upper end of the coil is connected with the inner chamber by a small pipe, the flow of the liquid being regulated by a tap or valve. The lower end of the coil terminates at any convenient part of the outer chamber, and is connected by a pipe with a separating box, inside which are placed, vertically, groups of pipes, the groups being separated by vertical screens extending partly across the box, so as to allow the liquid to circulate among the pipes in an irregular manner, and thus separate the liquid from the vapour. The heating medium injected into the outer chamber circulates round the coil, and after giving up more or less of its heat, passes out by a pipe. The liquid under treatment is supplied from a reservoir, and enters at the top of the inner chamber under pressure, and rising in a pipe, reaches the coil, whence it passes into the separating chamber, from which the concentrated liquid is removed by a pump. To obtain more perfect concentration, several of these machines may be combined.

—E. S.

Improvements in Purifying Water, and in Apparatus therefor. E. Devonshire, London. Eng. Pat. 480, January 10, 1890. 4*d*.

In this invention, fragments of flint, limestone, or basic slag are substituted for iron or other materials usually employed, and are placed, either separately or together, in a rotating cylinder provided with hollow trunnions, through which the water flows. Shelves are placed in the cylinder, by which the material is constantly lifted and allowed to fall through the water. The apparatus employed is such as is described in Eng. Pats. 5496 of 1883, 12,256 of 1884, and 10,706 of 1889.—E. S.

Improvements in Apparatus for Separating Iron from Bones or other Substances. F. Christy, Chelmsford, and J. H. Carter, London. Eng. Pat. 530, January 11, 1890. 8*d*.

This invention is for the separation of iron pieces, such as nuts, bolts, &c., from bones and other substances to prevent damage to the grinding machinery. A cylinder of iron studded with a large number of electro-magnets set radially, and the outer ends of which are of alternate polarity, is used. The magnets are so commutated that during one half of a revolution they are active, and during the other half passive. The feeder on to the cylinder is kept continually shaken, so as to cause the iron to work itself under the other material by gravity, and so come more directly on to the magnets. When dealing with a material of nearly the same density as iron, the mechanical separation is assisted by placing powerful electro-magnets on the under side of the feeder. The material to be treated is fed on to the top of the cylinder and carried forward as it revolves. The non-magnetic material falls off at the side and the iron is carried half-way round and dropped into a box beneath the cylinder. When the apparatus is combined with a grinding machine so that the non-magnetic material delivered from it passes into the feed-hole of the grinding machine, it serves as an automatic feed, and saves the labour of feeding by hand.—B. H.

Improvements in Filter-Presses. J. Brock and T. Minton, Widnes. Eng. Pat. 606, January 13, 1890. 8*d*.

The improvements are intended to facilitate the opening and closing of cylindrical filter-presses such as are described in Eng. Pat. 2127 of 1887 (this Journal, 1888, 313), and mainly consist in supporting the cylinder on bearings at its ends, instead of on supports underneath, thus allowing of a clear space for emptying: and also in the mode by which the various parts are connected.—E. S.

Improvements in Filters for the Purification of Water and other Liquids. A. Smith, London. Eng. Pat. 828, January 16, 1890. 6*d*.

A cylindrical case is provided at each or one end with a water-tight cover. In each cover is a central hole through which a pipe with screwed ends, and having "fly-nuts," passes. The pipe being longer than the case, forms both the outlet and the inlet. It has several perforations in its length, and beneath one or more of the upper ones, near the inlet end, a plug is placed so that the liquid to be filtered must flow into the interior of the case, the remaining holes acting as outlets for the filtered liquid. The pipe is either filled with the filtering medium or is surrounded by it. This construction affords ready access to the interior for either cleansing or renewing the filtering medium.—E. S.

An Improved Receptacle or Apparatus for Containing Material for Absorbing Moisture or Humidity. R. A. Kemp, London. Eng. Pat. 1242, January 23, 1890. 8*d*.

This invention relates to an improved box for containing deliquescent salts or like substances employed for absorbing moisture from the atmosphere, and is chiefly designed for use in musical instruments that are liable to injury from damp; or it may be placed in drawers, chemical balance cases, &c., for the same purpose, without any risk of damaging the articles which it is desired to keep dry.

A box constructed of sheet iron or any suitable material is formed of an outer and inner shell, the inner one being fixed in the outer so as to leave a space between the two shells. The inner shell holds the chloride of calcium or other hygroscopic substance, while the outer shell is adapted to receive and contain the liquid absorbed by the salt, and is so constructed that, should the box be upset, the liquid will not be spilled or thrown over the article with which it is being used. A sponge placed under the lid of the box affords further protection. Atmospheric air enters the box through holes in the lid, and any moisture which it contains will be absorbed by the salt. As the moisture is taken up the deliquescent crystals become liquefied and dribble through a hole in the bottom of the inner shell into the space between the two shells, the enclosed air escaping through a pipe.—E. S.

Improvements in or Pertaining to Drums or Vessels with Covers for containing Substances, such as Anti-fouling Compositions and Paints, having Constituents liable to Settle. V. B. Lewes, Greenwich. Eng. Pat. 1757, February 1, 1890. 6*d*.

See under XIII., *page* 150.

Improvements in the Purification of Water by Distillation. W. C. Young, Forest Gate. Eng. Pat. 7340, May 20, 1890. *4d.*

The water is mixed with an excess of lime or other non-volatile inorganic alkaline material, and, after either filtering or allowing to clear by subsidence, is distilled, the distillation being arrested before all the water passes over. Moreover, the first portions are rejected when water free from ammonia is required.—D. A. L.

Improvements in the Construction of Apparatus for Softening and Purifying Water. R. S. Brownlow, Manchester. Eng. Pat. 16,906, October 9, 1890. *6d.*

This invention relates chiefly to apparatus employed in the purification of water by the addition of chemical reagents, which cause the precipitation in a solid or flocculent form of the impurities contained therein, but it is also applicable to the purification of any fluid containing precipitable matter, and the object of the invention is to provide baffling plates which shall compel the fluid to take a much more devious course than usual, and shall present a greater number of precipitating surfaces. To effect this, a vertical vessel (preferably cylindrical) encloses a series of plates forming passages sloping alternately upwards and downwards, and combined with a vertical division so arranged as to cause the fluid to rise through the vessel with an upward and downward motion, and at the same time with either a continuously circulating, or alternately reversed motion.—L. S.

Improvements in Vacuum Pans. F. H. Flottmann, Bochum, Germany. Eng. Pat. 16,461, October 16, 1890. *6d.*

The apparatus, which is adapted for concentration, extraction, desiccation, &c., practically consists of two cylindrical or globular vessels, one fitted to revolve inside the other. The inner one, which is intended for holding the material to be treated, is mounted, by means of hollow trunnions working in stuffing-boxes in the outer cylinder, in such a manner that it can be exhausted and rotated independently of the other cylinder or jacket. The latter is likewise capable of a partial movement on trunnions (situated in a plane at right angles to the stuffing-boxes), these trunnions, being hollow, also serving for the introduction of steam, &c., into the space between the two vessels. The partial movement (horizontal to vertical) of the outer jacket, and consequently of the whole apparatus, is produced by worm gearing, and its object is to enable the inner vessel to be charged through one of its trunnions, the other trunnion being suitably connected with the exhauster, gauge, &c. The stuffing boxes, it will be seen, are in a horizontal plane while the inner vessel is being rotated. For details the original drawings must be consulted.—O. H.

A New or Improved Manufacture of Artificial Stone or Composition and Building Blocks and other Articles thereof. F. Jurschina and R. R. von Gunesch, Vienna, Austria. Eng. Pat. 18,168, November 15, 1890. *4d.*

See under IX., *page* 141.

Improvements in Apparatus for the Enrichment of Phosphate of Lime and of Phosphated Chalks for the preparation of Cements, Marls and Starches, and for similar Purposes. A. Cajot, Brussels, Belgium. Eng. Pat. 18,732, November 19, 1890. *6d.*

The material to be treated is crushed, mixed with water, and fed through a hopper to a cupped chain or band which carries it into a case divided into several water tight compartments through which it passes in succession, being thrown through holes in the partitions so inclined as to project it towards the partition walls. Each of the compartments is provided with a cupped chain or band similar to that in the first, and is further divided at its upper part only by a partition. At the lower part of this partition is a pipe supplying water for the washing process to which the material is subjected, and somewhat above this is an aperture whence the "water charged with lime, alumina, and other impurities" flows away. Of this apparatus it is stated that "it affords the advantage of immediately separating materials the specific gravity of which differs but slightly, but which wash out more or less perfectly in water on account of the porosity and of the tenacity of the molecules."—B. B.

II.—FUEL, GAS, AND LIGHT.

PATENTS.

Apparatus for Charging and Drawing Retorts mechanically. J. Roscoe, Hyde. Eng. Pat. 18,108, November 13, 1889. 1s. 6d.

The principal object of this invention is to reduce the shock on the body of the retort produced by charging large masses of coal. This is effected by means of a scoop constructed so that the two sides and the base can be moved both jointly and independently. The scoop, which is capacious enough to contain a full charge of the retort, is driven forward by suitable mechanism into the retort to the rear end. The bottom of the scoop is then withdrawn, depositing the coal in the retorts, and subsequently the sides are withdrawn. The sides are connected by cross-pieces or bows which prevent the retrograde movement of the bottom of the scoop from being communicated to the coal. The improvement in drawing apparatus consists of a mechanical sliding rake provided with a removable head and having a double oscillating motion so that the head of the rake may be moved in any direction within the retort.

The mechanism by which the various motions are imparted to the scoop and rake, and the details of construction, are fully described in the specification and illustrated by eight sheets of drawings.—S. B. A. A.

A Method of Enriching and Increasing the Volume of Gas obtained from Coal and utilising the Waste Heat from Retort Settings. F. Pritchard, Huyton Quarry. Eng. Pat. 18,163, November 14, 1889. *8d.*

This method is a modification of the Dinsmore process of manufacturing coal-gas, the main difference being that the reheating duct is placed outside the retort chamber in the brickwork above the arch. This duct is preferably a cast-iron chamber of rectangular section disposed parallel to the retorts and divided into two communicating compartments by a horizontal diaphragm extending from the door almost to the back of the duct. It is heated by the waste gases from the retort chamber, which pass through a flue piercing the arch and opening into a flue which envelopes the bottom and portions of the sides of the duct and communicating past a damper with a pass-by flue which opens into the main flue; the enveloping flue likewise communicates past a damper with the main flue. The temperature of the duct is regulated by diverting the current of waste gases from the enveloping flue to any required extent by suitably adjusting the dampers. The coal-gas is conveyed from the retorts into a collecting chamber and thence past suitable valves into the lower compartment of the duct; it then passes from the upper compartment into the water-jacketed ascension main, &c., as is usual. As the enveloping flue does not surround the upper part of the duct the gas is less strongly heated during the latter half of its course.—S. B. A. A.

Improvements in the Distillation of Coal, Shale, and the like, the Invention comprising the production of a Special Description of Coke. T. Parker, Wolverhampton. Eng. Pat. 67, January 2, 1890. 8*d*.

The objects of this invention are the increase in the quantity and value of the solid and liquid volatile derivatives from coal or shale, and the production of a porous variety of coke which will burn freely in an open fireplace. The coal is charged into a large chamber closed by a cup and cone and provided with tuyeres near the bottom, and is heated to a temperature of 550°—650° C. by forcing or drawing through it a current of superheated steam, water-gas or other gas which will not support combustion to any material extent. An arrangement is described in which a portion of the products of distillation, freed from condensible products by passing over a tar-pit and through condensers, is in part burned in a regenerative stove, the remainder passing through the heated stove into the coal chamber, where it serves to raise the coal to the required temperature. Steam or water-gas may also be used to convey the heat from the stoves to the coal, a small portion only of the products of distillation being used for heating the stoves.

In another arrangement a portion of the products of distillation is mixed with air, ignited in a small combustion chamber and led into the coal chamber, the spent gases passing into the chimney by an opening a little above the level of the tuyeres. This process of distillation by internal heating may, it is alleged, be advantageously applied to the manufacture of ordinary coal-gas and common coke at the usual temperatures.—S. B. A. A.

Improvements in the Manufacture of Gas. W. T. Cotton, London, and E. F. B. Crowther, Manchester. Eng. Pat. 343, January 8, 1890. 6*d*.

These improvements are in the construction of vertical retorts. The retorts are tapered internally, their larger diameter being at the bottom, where each retort is supported on a shallow box or casing. The retorts are not closed below by the casings but the opening is continued downwards by corresponding apertures in the upper and lower plates of the casings and by a wide exit tube fastened to the under surface of the lower plate. The casings enclose a moveable draw-plate consisting of slabs of fire-resisting material bolted together and provided in places with apertures similar to those in the casing plates. During coking the coal in the retort rests upon the slabs, and the coke is discharged by advancing the draw-plate by suitable mechanism until its apertures are brought to correspond with those in the casing, when the coke falls through on to the barrows placed beneath the exit tube; the draw-plate is then moved back into its previous position. Air is prevented from entering the casing and gas from escaping by means of a pan containing water placed under the exit tube. This vessel is hinged to one side of the tube and fastened to the opposite side by a spring catch which can be released before discharging.—S. B. A. A.

Improvements in Artificial Fuel and in the Process of Making the same. W. B. McClure, E. Corning, J. E. McWilliams, and J. W. White, St. Paul, Minn., U.S.A., and T. Hodgson, Buffalo, New York, U.S.A. Eng. Pat. 15,012, September 23, 1890. 6*d*.

1,660 lb. of finely divided and heated culm or coal-dust, 100 lb. of sharp clean sand, 40 lb. of finely powdered well-burnt lime-dust are thoroughly mixed and incorporated by the aid of heat with 125 lb. of naturally solid asphaltum mixed whilst in a molten condition with 75 lb. of naturally liquid asphaltum or petroleum tar. The compost is pressed into blocks and cooled in a bath of cold water.

—S. B. A. A.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

Notes on the Conversion of the Nitrogen contained in Acid Sludge of Oil Works into Ammonia. I. J. Redwood.

See pages 108—110.

The Nitrogen of Crude Petroleums and Paraffin Oils, G. Beilby.

See pages 120—121.

Utah Ozokerite. A. N. Seal. J. Franklin Inst. 1890, **100**, 402—406.

Utah ozokerite has not been fully investigated and the results obtained are somewhat conflicting. Newberry (Eng. and Mining J. March 22, 1879), Wurtz (Eng. and Mining J. July 1889), and Beilstein (Ber. **16**, 1574), have previously published some details. The author describes this ozokerite as of a dark brown colour, wax-like in consistency with a foliated structure; crystals of gypsum were found with it. The material melts at 53°—55°, the specific gravity being 0·9285; it is soluble in warm benzene, ether and carbon bisulphide, giving a fluorescent solution. On boiling with absolute alcohol a pure white solid hydrocarbon separated out in pearly scales; on combustion it was shown to consist of carbon, 85·44; hydrogen, 14·45. On melting it became yellowish, of waxy consistency with sp. gr. 0·9708, was soluble in all solvents for ozokerite and further in hot alcohol and hot acetone. Experiments showed that it was little acted on by strong sulphuric acid or by bromine, and was thus evidently a paraffin. The molecular weight by Raoult's method was 256.

Experiments with the ozokerite showed that it contained very few olefines, and was not readily acted on by reagents; the melting point and percentage composition pointed to a formula of $C_{25}H_{52}$, the molecular weight by the Raoult method would give about $C_{18}H_{38}$, the true formula probably lying between these two.—D. A. S.

PATENTS.

Improved Process and Apparatus for the Production of Best Hard Charcoal, together with the Simultaneous Recovery of Acetic Acid, Wood Spirit, Tar, Ammonia, Gas. L. Zwillinger, Vienna, Austria. Eng. Pat. 18,823, November 23, 1889. 8*d*.

Hitherto the carbonisation of organic materials such as wood, peat, brewers' grains or refuse, lignite, bones and the like, has been effected in retorts by simply heating them or assisting this process by the injection of steam or other gases, as for instance, water-gas. The processes in which steam is used have the disadvantage that steam, being a gas easily condensed, is retained by charcoal by reason of surface attraction, and cannot therefore perform its object of removing the volatile products evolved in a sufficiently complete manner. Water-gas is more suitable for this purpose, but its use is inconvenient as it necessitates an apparatus for its production. In all these processes the introduction of air or free oxygen into the retorts must be carefully avoided. The object of this invention is to remove the above difficulties and actually, in contradistinction to these processes, by the application of atmospheric air, which is employed to make the steam more readily movable in the heated retorts containing the raw material. The air employed is passed through water and has its percentage of oxygen so reduced, and at the same time is so saturated with steam, that only carbonisation and not combustion is brought about. The steam with which the air is saturated is for this reason securely retained by the air and easily carried through the material to be carbonised, and can thus assist the formation of acetic acid and other volatile products. The apparatus for producing superheated air saturated with steam and rendered poor in oxygen is described in detail in the specification and illustrated by one sheet of drawings.

—D. B.

A Method of Separating the Isomers contained in Crude Nitrotoluene. M. Lange, Amersfoort, Holland. Eng. Pat. 1407, January 27, 1890. 4*d*.

THE process depends on the difference in the action of sulphonating agents on different nitrotoluenes. It has been found that in sulphonating crude nitrotoluene, the ortho-compound only is at first attacked, whilst the para-derivative remains unaltered. The inventor utilises this difference of reaction in view of producing the sulphonic acids of para- and orthonitrotoluene from crude nitrotoluene. He proposes to run fuming sulphuric acid, sulphuric anhydride or sulphuric monochlorhydrin slowly into the said mixture at a temperature not exceeding 100°. From time to time a sample is withdrawn for examination, and when it is found that only paranitrotoluene separates out in a solid state the addition of the sulphonating agent is stopped. The product is then poured into water and the soluble portion filtered off from the paranitrotoluene, or the latter is distilled off by means of steam. The sulphonic acid is then converted into solid form by conversion into the calcium salt or by other known means.—D. B.

IV.—COLOURING MATTERS AND DYES.

Induline. E. Istel. Chem. Zeit. **14**, 1535.

THE author has prepared a blue colouring matter, first discovered by Caro, by heating together 2½ parts of aniline hydrochloride, 1 part of amido-azo-benzene hydrochloride, and 6 parts of water for 24 hours at 70—80° C. It is separated from the melt by solution in water, and the addition of salt. The new body is difficultly soluble in cold, easily soluble in hot water, forming a blue solution which possesses a reddish-brown fluorescence. It is also soluble in alcohol. Its solution dyes cotton prepared with tannin, or plain cotton in presence of sodium chloride or acetate, a splendid blue, which in the case of tannated cotton is extremely light-fast.

Wool and silk are dyed in a neutral bath, the former with a more reddish shade. The portion of the melt insoluble in water is partially soluble in alcohol, which extracts from it a beautiful grey-dyeing spirit-nigrosine, capable of conversion into a water-soluble nigrosine by means of sulphuric acid. The portion of the residue insoluble in alcohol consists of azo-phenine. The fact that the above bodies are produced at such a low temperature (50—70° C.) was certainly not previously known.—H. T. P.

Aniline Black. H. Gutknecht. Chem. Zeit. **14**, 1557.

THE ordinary way of producing aniline black on the fibre consists in steeping the material in a solution of aniline hydrochloride and potassium chlorate, squeezing out the excess of solution, and drying the fabric at about 30° C., the oxidation being finished by a bath of hydrochloric acid and an alkaline chromate. During the first stage of the oxidation there is considerable danger of the material being injured by the fumes of hydrochloric acid that are produced, and the author therefore recommends the substitution of aniline potassium sulphate for the aniline hydrochloride. This double salt is prepared by adding the theoretical amount of aniline to a hot solution of potassium bisulphate and filtering. The solution, on cooling, deposits the double salt in large crystals. It is soluble in 6 parts of cold water, so that a cold saturated solution contains 7·5 per cent. of aniline, which is just about the correct quantity for producing aniline black on cotton. The potassium bisulphate formed during the course of oxidation does not attack the fibre as long as any moisture is present. The temperature of oxidation may also be considerably raised, thus leading to a considerable saving of time, and a better utilisation of the aniline.—H. T. P.

On a New Process for the Extraction of Indigotin from Commercial Indigo. T. M. Morgan. J. Amer. Chem. Soc. 1890, **12**, 302.

THE following process yields pure indigotin in considerable quantities:—

Commercial indigo, finely ground and intimately mixed with about an equal weight of zinc-dust, is spread in layers about an inch deep on thin boards and introduced into a steam chest that can be made air-tight, with entry- and exit tubes for steam, and an aperture for the introduction of a solution of sulphurous acid. The air is expelled by a rapid current of steam, then the steam is nearly cut off, and sulphurous acid solution introduced a little at a time so as to keep the steam in the chest saturated; and this is continued till the reaction is completed. This takes place in from one to two hours, when the indigotin is completely reduced. The product is then of a dirty yellowish or greenish-yellow colour. It dries quickly on taking from the steam chest, and is then not liable to rapid oxidation, and may be kept for several days unchanged. Indigo white may be obtained from this mixture by treating with wood spirit in an extraction apparatus, or by digesting in flasks filled to the neck with this solvent. On exposure of the solution to the air in shallow vessels, the indigotin is precipitated in a pure and crystalline state. The yield is large and would probably be a theoretical one if sufficient precautions were employed.—P. J. H.

Industrial Society of Mulhouse. Meeting of November 12, 1890. Chem. Zeit. **14**, 1675.

NÖLTING and Polonowsky find that tetra-methyldiamido-benzhydrol will condense not only with amines in which the para position is free, but also with para-substituted amines such as para-toluidine, meta-xylidine, pseudo-cumidine, &c. Condensation takes place in the meta-position to the group NH_2 if the process be carried out in presence of a large excess of concentrated sulphuric acid, but in the ortho-position if hydrochloric acid be present. The formula of the condensation products obtained with para-toluidine are—

$$\left.\begin{matrix}(CH_3)_2N.C_6H_4\\(CH_3)_2N.C_6H_4\end{matrix}\right\rangle \underset{(1)}{CH}.\underset{(6)}{C_6H_3}\underset{(3)}{(CH_3).NH_2}$$

and—

$$\left.\begin{matrix}(CH_3)_2NC_6H_4\\(CH_3)_2NC_6H_4\end{matrix}\right\rangle \underset{(1)}{CH}.\underset{(5)}{C_6H_3}\underset{(2)}{(CH_3).NH_2}$$

The former, on oxidation, yields a bluish-green; the latter is only oxidised if acetylated first and then gives a very blue-green. Nölting and Swarinsky have condensed para-nitrodimethylamidobenzhydrol with para-toluidine in an analogous manner. By acting on dimethylmetatoluidine with the three nitrobenzaldehydes the nitrotetramethyldiamido-tolylphenylmethanes were obtained—

$$NO_2C_6H_4CH\left\langle\begin{matrix}\underset{(6)}{C_6H_3}\underset{(4)}{(CH_3).N(CH_3)_2}\\\underset{(6)}{C_6H_3}\underset{(4)}{(CH_3).N(CH_3)_2}\end{matrix}\right.$$

All these bodies yield green dyes on oxidation. Of the amido bases obtained by reduction of these three nitro-bodies, the para-derivative gives a violet, the meta-derivative a green dye. The ortho-amido compounds must first be acetylated and then yields bluish-green dyes on oxidation, and methylmetatoluidine therefore behaves just like dimethyl-aniline towards the nitrobenzaldehydes, whereas meta-toluidine oxidised in presence of para-toluidine yields no coloured product. By condensation of nitrodimethylamido-benzhydrol with meta-toluidine and dimethylmetatoluidine two bases are obtained—

$$\left.\begin{matrix}NO_2C_6H_4\\(CH_3)_2N.C_6H_4\end{matrix}\right\rangle \underset{(1)}{CH}.\underset{(6)}{C_6H_3}\underset{(4)}{(CH_3).NH_2}$$

and—

$$NO_2C_6H_4CH\begin{matrix}\diagup\ C_6H_4.N(CH_3)_2\ (4)\\ \diagdown\ C_6H_3(CH_3).N(CH_3)_2\ (6)\ (4)\end{matrix}\ (1)$$

Both yield green dyes on oxidation. By condensation of dimethylmetatoluidine with ortho-formic ether, $CH(OC_2H_5)_3$ Nölting and Trautmann have obtained hexamethyltriamidotritolylmethane, $CH_{(1)}\left(C_6H_5N(CH_3)_2CH_3\right)_3$ (4) (6) and by oxidation of this body a pure blue colouring matter. Nölting and Freyes have acted with benzhydrol on *o*-toluylenediamine and obtained a tetramido-derivative of triphenylmethane—

$$\begin{matrix}(CH_3)_2N.C_6H_4\\ (CH_3)_2N.C_6H_4\end{matrix}\diagup\ CH.C_6H_2(CH_3)(NH_2)(NH_2)\ (1)\ (2)\ (4)\ (5)$$

which on oxidation yields a greenish blue. On treating this body with phenanthrenquinone, an azine results, which may be oxidised to a green dye.—A. R.

PATENTS.

Manufacture of Sulpho-Acids and Colouring Matters therefrom. F. Wirth, Frankfort-on-the-Maine, Germany. From the "Farbenfabrik vormals Brönner," Frankfort-on-the-Maine, Germany. Eng. Pat. 3724, August 4, 1882. Amended May 2, 1890. 6*d*.

The original specification has already been abstracted (this Journal, 1889, 700). The patent refers to the production of naphthylamine sulphonic acids by heating the naphthol sulphonic acids with ammonia. In the amendment attention is called to the fact that the derivatives of β-naphthol are more easily converted than those of α-naphthol, and that the reaction takes place at high temperatures only. The production of "another β-naphthylamine sulpho-acid" is disclaimed, and also the combination of the diazo-compounds of the naphthylamine sulphonic acids with the phenol ethers.—T. A. L.

Improvements in the Manufacture of Colouring Matters. G. W. von Nawrocki, Berlin, Germany. From P. Böttiger, Lodz, Russia. Eng. Pat. 4415, March 5, 1884. Amended May 2, 1890. 6*d*.

A process for obtaining colouring matters which dye wool and unmordanted cotton red by combining the salts of tetrazodiphenyl with α- or β-naphthylamine or their sulphonic or disulphonic acids. The use of the β-naphthylamine-α-sulphonic acid and of the γ-disulphonic acid is disclaimed in the amendment.—T. A. L.

The Production of New Azo-Colouring Matters. A. G. Green and T. A. Lawson, London. Eng. Pat. 14,304, September 10, 1889. 6*d*.

By reducing *p*-nitro-*o*-toluidine of melting point 107° C. in an alkaline solution with sodium stannite it is converted into azoxytoluidine (Limpricht, Ber. **18**, 1403). If an alcoholic solution be employed, azotoluidine is produced. Both these bodies when diazotised combine with the sulphonic acids of phenols and amines to form colouring matters capable of dyeing unmordanted cotton. A bluish-red dyestuff is formed by combining diazotised azoxy-*o*-tolnidine with α-naphthol-*p*-sulphonic acid (corresponding to Piria's naphthionic acid).—T. A. L.

Improvements in the Production of Azo-Colouring Matters. R. J. Friswell and A. G. Green, London. Eng. Pat. 134. January 3, 1890. 4*d*.

Oxy-azo-toluidine of melting point 212° C. (Limpricht, Ber. **18**, 1405), when diazotised and combined with amines, phenols, and their sulphonic or carboxylic acids, yields dyestuffs. When combined with α-naphthol-*p*-sulphonic acid (corresponding to Piria's naphthionic acid), the colouring matter dyes unmordanted cotton red from a neutral or alkaline bath.—T. A. L.

Improvements in the Manufacture of Blue Colouring Matters. A. Kern and E. Sandoz, Basle, Switzerland. Eng. Pat. 569, January 11, 1890. 6*d*.

The products obtained by the action of gallocyanine on aniline and its homologues are insoluble in water (Ber. **21**, 1741; this Journal, 1888, 559). By sulphonating these compounds with ordinary sulphuric acid or acid containing anhydride they are rendered soluble, and dye blue shades on silk and wool without a mordant and cotton mordanted with chromium salts. The compounds formed by the action of aniline and its homologues on the products obtained by reacting with nitrosodimethylaniline hydrochloride on gallic acid or its methylic ether and similar substances can also be sulphonated and employed for dyeing as above.—T. A. L.

The Production of Dioxynaphthalinemonosulpho Acid and of Disazo Dyestuffs from the same. A. Bang, Leeds. From Dahl and Co., Barmen, Germany. Eng. Pat. 735, January 15, 1890. 4*d*.

The α-naphthylamine disulphonic acid of which the lime salt is soluble in 80 per cent. alcohol yields, when fused with caustic soda, a dihydroxynaphthalenemonosulphonic acid which can be combined with the tetrazo compounds from benzidine, tolidine, diamido-stilbene, diamido-carbazol and dianisidine to form violet to blue cotton colouring matters. The dihydroxynaphthalene sulphonic acid is produced as follows: 30 kilos. of sodium α-naphthylamine disulphonate are added at a temperature of about 180° C. to a solution of 110 kilos. of caustic soda and 20 litres of water. The temperature of the melt is afterwards raised to 200°—220° and maintained for 8—10 hours. It is then dissolved in 400 litres of water and 300 kilos. of 30 per cent. hydrochloric acid added. After filtering and cooling nearly the whole of the dihydroxynaphthalene sulphonic acid separates out. To obtain dyestuffs from it 26 kilos. of the acid and 40 kilos. of sodium carbonate are dissolved in water, and to this is added a solution of the tetrazo compound obtained by diazotising 10·5 kilos. of tolidine (or an equivalent quantity of benzidine, diamido-stilbene, diamido-carbazol or dianisidine) with 30 kilos. of hydrochloric acid and 7 kilos. of sodium nitrite. After standing 24 hours the dyestuff is filter-pressed and dried.—T. A. L.

Manufacture of Azo-amines by the Reduction of Azo-Colouring Matters derived from Nitramines. J. Imray, London. From "La Société Anonyme des Matières Colorantes et Produits Chimique de St. Denis," A. F. Poirrier and D. A. Rosenstiehl, Paris, France. Eng. Pat. 1579, January 29, 1890. 6*d*.

A method for obtaining diamido-azobenzene (*p*-azoaniline) and its homologues by combining a nitro-amine with a phenol or amine and reducing the azo compound thus formed in an alkaline solution. The following example is given: *p*-nitraniline is diazotised and combined with naphthol disulphonic acid. 100 kilos. of the colouring matter thus obtained are dissolved in 1,000 litres of water and 100 litres of caustic soda of 40° B. The temperature is raised to 50° C. and 80 kilos. of glucose of 75 per cent. are added. The mixture is then boiled, when the violet colour of the liquor gradually changes to brown. After cooling, the *p*-azo-aniline separates in crystalline needles and may be purified by dissolving in hydrochloric acid, filtering and precipitating with soda. The *p*-nitraniline may be replaced by *m*-nitraniline or by equivalent quantities of the corresponding derivatives of tolnidine, xylidine, &c. Any alkaline reducing agent may be employed and the phenol or amine with which

the nitramine is combined may be a sulphonic acid or not, but it is preferable to select those combinations which are soluble in water in presence of alkalis.—T. A. L.

Improved Manufacture of Colouring Matter of the Induline Series Soluble in Water. O. Imray, London. From the "Farbwerke vormals Meister, Lucius und Brüning," Hochst on-the-Maine, Germany. Eng. Pat. 1699, January 31, 1890. 4*d*.

The following compounds have been separated from the induline melt obtained by heating together a mixture of aniline, its hydrochloride and amido-azo-benzene.

1. A soluble induline, $C_{24}H_{15}N_3HCl$, the base of which forms stable salts with organic acids soluble in water.

2. An induline soluble in spirit, of which the base does not form salts with organic acids. As already described in Eng. Pat. 16,325 of 1888 (this Journal, 1889, 878), the induline mentioned under (1.) yields colouring matters of the induline series soluble in water when heated with aromatic *m*- and *p*-diamines. In a similar manner soluble colouring matters are obtained from the induline mentioned under (2.) by heating it with aromatic diamines, and preferably with *p*-phenylenediamine. 100 kilos. of induline, 150 kilos. of *p*-phenylenediamine, and 30 kilos. of *p*-phenylenediamine hydrochloride are heated to 180° C. for about three hours. The excess of *p*-phenylenediamine is extracted by boiling water and the residue dissolved in 2,000 litres of hot water and 70 kilos. of 30 per cent. hydrochloric acid. After filtering, the colouring matter is precipitated by the addition of salt. It dyes cotton blue.—T. A. L.

Production of Yellow Dye or Colouring Matter. T. R. Shillito, London. From J. R. Geigy and Co., Basle, Switzerland. Eng. Pat. 1771, February 1, 1890. 4*d*.

Dihydro-thio-*p*-toluidine sulphonic acid or primuline (polychromine), both bodies being formed by the action of sulphur on *p*-toluidine and subsequent sulphonation, yield, when their diazo compounds are boiled with ammonia, colouring matters which dye unmordanted cotton yellow. 50 kilos. of primuline are dissolved in 1,000 litres of water, 30 kilos. of hydrochloric acid of 20°5 B. are added, and the solution diazotised by the addition of 7 kilos. of sodium nitrite. 30 kilos. of ammonia of 25° B. are then added, and after standing about 12 hours the solution is boiled and the colouring matter precipitated by the addition of salt. It forms a brown powder easily soluble in water. The yellow colour on the cotton fibre is changed by caustic alkalis to an orange red (see also this Journal, 1890, 851 and 1032).

—T. A. L.

Production of Yellow Basic Colouring Matter. O. Imray, London. From "The Society of Chemical Industry in Basle," Switzerland. Eng. Pat. 1808, February 3, 1890. 4*d*.

When *m*-tolylenediamine is heated with oxalic acid in presence of a condensing agent such as zinc chloride, it is converted into the base of a yellow dyestuff soluble in hydrochloric acid with the formation of the hydrochloride which dyes silk and cotton mordanted with tannin a bright yellow. 2·3 kilos. of *m*-tolylenediamine, 2·3 kilos. of dry oxalic acid, 1·5 kilos. of glycerol, and 1·8 kilos. of zinc chloride are heated with constant agitation to about 130° C., and afterwards to 160° C., for 3—4 hours. The melt is then dissolved in 16 kilos. of hydrochloric acid of 25 per cent., and diluted with 8 litres of water, when the colouring matter separates out. In order to purify it, it is dissolved in boiling water and precipitated with salt.—T. A. L.

Improvements in the Manufacture of Colouring Matters. R. Holliday, Huddersfield. Eng. Pat. 1811, February 3, 1890. 4*d*.

A process for sulphonating the product obtained by heating 3 parts by weight of sulphur with 4 parts by weight of *p*-toluidine for 12 hours to 200°—250° C. after removing the dehydrothiotoluidine from the melt by treatment with hot dilute hydrochloric acid. One part by weight of the base is added to 3—4 parts of fuming sulphuric acid containing 30 per cent. of anhydride, and the mixture agitated until a sample dissolves to a clear solution in water. The sulphonation may be accelerated by warming, and when complete the melt is poured on to ice or into water and salted out or diazotised directly and combined with phenols or their sulphonic acids to form dyestuffs.—T. A. L.

Improvements in the Manufacture of Azo-Colouring Matters for Dyeing and Printing. B. Willcox, London. From the "Farbenfabriken vormals Fr. Bayer und Cie.," Elberfeld, Germany. Eng. Pat. 1828, February 3, 1890. 6*d*.

An extension of Eng. Pat. 8299 of 1889 (this Journal, 1890, 608) substituting for the α-naphthylamine there mentioned the ethyl and methyl ethers of α-amido-β-naphthol. The following process yields a greenish-blue mordant dyestuff. Amido-sulpho-salicylic acid is diazotised and combined with an ether of α-amido-β-naphthol at about 50° C. The amido-azo compound obtained is filtered off, dissolved in alkali, and diazotised with sodium nitrite and hydrochloric acid. A black precipitate which first forms changes to red, and after filtering off is added to an alkaline solution of β-naphthol with the formation of the dyestuff.

—T. A. L.

Production of Soluble Blue Colouring Matters of the Induline Class. J. Imray, London. From "La Société des Matières Colorantes et Produits Chimiques de St. Denis" and Dr. Chapuis, Paris, France. Eng. Pat. 1874, February 1, 1890. 4*d*.

By heating *p*-azoxyaniline, aniline, and aniline hydrochloride to 160°—180°, and treating the melt with water and hydrochloric acid, the hydrochloride of an induline is formed which can be precipitated by salt and zinc chloride. The product dyes cotton mordanted with tannin violet-blue, which is said to be fast to soap or light. In place of aniline other aromatic amines may be employed.—T. A. L.

Improvements in the Manufacture of Soluble Blue Cotton Dyestuff or Colouring Matter. H. H. Lake, London. From K. Oehler, Offenbach-on-the-Maine, Germany. Eng. Pat. 2199, February 15, 1890. 4*d*.

By heating so-called spirit induline with *p*-phenylene or *p*-tolylene diamine to 175° C., it is converted into a blue colouring matter soluble in water. The same process can also be applied to the induline obtained by heating together aniline, its hydrochloride, nitrobenzene, and an iron salt. The colouring matters are very easily soluble in water, but insoluble in brine. They dye cotton an indigo blue shade, which becomes darker by treating the dyed fibre with chromates.—T. A. L.

Improvements in the Manufacture of Colouring Matters. H. H. Lake, London. From A. Leonhardt and Co., Mühlheim-on-the-Maine, Germany. Eng. Pat. 3098, February 26, 1890. 6*d*.

Substituted naphthylenediamines are obtained by heating primary aromatic amines with dihydroxynaphthalene of melting point 216° in presence of a suitable condensing agent. The dihydroxynaphthalene is formed by fusing β-naphthalene disulphonic acid or Schaeffer's β-naphthol sulphonic acid, with alkalis. The substituted naphthylenediamines when heated with *p*-nitroso derivatives of aromatic amines or with quinone dichloro-imide in a suitable solvent yield basic green colouring matters.—T. A. L.

Improvements in the Manufacture of Colouring Matters. The Clayton Aniline Company and John Hall, Manchester. Eng. Pat. 5155, April 2, 1890. 6*d.*

Dyestuffs of the benzidine series are according to this specification obtained by combining tetrazo-diphenyl or tetrazo-ditolyl with one molecule of the sulphonic acids of phenyl- and *o*-tolyl-β-naphthylamine referred to in Eng. Pat. 10,934 of 1889 (this Journal, 1890, 853) and reacting with these intermediate compounds on sodium naphthionate or in general on phenols, amines, their sulphonic and carboxylic acids.—T. A. L.

Improvements in the Production of Mixed Azo-Colours. C. A. Martius, Berlin, Germany. Eng. Pat. 2213, February 15, 1886. Amended April 26, 1890. 6*d.*

Already abstracted (see this Journal, 1889, 701). The employment of several substances is now disclaimed and there are some clerical amendments.—T. A. L.

A Process for the Production of a Substantive Cotton Colour. J. Dawson and R. Hirsch, Huddersfield. Eng. Pat. 14,432, September 13, 1890. 4*d.*

In Eng. Pat. 3803 of 1885 (this Journal, 1886, 96) a process is described for the production of colouring matters by the action of a salt of tetrazo-ditolyl on naphthionic acid. The present patent refers to an improvement on the method there mentioned by using an excess of naphthionic acid (4—6 molecules) to that previously employed. The following quantities are given:—10 kilos. of *o*-tolidine are dissolved in 30 kilos. of 30 per cent. hydrochloric acid and 200 litres of water and diazotised at a temperature below 10° C. by the addition of 75 litres of water containing 6·7 kilos. of sodium nitrite. The diazo solution is then added to 900 litres of water containing 90 kilos. of commercial naphthionic acid and the mixture allowed to stand six days. The black precipitate which forms gradually becomes reddish yellow and turns brilliant scarlet on the addition of caustic soda. When no further change of colour is observed, 1,000 litres of water are added, the mixture is made alkaline by the addition of 20 kilos. of 30 per cent. caustic soda lye and the temperature raised to 80° C., when the colouring matter is precipitated by adding 100 kilos. of salt, after which it is filter-pressed and dried. The mother liquor contains the excess of naphthionic acid which may be recovered by precipitation with hydrochloric acid.

—T. A. L.

Manufacture of Colouring Matters Obtained by the Action of Amines of the Fatty Series upon Galloeyanine. J. Imray, London. From "La Société L. Durand Huguenin et Cie.," Basle, Switzerland. Eng. Pat. 18,526, November 17, 1890. 4*d.*

Blue to green dyestuffs are formed by heating galloeyanine with primary and secondary amines of the fatty series in a concentrated aqueous solution at a temperature of 90°—100° C. The product is then dried and differs from galloeyanine in being easily soluble in water. The colouring matters dye mordanted and unmordanted wool and can also be employed for printing on cotton and for the formation of lakes.—T. A. L.

V.—TEXTILES: COTTON, WOOL, SILK, Etc.

PATENTS.

Improved Apparatus for the Preparation of Textile and Filamentous Materials intended to Facilitate their Cleaning and the Removal of Thistles or Burrs therefrom. S. Pegler, Roubaix, France. Eng. Pat. 17,882, November 9, 1889. 6*d.*

A series of rollers, working in pairs, is furnished longitudinally with metallic blades. The speed of the rollers increases from pair to pair, and the textile materials which are brought between the rollers are thereby drawn out and opened and the burrs and other foreign matters loosened which can then be easily extracted by the usual methods.

—H. S.

A New or Improved Machine or Apparatus for Finishing Textile Fabrics. G. Douglas, Bowling. Eng. Pat. 18,772, November 23, 1889. 8*d.*

Two endless cloths, one placed over the other and heated by being brought into contact with steam cylinders, cover the greater part of a large cylinder. Fabrics to be pressed and finished are placed between the two cloths while in motion, the pressure being regulated by the tension of the cloths.—H. S.

Improvements in the Treatment of Hemp, Flax, Jute, Cotton, and other Substances, in Order to Preserve the Same. E. T. Truman, London. Eng. Pat. 19,773, December 9, 1889. 4*d.*

Substances, such as the peroxides of manganese, lead, barium, &c., which have the property of decomposing ozone into oxygen, are stated to preserve hemp, flax, gutta-percha, india-rubber, and other similar substances from oxidation and decay. In practice these peroxides are mixed with ozokerite, tar, and other substances, and then applied to the materials to be protected, *e.g.*, sail cloths, tarpaulins, packing used for electrical conductors, cables, &c.—H. S.

An Improved Method of and Apparatus for Treating Wool in the Batting and Carding Processes preparatory to Spinning. A. J. Pilard, Paris, France. Eng. Pat. 20,386, December 18, 1889. 8*d.*

In this process water is substituted for fatty matter in the preparation of wool, during the whole carding process up to the spinning. All the machinery is therefore treated with red lead, and the teeth of the cards made of tinned steel or aluminium bronze, to prevent oxidation. The wool is first subjected to two batting processes, then moistened with half its weight of water, left to stand 48 hours, and then carded, during which operation it is repeatedly moistened by means of apparatus between the cards, to keep up the hygrometric condition which is acknowledged to be the best for the carding of wool. When wool, carded thus, is subjected to the combing process, a considerable decrease of noils, and therefore increase of the combing wool, is effected. This process is also applicable to wool mixed with other fibres.—H. S.

Improvements in the Treatment of Textiles by Means of Ammoniacal Oxide of Copper for the Purpose of Rendering same Waterproof and Non-Combustible. C. Baswitz, Berlin, Germany. Eng. Pat. 20,665, December 23, 1889. 4*d.*

Textiles are thoroughly impregnated with a solution of vegetable parchment in cuprammonium, and become possessed of all the qualities of parchment. The mechanical process is the same with that previously described in Eng. Pat. 16,708 of 1889 (compare this Journal, 1890, 1047).

—H. S.

Improvements in the Method of and Apparatus for Treating or Scouring and Washing Wool and other Fibrous Substances. John Smith, Isaac Smith, and Joseph Smith, Siddall. Eng. Pat. 1461, January 28, 1890. *8d.*

Several scouring vessels are placed on different levels, and made to communicate with each other by tubes at the bottom. Above them other vessels are placed, having perforated bottoms through which the scouring liquor falls as a spray or shower into the vessels below. The wool is carried through the different vessels on endless travelling lattice sheets, and is thus exposed to the spray of the scouring liquor. At the end of each vessel a pair of rollers squeezes the liquor from the wool before it enters the next vessel. The liquor may be pumped into the upper vessels and utilised again. The construction of the apparatus may be modified by dispensing with the travelling lattice and allowing the wool to float in a long vessel filled with scouring liquor. Wool and liquor move slowly in one direction, and at the end of the vessel a pair of rollers squeezes the wool free of the liquor which falls into a vessel below, from which it can be raised by pumps into the upper vessel and re-used. A series of perforated revolving cylinders regulate the motion of the wool and liquor. By this process the felting and entangling of the material is avoided, whilst the cleansing is satisfactorily performed.
—H. S.

Improvements in the Process of Cleaning and Extracting Oil and Grease from Cotton-Waste and other Fibrous Materials. D. Barnett, St. Peter's Park. Eng. Pat. 1652, January 30, 1890. *8d.*

Cotton-waste, after being used for cleaning engines and machinery, is treated with petroleum or other liquid hydrocarbon, by being placed in a cylinder of wire-work which revolves in a cylindrical vessel containing the petroleum. After treatment the waste is removed from the bath, and the petroleum expelled from it by pressure or other means, when the waste is washed with a suitable agent such as solution of soap, caustic, or other detergent, and turpentine. The waste is now rinsed with water and dried, when it is fit for re-use. The petroleum, after having taken up sufficient oil or grease, is separated in the usual way.—K. E. M.

An Improved Process for Washing and Scouring Wool and Fibrous Materials containing Grease. G. W. Arnott, P. A. Olivier, and G. Seagrave, London. Eng. Pat. 5482, April 10, 1890. *8d.*

Potash, sand, and other mineral matters present in the material are removed in a centrifugal machine by means of jets or sprays of water, operating in the centre of the machine. The oily and fatty matters are then extracted by carbon bisulphide, benzene or ether, the material being afterwards carefully washed with water. The fibres are said to be rendered softer than by the ordinary treatment, and a less quantity of the above-mentioned solvents required. The apparatus used for this process is a hydro-extractor which rotates first slowly and afterwards quickly, during each of the three parts of the operation, until the material is clean and dry. It is connected with a series of separators, where the sand and the earthy matters are deposited, the dissolved substances flowing into tanks and distilling vessels, where they are treated in the ordinary way. The hydro-extractor is suitably cased in to prevent the escape of volatile substances.—H. S.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

A "Discharge" for Dyes Mordanted with Chromic Oxide. H. Schmid. Chem. Zeit. **14**, 1439—1440.

Dyes fixed on the fibre by means of chromium sesquioxide are daily gaining in importance, owing to their relatively great stability and soap-fastness. A great variety of shades is obtainable by employing the numerous phenolic and other dyes that form lakes with chromium oxide, such as Gallocyanin, Coerulein, Alizarin, Alizarin-blue, -orange, -green, -black, -grey, &c. Designs are most readily -yellow, produced on materials so dyed by using a suitable discharge, the patterns obtained being distinguished for sharpness and cleanness. In the process hitherto employed the mordant is directly precipitated on the fibre by soaking the latter in a solution of chromium oxide in soda ($Cr_2(NaO)_6$); or the material is soaked in chromium bisulphite and subsequently dried by heat. Again, a solution of a chromium salt may be used, followed by a bath of sodium zincate. The design is then printed on the fabric with an acid discharge, and the material is finally dyed with one of the above dyes. In order to effect a more rapid and complete discharge of the mordant, the author employs the following mixture:—

	Grms.
Water	9,000
"British Gum"	7,000
Potassium ferricyanide	6,000
Potassium chlorate	600
Sodium chlorate	600
Magnesium carbonate paste	12,000

Coloured patterns are obtained by mixing potassium ferricyanide, magnesium carbonate, and alkaline chlorates with a suitable mineral colouring matter, such as chrome yellow, vermilion, &c., thickened with albumen. The fabric, previously prepared with a mixture of mordant and dye and dried (but on which the colour has not been developed), is printed on with the above composition and steamed. Below are formulæ for some dischargeable colours:—

Violet.

	Grms.
Gallocyanin in powder	120
Soda lye at 10° B.	320
Water	24,000
When dissolved, add in the cold with stirring—	
Sodium bisulphite at 36° B.	400
Cold water	14,000
Finally add—	
Chromium acetate at 20° B.	400
Calcium acetate at 15° B.	240
Water	920

and finally dilute the whole to 40 litres.

Blue.

	Grms.
Alizarin blue S	120
Water	23,000
Sodium bisulphite	100
Chromium acetate	240
Calcium acetate	100

Grey.

	Grms.
Alizarin blue S	120
Water	23,000
Sodium bisulphite	180
Chromium acetate	240
Calcium acetate	100
Extract of Persian berries at 30° B.	53
Alizarin, SX (20 per cent.)	31
Nitroalizarin	5

—H. T. P.

New Dyes. Chem. Zeit. Rep. **14**, 334.

Pyromine is prepared by oxidation of tetramethyldiamidodiphenylmethaneoxide, which dyes tannin-mordanted cotton a brilliant blue-red, and surpasses all known dyes of similar shade for fastness. The dye can also be used for silk, jute, leather, paper, lakes and pigments.

Acridine Orange is another dye prepared by condensation of formaldehyde and *m*-toluylenediamine, and dyes cotton mordanted with tannin and tartar emetic a fast and brilliant orange. Silk is dyed in a soap-bath with acetic acid. Leather and jute require no mordants.—A. R.

New Method for Producing White and Buff Discharges on Indigo Grounds. W. Geller. Farber. Zeit. **2**, 24.

The goods are printed with 300 grms. of dextrin thickening, 150 grms. of sulphate of lead, 40 grms. of sodium chlorate, 42 grms. of ammonium chloride, and 19 grms. of potassium ferricyanide. The salts are best dissolved at 40°—50° in the gum, the sulphate of lead being added last. After printing, the goods are steamed with dry steam for half an hour, then passed through a solution of 30 grms. of caustic soda of 38° B. per litre of hot water, and in case the whites are yellowish, through very dilute sulphuric acid. Instead of the ferricyanide, potassium bichromate may be used. In this case, passage through sulphuric acid can be dispensed with.

The buff is produced by boiling 130 grms. of leio-gum, 60 grms. of starch, 65 grms. of sodium chlorate, and 250 grms. of water, then adding 70 grms. of ammonium chloride and 40 grms. of potassium ferricyanide at 40°—50°, and finally, 220 grms. of lead sulphate, 16 grms. of oxalic acid, 100 grms. of ferric acetate (prepared from 20 grms. ferric chloride and the corresponding amount of sodium acetate). After printing, the goods are passed through the Mather-Platt steaming chamber, treated with ammonia to neutralise the oxalic acid, steamed, and passed through caustic soda as above.—A. R.

PATENTS.

Improvements in the Treatment of or Finishing of Manufactured or Partially Manufactured Materials from Cotton or similar Fibres or other Substance containing Cellulose. H. A. Lowe, Heaton Moor. Eng. Pat. 20,314, December 17, 1889. 6*d*.

The material is immersed for several minutes in a concentrated solution of sodium hydrate (usually of 40° to 55° Tw.), then squeezed and thoroughly washed with warm water. By this treatment the fibres are said to become more cylindrical, and their walls thicker. The material itself being thereby rendered stronger, can be dyed better and more uniformly.—H. S.

An Improved Process and Composition for Producing Printing Ink. C. Huelser, London. From G. Callmann, Weimar, Germany. Eng. Pat. 20,830, December 28, 1889. 4*d*.

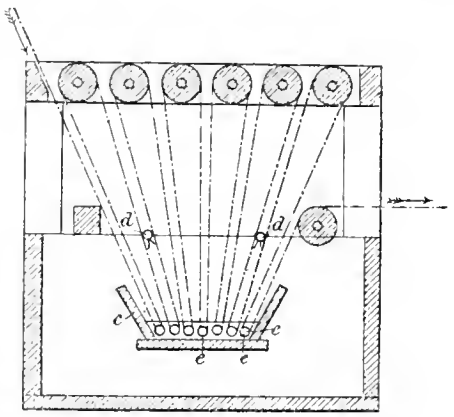
Use is claimed of the powder produced by grinding brown coal (to pass through a sieve of at least 3,500 meshes per square centimetre), instead of soot, &c. hitherto used, for making black printing ink. The ink made with powdered coal is said to be characterised by its "intensely black velvety shade."—E. B.

Improvements in Apparatus for Treating Fabrics, Paper, and other Materials with Gases, Steam, or Hot Air. E. Remy, Mülhausen, Germany. Eng. Pat. 20,905, December 30, 1889. 8*d*.

The material is carried through the chamber in which it is to be treated by two travelling endless chains, arranged parallel to each other, and provided with arms or levers, each adapted to turn about a centre, two arms constituting a set, and in corresponding positions on the two chains, and connected by a bar or roller that is capable of being turned over by means of turnstiles placed near the entrance to the chamber, and operating in such a manner that all the bars are brought in succession underneath the entering material, and cause it to be automatically formed into long folds that hang down side by side, thus exposing a large surface to the action of the gases, steam or hot air within the apparatus, the material being afterwards straightened out at the opposite end of the chamber. The apparatus may be partly or entirely closed, openings being however provided for the material to enter and leave, and also for means to actuate the parts within the apparatus.—E. S.

Improvements in the Production of Azo-Colours upon Cotton or other Vegetable Fibre in the Piece, and in Apparatus therefor. S. and J. Knowles, Tottington. Eng. Pat. 1062, January 21, 1890. 8*d*.

The diazotising baths employed in the production of azo-colours on cotton piece-goods, are extremely sensitive, and rapidly rendered inoperative by the passage through them of cloth prepared with phenols. To overcome this difficulty, the present inventors run the piece continuously through the machine shown in the Figure, to which the diazo solution



Piece-Dyeing with Azo-Colours.

is supplied in quantity as required, by means of the spurt pipes *d*, *d*. The lower series of rollers *e*, *e*, *e*, are preferably composed of metal, and are supported in a shallow vessel *c*, which serves to receive the liquor not absorbed by the cloth, the operation being so regulated that only a small quantity of such liquor is at any time in the receiving vessel.—E. B.

Improvements in the Manufacture of Colouring Matters, and in Dyeing or Printing Wool and other Fibres therewith. R. Holliday, Huddersfield. Eng. Pat. 1812, February 3, 1890. 4*d*.

A nitroso- or dinitroso-compound of one of the dihydroxynaphthalenes is reduced in an aqueous solution with sodium hydrosulphite or other suitable reducing agent. The fibre is then immersed in the bath and, after the superfluous liquid has been removed, is oxidised by exposure to the air. The colouring matter may also be obtained as a paste or powder by oxidising the bath itself and collecting the precipitate. In order to employ it for dyeing it is mixed with water and reduced with hydrosulphite as above, or the reduced compound may be thickened with gum or starch and used for printing, the colour being subsequently developed by steaming.—T. A. L.

Improvements in or appertaining to Dyeing with Indigo. J. Braithwaite, Kendal. Eng. Pat. 2195, February 11, 1890. 6*d*.

The inventor claims as an improvement in dyeing with indigo, the omission of any addition of "alkaline carbonate or other like salt," the vat being formed by the reduction of indigo with hyposulphurous acid, and being "neutral or somewhat acid," instead of alkaline as hitherto. Such a vat is prepared by taking, for example, 20 lb. of indigo, 10 lb. of zinc-dust, and 15 lb. of sodium bisulphite. The ingredients named may be mixed together in a dry state to form powders or cakes which may be kept for months and merely require mixing with warm water to form a dye-vat. Sodium sulphite may be substituted for sodium bisulphite in these dry mixtures, a sufficient amount of mineral acid being added to the water to produce sodium bisulphite when such is the case.—E. B.

Apparatus for Dyeing and otherwise Treating Textile Fibres in the Form of Bobbins or Cops. W. L. Wise, London. From F. Mommer and Co., Barmen-Ritters-hausen, Germany. Eng. Pat. 2763, February 20, 1890. 8*d*.

The cops are packed in regular layers as closely as possible in rectangular boxes, and the spaces between the layers filled up with india-rubber or a similar material, in order to obtain an even resistance in the dyeing bath, which is necessary for dyeing the cops uniformly. The dyeing liquid is forced through the bottom of the boxes by considerable pressure, and passing through the material escapes through the covers, and subsequently returns to the pump. The material is then washed with water in a similar way. The material is freed from the dye liquid or water by placing the boxes, each having its perforated bottom turned outward, on a specially constructed centrifugal machine, or by forcing a current of heated air through the bottom of the boxes.—H. S.

An Improved Ink for Printing and similar Purposes. H. H. Lake, London. From W. G. Fuerth, Newark, New Jersey, U.S.A. Eng. Pat. 16,689, October 20, 1890. 4*d*.

Vaseline is combined with boiled oil or other fatty substance and colouring matter to form a concentrated printing ink, which possesses the advantages of not clogging or hardening on ordinary roller-composition, of printing smartly, without spreading or flowing, and of not leaking from its packages; it is rendered of the proper consistency for printing by the friction of the rollers over it.—E. B.

VII.—ACIDS, ALKALIS, AND SALTS.

The Decomposition of Strontium Carbonate by Heat. J. T. Conroy.

See pages 101—106.

The Manufacture of Potassium Carbonate from the Crude Residue of Beetroot Molasses, with the Preparation of Potassium Chloride, Potassium Sulphate, and Sodium Carbonate. W. Greif. Chem. Zeit. **14**, 1140—1142, 1504—1505, and 1535—1537.

The composition of the crude calcined residue of beet molasses is extremely variable. The chief constituent, potassium carbonate, ranges from 25 to 60, and averages 40 per cent. A very good sample had the following composition:—

	Per Cent.
Potassium carbonate	65·5
Sodium carbonate	12·2
Potassium sulphate	2·6
Potassium chloride	10·5
Water	2·4
Insoluble matter	6·8
	100·0

The apparatus to be employed in working up the crude ash depends on the percentage of insoluble matter contained in it. Samples having not more than 10 per cent. of insoluble matter are treated in the following arrangement of wrought iron vessels (Fig. 1). B is a dissolving tank of 12 cbm. capacity, placed at a suitable height, say 4 m., above the floor. A cast-iron bend, closed by a wooden plug, is screwed into the bottom of the vessel. C is a "mud-pan" of 2½ cbm. capacity. D is a tank, holding 0·8 cbm., let into and level with the floor. F is a Körting's steam elevator. A wooden framework is placed close to the vessel B, for the workman to stand upon. Two iron sieves are suspended inside B by means of a chain which passes over a pulley above. For extracting samples with over 10 per cent. of insoluble matter, the apparatus shown in Fig. 2 is employed. A is a wrought-iron tank holding about 6 cbm., in which the liquid used for treating the ash is warmed by means of free steam from E. B is a dissolving-tank of 12 cbm. capacity, fitted with a tap L just above the bottom. In the vessel B is a perforated iron sieve H resting on well-burnt bricks. C is the "mud-extractor" of 9 cbm. capacity, fitted with two steam inlets. D is a tank, holding 0·8 cbm., fitted with its upper edge level with the floor. F is a steam elevator.

Fig. 1.

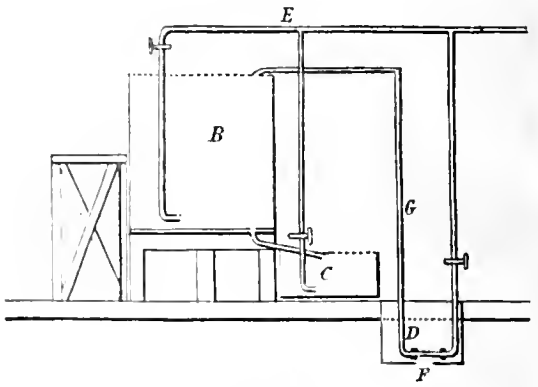
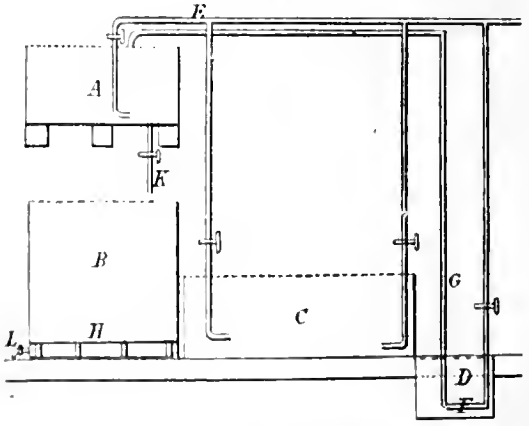


Fig. 2.



The Treatment of the Crude Residue of Beetroot Molasses.

The treatment of ashes containing up to 10 per cent. of insoluble matter is conducted as follows: The tank B (Fig. 1) is about two-thirds filled with water, which is then heated by means of steam to about 50° C. Crude ash is then dropped into the sieve until the solution has a density of about 30 B. Finally, the mixture is heated nearly to boiling, and subsequently allowed to settle for two days, when the clear lye is syphoned off and transferred to evaporating pans. A fresh portion of ash can then be

treated in B. After every two or three operations the slime collecting in B is run off through the tube at the bottom into C, where it is repeatedly extracted with water heated to boiling by free steam, until all soluble salts are removed. The weak lyes obtained are syphoned off into D, and from thence elevated into B, and employed to extract a fresh portion of crude ash. Samples containing over 10 per cent. of insoluble matter are treated as follows:—The false bottom of the vessel B (Fig. 2) is covered with a smooth layer of straw, hand-deep. The raw ash is evenly distributed over this filtering bed until the vessel is filled. Meanwhile, water is warmed in A to 50° C. and then sprinkled over the contents of B until the ash is completely covered. After 24 hours the solution, which has a density of 40°—42° B, is drawn off through L. The first portion, which is always turbid, is collected separately, whilst the clear portion of the lye is transferred to an evaporating pan. The tank B is again filled with hot water, which after five hours is tapped off, the operation being repeated until the extract has a density of only 2°—3° B. The mud from B is run into C, where it is boiled with water and steam to extract the remaining soluble matter. The weak lyes obtained are syphoned off into D and then elevated to A to be used instead of water for dissolving purposes.

The solutions obtained by the above processes are subsequently treated in precisely the same way. They are concentrated in an evaporating pan (1) up to a density of 40° B. at the boiling point, when the fire is somewhat slackened. After three to four hours, the clear lye is run into crystallising tanks which are made of wrought-iron, 3 m. × 4 m. × 50—60 cm. deep. It is well to construct the tanks with an inclined bottom. During the three to four hours that the hot solution remains in the evaporating pan (1) it deposits a heavy crystalline mud consisting chiefly of potassium sulphate. Once or twice weekly the precipitate is removed and washed with cold water, in a small iron box fitted with a sieve bottom, until the washings have a density of only 10°—13° B. The washings are returned to the pan (1) and again concentrated with fresh lye.

The liquid in the crystallising tanks is allowed to remain until it has cooled to 29° C. or at lowest 27° C., by which time the greater portion of the potassium chloride will have separated. Further cooling should be avoided, because it leads to the most undesirable crystallisation of a double carbonate mixed with potassium chloride. Therefore, as soon as the temperature reaches 29° C., the liquid is syphoned off and transferred to an evaporating pan (2). The crystals are washed with cold water until they contain at most only 1 per cent. of potassium carbonate, the washings being returned to the evaporating pan (1).

The potassium sulphate when dried has the following average composition:—

	Per Cent.
K_2SO_4	92·22
K Cl	3·15
K_2CO_3	2·34
H_2O	1·22
Insoluble and undetermined	1·07
	100·00

The dried potassium chloride consists of—

	Per Cent.
K Cl	89·14
K_2SO_4	9·67
K_2CO_3	0·91
Insoluble and undetermined	0·28
	100·00

The lye, almost freed from potassium chloride and sulphate is concentrated in pan (2) up to 50° B. Much soda separates during this operation, and must be continually chipped off the bottom of the pan with a sharp chisel in order to avoid burning of the metal. After concentration the liquid is allowed to remain at rest for one hour, so that the soda may settle. The liquid is then syphoned into an evaporating pan (2*a*) where it remains until it has cooled to 50° C., after which the liquid is transferred to a crystallising tank. The deposit formed in the pan (2*a*) consists of potassium chloride and sulphate, and is again worked up in pan (1). The soda deposit from pan (2) is transferred as quickly as possible to a washing-tank provided with a perforated false bottom covered with coarse linen. Here it is washed with a hot solution of soda at 32°—34° B., and in order to prevent the mass setting it is necessary to stir it vigorously with a shovel for some time. Washing is continued until the filtrate has a density of about 38° B. The washings are added to pan (2). Meanwhile, the liquid in the crystallising tank deposits on cooling large crystals of a double carbonate of sodium and potassium, and the more thorough the cooling, the more complete is the separation of the double salt. The supernatant liquid is further concentrated in another pan (3) up to 52°—57° B. A further portion of soda separates at this stage, and is added to pan (2). When the lye has attained the desired concentration it is allowed to settle for one hour and transferred to a calcining furnace. The double salt from the crystallising pans is dissolved in lye freed from potassium sulphate and chloride, from which the bulk of the soda separates at the boiling temperature. The calcining-oven is of the usual form, and is most carefully constructed. The furnace being raised to a light red heat, the concentrated lye from the pan (3) is run in a thin stream on to the hearth, and heated until it assumes a pasty consistency. At this stage a crust begins to form, which must be broken at intervals, the lumps formed being raked towards the bridge of the furnace. Great care must be taken to prevent the crust being melted, as serious explosions might result from the molten mass coming in contact with the underlying lye. When the charge assumes a crumbly state, all except about 300 kilos. is raked close up to the wall of the furnace, opposite the fire bridge. The 300 kilos. are evenly spread over the floor of the oven and constantly raked about. The heat is then gradually raised until the mass of potash almost glows, but does not melt. The mass is then withdrawn and a fresh portion of the charge spread over the furnace, and so on. A single workman can calcine from 1250—1500 kilos. of potash in 10 hours. In most cases the potash is still, more or less, coloured. In order to refine it, it is redissolved in water up to a density of 52°—54° B., allowed to settle and again calcined. The composition of the potash depends on the concentration of the lye before calcination, as will be seen from the following analyses of different samples:—

	Strength of Lye.		
	52° B.	55° B.	57° B.
K_2CO_3	81·0	90·0	92·3
Na_2CO_3	12·0	3·3	2·4
K_2SO_4	1·1	2·1	1·2
KCl	2·4	2·8	2·0
H_2O	2·5	0·4	0·6
Undetermined and insoluble	1·0	1·4	1·5
	100·0	100·0	100·0

In addition to the above, silicate and phosphate of potash are always present, in consequence of which the potash is unfit for clear-glass making. For certain purposes a hydrated potash is required. For this purpose a strong solution of refined potash is concentrated in a bright cast or wrought iron pan, until it is found by trial that the mass contains about 16—20 per cent. of water. If a wrought-iron pan be used, it must be formed from one piece.

A purer potash is prepared from the potassium sulphate and chloride obtained during the initial stages of the lye concentration, by the Leblanc process.

The soda from the evaporating pan (2) is converted into soda crystals by solution and crystallisation.—H. T. P.

Ammonium Pyrosulphate. A. Fock and K. Kluss. Ber. **23**, 3149—3151.

Almost all ammonium salts are isomorphous with the corresponding potassium salts. Amongst the salts of the sulphur acids, however, remarkable exceptions occur. Thus, in the case of acid sulphates there is no certain indication of isomorphism.

The authors have shown (Ber. **22**, 3096) that the thiosulphates do not exhibit isomorphism. From Marignac's work, quoted in Rammelsberg's "Handbuch der kryst. Chem." similarity of crystalline form would seem not to exist in the case of the sulphites, but doubt seemed to exist owing to little being known of ammonium pyrosulphite $(NH_4)_2S_2O_5$. The authors have obtained it in the form of deliquescent crystals by passing sulphur dioxide into a well cooled strong solution of ammonia, and then concentrating over sulphuric acid. These crystals are not isomorphous with crystals of the corresponding potassium salt. Analysis of the crystals agreed sufficiently well with the formula to satisfy as to their composition.—T. L. B.

Sulphuric Acid Manufacture: The Chamber Process. A. Scherteł. (Jahrb. Berg. u. Hüttenw. Sachsen, 1890.) Zeits. f. angew Chem. 1890, 639—646.

A series of experiments carried out on chambers fed with sulphur dioxide, obtained in the roasting of blende, &c.

In a number of systems of chambers combined in the usual way analysis of chamber gases at different points gave results similar to those of Lunge and Naef (this Journal, 1884, 258 and 633). In the first third of the first chamber a perfect mixing of the gases throughout the section of the chamber is not always found.

The effect was tried of passing the gases in at both ends of the first chamber, the exit being in the middle at the top; the middle portion of the chamber in this way becomes better worked, and the process of sulphuric acid formation thus, from analyses of the gases, would seem to be more evenly distributed throughout the chamber. Increased proportional action of the first chamber was also obtained. The previous work of the author (see this Journal, 1889, 284) is also reiterated.

In order to see how far the possibility existed of economising space by the erection of small chambers instead of the present larger ones, the first chamber of one system was divided into three by two partitions, so arranged that the gases must pass through each subdivision either from bottom to top, or from top to bottom. This brought about considerable variation in the temperature of the various portions of the chamber, the middle portion having a temperature higher, by some 10 degrees, than the two end sections. The yield of acid increased, but so did also the loss of nitre.—T. L. B.

New Application for Calcium Plumbate. G. Kassner. Chem. Ind. 1890, **13**, 392—393.

See under XXII., *page* 160.

The Ferrous Sulphate Manufacture in France. Chem. Ind. 1890, **13**, 472—473.

Ferrous sulphate is now frequently used as a manure, and its manufacture, especially in France, has therefore increased considerably. It is chiefly manufactured from pyrites, which are oxidised by exposure to the air. A second technically important method of preparation is the direct use of old iron or iron cuttings, which are dissolved in sulphuric acid of 20—25° B., wooden vessels, lined with lead, being used for the purpose. A greater profit, however, is yielded by the use of acid residues from other manufactures, which can be obtained very cheap. Some factories in France produce in this way very large quantities of ferrous sulphate. Agriculture proves more and more the great importance of this manure for the assimilation of the potash, contained in the silicates of the soil. Its price at present is 4 to 6½ francs per 100 kilos.—H. S.

Manufacture of Acid-proof Slabs for Glover-towers. Thonind. Zeit. 1890. **14**, 642.

It is preferable to use materials rich in silica for stones which are to resist chemical actions. If clay free from iron cannot be obtained, a suitable mixture is 25—30 parts of felspar, an equal quantity of rich clay and 40—50 parts of quartz. The mass must not contract too much on firing. The following mixture may be advantageously used for glazing: 54 parts of quartz, 84 parts of felspar, 35 parts of levigated chalk, and 36 parts of kaolin. The ingredients are moistened and well ground together before use.—A. R.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

On the Application of Mesuré and Nouel's Pyrometer in the Earthenware Trade. H. Hecht. Thonind. Zeit. 1890, **14**, 575.

The author has experimented with this pyrometer, which is is a kind of polarisation apparatus consisting of two Nicol's prisms as polariser and analyser, between which is a quartz. He finds that at the high temperatures used in earthenware manufacture, a difference of 100° C. make very little difference of reading on the instrument, and furthermore, the instrument is affected by the inevitable presence of the flame of the furnace itself, instead of by the heated body only, so that the author concludes that this form of pyrometer is not suitable for the earthenware manufacture.

—T. L. B.

Oberjahna Pottery Clay. H. Hecht. Thonind. Zeit. 1890, **14**, 592.

The medium class of fire-clay is peculiar in that the sand contained therein is in such a fine state that washing alters the composition but slightly, as shown by the accompanying analyses:—

	Crude Clay.	Washed Clay (54·3 per cent.).
$Al_2O_3.2SiO_2.2H_2O$	30·55	37·48
Quartz	66·61	59·61
Felspar	2·84	2·91

This material from its character and composition and from the fact that it gives a pure white melt with felspar (ferric oxide 0·55 per cent.) may be directly used as earthenware mass.—T. L. B.

Enamels for Iron and other Metals. Petrik. Monit. de la céramique et de la Verrerie, 1890, **21**, 199.

In case the enamel leaves the iron or if the surface of the iron should become curved, that is to say, if the contraction of the enamel on cooling be less than that of the metal, then according to the author the following points must be attended to: Either (*a*) the percentage of silica must be increased, or (*b*) part of the boric acid must be replaced by silica, or (*c*) in the case of enamels containing lead a portion of the oxide of lead must be replaced by alkali or alkaline earth, or (*d*) part of the alkaline earths must be replaced by alkali, or (*e*) the quantity of alkali must be increased, and the boric acid decreased, or (*f*) part of the oxide of tin may have bone ash substituted for it.

The composition is given of a number of satisfactory enamels.—T. L. B.

The Production of High-Temperature Blue on Porcelain. C. Lauth. Le Manufacture de Sèvres, 1879—1887.

THE production of high temperature blue on porcelain is carried out at Sèvres as follows:—15 parts of black oxide of cobalt are ground up with 85 parts of pegmatite, and the mixture after being roasted painted on to the glaze of the fired porcelain. The pegmatite used contains 8·73 per cent. of alumina, 26·49 per cent. of quartz, and 64·58 per cent. of felspar, and is obtained from St. Yriex la Perche, near Limoges. When the colour is put on underneath the glaze or on to the porcelain during cooling, the results are less satisfactory. After painting, the article is fired, when the colouring mixture soaks into the glaze and gives a beautiful blue colouration. During this burning the glaze is especially apt to boil up, a circumstance which cannot be overcome by a second firing. The cause of this the author has shown to be on the one hand the presence of reducing gases at the end of the firing, and on the other hand to there being too little draught when counter currents form, which give rise to an accumulation of gas and thus prevent complete combustion.—C. A. K.

PATENTS.

Improvements in or Connected with Apparatus or Appliances for Polishing Glass. V. Malevez, Courcelles, Belgium. Eng. Pat. 20,014, December 12, 1889. 6*d*.

A RING or frame actuated by a driving shaft is furnished with small disc polishers working on spindles. These polishers, besides the motion imparted to them by the revolving frame, acquire an individual motion of their own. If desired, however, they can be held in one position by means of a cotter passing through the collar of the polisher and spindle.—S. G. R.

Improvements in Machinery for Rolling Glass. Chance Bros. and Co., Limited, and E. F. Chance, West Smethwick. Eng. Pat. 785, January 15, 1890. 8*d*.

THE molten glass after passing downwards over an inclined plate through a pair of primary rolls is carried on to another inclined plate and thence to a pair of secondary rolls. The axes of these are horizontal, but are not vertically placed one above the other, their plane, however, being at right angles to that of the feeding or inclined plate. The secondary rolls rotate at a higher rate of speed than the primary, and may be impressed with a design or pattern which is then communicated to the still plastic glass sheet in its passage between them. The specification is illustrated by a drawing.
—S. G. R.

Improvements in Plate and Rolled Plate Glass Annealing Kilns and Machinery. W. W. Pilkington, St. Helens. Eng. Pat. 927, January 18, 1890. 8*d*.

THE annealing kiln is built in the shape of an L, the glass being passed in at the one end, and when annealed pushed or drawn out through the other. The kilns are provided with gas and air nozzles, and also with baffle arches, in order more easily and effectually to control the temperature. The plates are moved forwards by means of rods fitted with studs, and suitably geared, which catch in the rear end of each plate. The plates are then allowed to cool in chambers, placed at the delivery end of the kiln, and which are alternately in use.—S. G. R.

Process for Producing Opalescent Glass from a Glass Mixture containing Silico-fluorides of Alkalis or Compounds thereof. C. Huelser, London. From J. Kempner, Goerlitz, Germany. Eng. Pat. 2626, February 18, 1890. 4*d*.

THE patentee adds a small quantity of the silico-fluorides of potassium or sodium to the batch. This addition gives an opalescent glass even when added in small quantity. Fluorides alone, including cryolite, unless in much larger excess, produce only a clear white glass.—S. G. R.

Improvements in the Manufacture of Fibrous Material from Slag or other Vitreous Substance, and in the Apparatus used in such Manufacture. C. Wood, Middlesborough. Eng. Pat. 5847, April 17, 1890. 8*d*.

THE filaments and heavy particles produced by the action of a blast of steam or air upon the molten slag are carried forward through a tube terminating in a bell mouth into a chamber, where they impinge upon the vertical projecting angle of an upright screen. The heavier dross falls first into a chamber placed beneath, while the lighter glassy-wool, deflected on either side towards the sides of the chamber, pass on and come in contact with two sets of vertical boards inclined in such a way that both those to the right and left of the screen slant inwards towards the centre of the chamber, thus slanting as regards themselves in opposite directions. The residual heavy particles are here trapped and the wool passes inwards into the chamber, the heavier fibres falling first and nearer to the partition boards.
—S. G. R.

A Method of Cutting Glass Tubes and Apparatus employed therein. H. Beeker, Barmen, Germany. Eng. Pat. 12,536, August 11, 1890. 8*d*.

AN iron rotating disc is pressed against the glass which is to be cut, the latter being also caused to slowly rotate in the same direction as the disc, an even cut being thereby effected. The pointed very hot flame of a gas jet is directed upon each of the shallow grooves, the glass then breaking smoothly across at each of these places and leaving no irregularities whatever. The specification is illustrated by drawings.—S. G. R.

Improvements in Pottery Kilns. F. C. Roberts, Philadelphia, U.S.A. Eng. Pat. 13,436, August 26, 1890. 8*d*.

IN the centre of the kiln, which is dome-shaped, is a down-take flue fitted with a circular cover with radial openings through which the products of combustion pass away to the regenerators and thence to the chimney. At equi-distances round the interior are placed air and gas ports in groups of three, the gas ports occupying the central position. Between the down-take and the ports are the supports upon which the articles to be fired are placed. By a suitable arrangement of valves the ordinary reversal of the currents of gas and air and of the hot waste products of combustion is obtained, but this reversal takes place outside the kiln, so that the currents within always flow in the same direction. The patentee claims this modification as being essential, the kiln otherwise becoming cooled down at the various inlets, an irregular and defective product being the result. The specification is illustrated by three sheets of drawings.
—S. G. R.

Improvements in Apparatus for the Manufacture of Glass-Ware. J. T. King, Liverpool. From E. and J. A. Jones, Pittsburg, U.S.A. Eng. Pat. 14,983, September 23, 1890. 8*d*.

A SUITABLE bed carried on pillars supports a mould, sliding into which is the "former." This having been filled with molten glass is raised to its position within the mould. A plunger, formed of a hollow tube, terminating in a rounded head carried on a pair of stout spiral springs within the hollow tube is now strongly depressed, whereby the glass is forced into the shape of the mould. The "former" is now lowered, leaving the glass behind and the orifice closed by a tightly fitting plate, the upper being also closed by a plate carried on the plunger. Compressed air is then admitted down the hollow plunger, and by slightly raising this can escape by the opening between the movable head and the body of the plunger into the cavity of the mould, thereby blowing the glass to the full size of the mould. The specification is illustrated.—S. G. R.

Improvements in Machinery for Manufacturing Cups and other Articles in Pottery-Ware. W. Boulton, Burslem. Eng. Pat. 16,112, October 10, 1890. *8d.*

A series of spindles are furnished with external or internal shaping profiles carried on a counter-balanced jolly-arm common to the whole series. There is a further arrangement so that two or more articles can be made simultaneously. In connection also is an automatic table working both vertically and horizontally. In its horizontal movement it brings the moulds filled with clay and then removes the articles when formed, whilst when working vertically the moulds are placed or removed from their position on the jigger-heads. Automatic scrapers or apparatus for removing the scrap clay projecting from the top of the moulds are also added.

—S. G. R.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

The Practical Application of Magnesia Cement. C. O. Weber.

See pages 111—114.

Comparative Examination of Puzzolana, Portland and Roman Cements. Bochme. Mitt. Konig. tech. Versuchs. 1890, 256—269.

In order to ascertain whether a reliable examination and comparison of different sorts of cement is practically possible, a series of Puzzolana and Roman cements were tested in the same way as Portland cements are usually tested in Germany. The tests were made in accordance with the rules laid down officially (see this Journal, 1888, 107—109), by which it is required that samples of mortar, consisting of one part of cement and three parts of sand (gravimetrically apportioned) must have at least a tensile strength of 16 kilos. and a strength of compression of 160 kilos. per sq. cm., respectively, after the samples have been hardened one day in the air, and 27 subsequent days under water.

The examination showed that the weights of equal volumes of the different kinds of cement varied considerably, so that if one volume of cement and three volumes of sand (the so-called "normal-sand" was always used) were mixed under similar conditions, different gravimetric results were obtained. In practice this volumetric mixture is the usual one employed. The different mortars which were hardened either entirely in the air or one day in the air, and then under water, were tested for their tensile strength and strength of compression, and for their powers of resistance to grinding. The results proved that the mortars consisting volumetrically of one part of cement and three parts of sand, were inferior to other mortars mixed gravimetrically 1 : 3. As regards Roman and Puzzolana cements, the average results were below the above-mentioned official standard, and varied so much that a method like that used for the testing of Portland cement, cannot be employed for Roman and Puzzolana cements. If in practice the cement and sand were mixed gravimetrically, instead of volumetrically, the results would be better and more uniform. (Compare this Journal, 1886, 188—199).

—H. S.

Hydraulic Cements. Candlot. Bull. Soc. d'Encouragement, 1890, 682—716.

The paper, which is long and accompanied by numerous voluminous tables, has been submitted to the judgment of H. le Chatelier, who reports as follows:—

The object of the paper is to elucidate the causes of the action of the sea upon works executed in hydraulic cement. Putting aside for the moment the influence of porosity of the materials used as too obvious to need elaboration, the present research has been concerned with such other disintegrating agencies which have hitherto been matter rather for speculation than knowledge. Candlot has already shown (this Journal, 1889, 544) that of the three salts present in sea-water in notable quantity—sodium chloride, magnesium chloride, and magnesium sulphate—sodium chloride is inert, and the magnesium salts begin to act only after they have produced corresponding calcium salts by double decomposition with the lime of the cement. With regard to one of them, calcium chloride, it has been demonstrated (this Journal, 1890, 72) that dilute solutions, *e.g.*, 20 grms. per litre, retard setting in the same way that sea-water does while strong solutions, *e.g.*, 300 grms. per litre, increase the speed of setting considerably. In the present memoir Candlot has arrived at what appear to be the reasons for this seeming anomaly: weak solutions of calcium chloride hinder the solution of the alumina of the calcium aluminate chiefly concerned in the *setting* as opposed to *hardening* of hydraulic cements probably decomposing it and forming calcium oxychloride with its lime; strong solutions of calcium chloride, however, increase the solubility of both aluminates and ferrites, a solution containing 300 grms. of calcium chloride per litre dissolving as much as 25 grms. of alumina per litre, while pure water will only dissolve 1 grm.; this large increase of solubility is due to the formation of a calcium chloro-derivative which being stable only in presence of a strong solution of calcium chloride has not yet been satisfactorily analysed. These interesting and wholly novel facts are not without analogies in chemistry. For instance, lead chloride, which is only slightly soluble in water, is completely insoluble in dilute hydrochloric acid, but is readily soluble when strong acid is used. A possible application of these results exists, viz., the construction of a method for detecting free lime in hydraulic cement; cement containing free lime sets immediately when gauged with a strong solution of calcium chloride, while in the contrary case the setting is slow. Candlot has also examined the action of calcium sulphate on hydraulic cements. The formation of a perfectly definite and well-crystallised salt—

$$Al_2O_3\,3\,CaO + 2{\cdot}5\,CaSO_4 + 6\,H_2O$$

has been proved. This salt is insoluble in lime water, but is decomposed by it when the proportion of lime falls below —about 0·2 grms. per litre, and *a fortiori* by pure water.

The tendency of calcium chloride and sulphate formed by double decomposition from the magnesium salts present in sea water, to act on the constituents of the cement—yielding compounds of this description, whose repeated crystallisation and decomposition gradually disintegrate the cement, throws a good deal of light on the failures of marine work that have occurred.—B. B.

Corrosion of Lead and Zinc in Contact with Cement. Seger. Thonind. Zeit. 1890, **14**, 545.

The fact that lead and zinc corrode when in contact with cement is here said to be due to the alkalinity of the cement, and to the sulphates contained in the bricks. The solution of these constituents is effected by the moisture deposited on the pipes or sheets (see also this Journal, 1890, 1037).

—T. L. B.

PATENTS.

Improvements in the Treatment and Utilisation of Peat, Sawdust, and other Fibrous and Vegetable Materials and Substances. R. Stone, London. Eng. Pat. 795, January 15, 1890. *4d.*

The inventor mixes silicate of soda or siliceous compounds, in solution or otherwise, with the peat, &c. The mixture may consist of silicate of soda, in solution, 15 parts, glue 5 parts, and the materials to be cemented, 80 parts. The composition is run or pressed into moulds or dyes of any required form, or rolled out into sheets, slabs, or other suitable forms.—E. G. C.

Improvements in or Appertaining to the Manufacture of certain kinds of Bricks and Fireclay Substitutes. C. H. Edwards, Liverpool. Eng. Pat. 2371, February 13, 1890. 6*d*.

Waste sand from plate-glass works containing about 75 per cent. of silica, 20 per cent. of ground glass, 2 per cent. of iron, and 3 per cent. of the chlorides of sodium, potassium or magnesium, or of emery, is mixed with a non-ferruginous clay or ground aluminous shale, such as is commonly found in contiguity with coal seams, in proportions ranging from 9 of sand with 1 of clay to 1 of sand with 1 of clay, the sand being dried previous to use and the clay ground in its natural, dry, or semi-dry state with it. Should the clay be too dry, water may be added. 20—25 per cent. of ground old firebrick may be added. The mixture is made into bricks and burnt in the ordinary way. When somewhat wet materials are used they can be mixed in that condition, preferably, in an open mixer.

The advantages claimed are, first, that the bricks are produced from a hitherto waste material, and that they are glazed on account of the glass present in the raw material, that they are hard, non-conducting to heat, and refractory enough for furnace use.—B. B.

Improvements in the Manufacture of Cement and in Apparatus for Use in the said Manufacture. W. Joy, Snodland. Eng. Pat. 2896, February 22, 1890. 8*d*.

Two improvements are claimed. The first is the introduction of steam into cement kilns during the burning of the charge, the steam being generated either in separate boilers or in pipes or other suitable apparatus arranged round the kiln to receive heat from it. The steam, before its introduction into the kiln, may be passed through incandescent coke or other fuel.

The second is a method for drying slurry by means of the waste heat of the kilns. It consists essentially of long chambers level with the top of the kiln, through which the hot products of combustion are caused to pass systematically, drying the slurry in their passage.—B. B.

Improved System of Continuous-acting Kilns. G. Appiani, Treviso, Italy. Eng. Pat. 2941, February 24, 1890. 8*d*.

The patentee has devised a system of heating continuous-acting kilns, also applicable to kilns fired intermittently, which essentially consists in constructing the kilns with retorts within them in which the fuel for heating them is gasified before use, the gaseous products passing from the retort inserted in the kiln that heats it to the next kiln where they burn, and in their turn serve to heat the internal retort and gasify a fresh supply of fuel. Where the demand for the coke or other residual material is not sufficient to justify the production of the full amount possible by this arrangement, the method of heating first described can be supplemented by burning some of it in the ordinary way in the kiln. It is not necessary that the retorts inserted in the kilns should be actual structures; they may be spaces in the mass of the material to be burnt, constituting what are in effect retorts.—B. B.

An Improved Method of Hardening and Preparing Soft Porous Stone for Enamelling and other Purposes. W. T. Sier, Newport. Eng. Pat. 3413, March 4, 1890. 4*d*.

Soft porous oolite stones are boiled in a bath of "silica or flint" of a "registered strength 1175" for eight hours under pressure, after which they are "placed in a drying stove registered heat 200 F." The material is then boiled with ground alabaster and lime water, when it is ready to receive the enamel and to be used for "chimney pieces and other architectural work." Soaking for eight days may be substituted for boiling, but the latter is preferable. The dried stone is then coated with "alabastine" or distemper, and is then fit for enamelling. For stones exposed to the weather the boiling with alabaster and lime water, after they have been worked to shape, suffices as a "preventative for salting."—B. B.

Improvements in Plastering Compositions. W. A. Robinson and J. Y. Terry, Syracuse, U.S.A. Eng. Pat. 15,678, October 3, 1890. 4*d*.

The invention consists in "mixing and commingling" sawdust ("previously saturated in a solution of lime, alum, white lead, and water"), sand, hair, plaster of Paris, glue and water.—E. G. C.

An Improved Method of and Kiln for Burning Bricks. P. Crean, Belfast. Eng. Pat. 16,231, October 13, 1890. 6*d*.

The furnaces are kept open until the bricks are "steamed," and then closed, the heat being maintained by the introduction of small quantities of slack or coal dust through openings provided in the kiln above the furnaces.—E. G. C.

A New or Improved Manufacture of Artificial Stone or Composition and Building Blocks and other Articles thereof. F. Jurschina and R. R. v. Gunesch, Vienna, Austria. Eng. Pat. 18,468, November 15, 1890. 4*d*.

One hundred parts by weight of ground quartz-sand or flint gravel, from 1—4 parts of Tripoli, and from 1—6 parts of Portland cement, are made into a plastic mass with soda water-glass at 25°—38° B. and pressed or cast into moulds. The proportions may be varied. The material is said to be useful for making building-blocks, paving-slabs, grindstones, and fireproof and acid-proof vessels and linings. Where hardness rather than sharpness in the finished goods is required, the materials after being dried are burned "at a glowing heat and allowed to cool slowly."—B. B.

X.—METALLURGY.

The Cyanide Process for the Extraction of Gold from Low-Grade Gold Ores. T. G. Young and W. Smith.

See pages 93—95.

The Cyanide Process for Extracting Gold. B. Blount.

See pages 95—96.

Preparation of Chromium. E. Glatzel. Ber. **23**, 3127—3130.

Potassium chromic chloride is reduced by magnesium in presence of potassium chloride. 100 grms. of potassium bichromate are dissolved in as little water as possible, and to the solution are added 400 cc. of hydrochloric acid (sp. gr. 1·124) and then 100 c.c. of 80 per cent. alcohol. Potassium chromic chloride is obtained according to the equation—

$$K_2Cr_2O_7 + 8\,HCl + 3\,C_2H_5OH = 2\,KCl.Cr_2Cl_6 + 3\,CH_3COH + 7\,H_2O.$$

To the solution so obtained, 160 grms. of potassium chloride are added, and after filtration the whole is evaporated to dryness, and further heated. Green particles are removed, and the mass is then powdered and mixed with 50 grms. of magnesium cuttings; that is, about double the quantity theoretically necessary. The mixture is raised to a red heat for half an hour in a covered Hessian crucible. On cooling, the crucible is broken, the dark grey mass is freed from particles of chromic oxide, and is then thrown into water. By decantation the potassium chloride and magnesium chloride are got rid of, and then the excess of magnesium and the magnesia are removed by the aid of dilute nitric acid. The chromium is finally dried on the water-bath. It is obtained in such a finely-divided state that filtration cannot be used in the foregoing purification processes.

As obtained, the chromium consists of microscopic crystals, almost white. Rubbed in an agate mortar, it shows metallic lustre. Its specific gravity at 16° C. is 6·7284 (Wöhler found 6·81 at 25°; Bunsen, 6·7). A magnet has no effect on the metal.—T. L. B.

New Metallurgical Process for Cobalt and Nickel Ores. Chem. Zeit. **14**, 1475.

THE ores are first melted in a reverberatory furnace to a matte containing 6—12 per cent. of cobalt, which is then roasted. The product is next treated with chloride of iron in muffles, when the following changes take place:—

$$Co_2O_3 + Fe_2Cl_6 = Co_2Cl_6 + Fe_2O_3.$$

The reaction is ended after about two hours, when the resulting mass is lixiviated with water in wooden vessels provided with a false bottom. The cobalt and nickel, together with a trace of iron, go into solution, which solution can be concentrated simply or worked up to oxide.

The extra cost of this new process, which is patented by W. Schoeneis, is small, since the iron chloride solution is a waste product in the wet copper process, and the resulting oxide of iron is a marketable product.—C. A. K.

Alloys of Sodium and Lead. W. H. Greene and W. H. Wahl. J. Franklin Inst., 1890, **100**, 483—484.

THE alloys examined contained from 3 to 31 per cent. of sodium, and were prepared by the direct union of the two metals. They were all brittle and crystalline, and all decomposed water. The brittleness and oxidisability increased with the percentage of sodium. The alloy richest in sodium was greenish in colour, but instantly blackened on exposure to air. Special examination was made of the alloys having the compositions corresponding to the formulæ Na_2Pb_2, Na_2Pb, and Na_4Pb. The densities of these alloys were determined in aniline and found to be much higher than the densities calculated on the supposition that they were simply mixtures. The following table shows the composition and density of each:—

	Na_2Pb_2.	Na_2Pb.	Na_4Pb.
Sodium per cent., theoretical	10	18·18	30·8
Sodium per cent., found.....	10	19·50	31·7
Density calculated	5·6	3·7	2·7
Density found	6·91	4·61	3·81

—A. W.

A New Modification of the Open-Hearth Steel Process. F. Kupelwieser. Eng. and Mining J. **50**, 575.

THE author recently published some calculations showing that by running the molten metal direct from the blast furnace into the open hearth furnace a saving in fuel might be effected to the extent of 3 cwt. per ton of metal. This plan was adopted with three furnaces at Witkowitz, where owing to local difficulties of transfer an empty Bessemer converter was used as an intermediate reservoir. Subsequently the process was modified by blowing the blast-furnace metal in this converter for two minutes, whereby the bulk of the silicon and manganese was removed and the metal rendered more suitable for the basic-lined furnace. The amount of heat developed by this short blow is calculated at 67,000 calories per ton of 1,000 kilos. About one-half of this is lost by radiation, and as there is a further diminution on account of the double transfer to and from the converter, the loss and gain of heat about counterbalance one another. The charges consist of 30 per cent. of blast-furnace iron, 10 per cent. of scrap, together with the necessary amount of ore and some lime. The work is rapid, and the three furnaces work from 15 to 18 charges or an average of 17 per 24 hours. The fuel used only amounts to between 10 and 12 per cent. of the weight of ingot produced.—A. W.

Zinc from Flue Dust of Zinc Furnaces. E. Jensch. Zeits. d. oberschles. berg. u. hüttenm. Ver. 1890, **29**, 355.

OWING to the extensive loss of zinc in the flue dust, this is smelted with calamine or blende. In an experimental smelt of flue dust the percentage of iron in the zinc was 0·71, whereas the zinc obtained from calamine or blende contains only 0·024 per cent. This is due partly to the chlorine of the flue dust, but chiefly to its finely divided condition; the draught carries over the fine oxides of iron into the zinc. Whether an alloy of zinc and iron is formed, or whether merely a mixing of the oxides of iron with the zinc takes place is not known.—T. L. B.

On Blast Furnace Slags and the Fusibility of Silicates (concluded). A. J. Rossi. J. Amer. Chem. Soc. 1890, **12**, 307—339. (See this Journal, 1890, 1039).

THE author points out the fact that all silicates, however complex their composition, may be reduced to five types:—

Acid silicates, of the formula....		$RO, 2SiO_2$.
Sesquiacid	„ „	$2RO, 3SiO_2$.
Neutral	„ „	RO, SiO_2.
Sesquibasic	„ „	$3RO, 2SiO_2$.
Bibasic	„ „	$2RO, SiO_2$.
Tribasic	„ „	$3RO, SiO_2$.

In order to ascertain in a given case to which type a silicate belongs, all the bases, whether of the form R_2O, RO, or R_2O_3, are replaced in the formula by an *equivalent* quantity of lime, CaO; the transformed formula approaches in all cases to one of the above-mentioned types. The author shows by a number of examples, taken from actual practice and quoted in detail, that the *quality of iron produced depends rather on the type of the slag produced* than on its special qualitative composition.

In the one case of *acid* slag, the iron was grey.

Out of five cases of *neutral* slags, the iron was in four cases white, and in one, mottled.

Out of 32 cases of *sesquibasic* slag, the iron was in 12 cases white, 3 cases white and mottled, 2 cases light grey and mottled, and 11 cases grey, the shade being mostly light.

Out of 30 cases of *bibasic* slag, the iron in 3 cases was white, in 2 grey and mottled grey, and in 25 cases grey. Graphitic No. 1, No. 2ˣˣ, No. 2ˣ, and No. 2, the darker shades corresponding most generally to slag appproaching nearly to the typical bibasic slag. The three cases of white iron were due to chromium present in the pig.

In the two cases of *tribasic* slag the iron was No. 1 graphitic iron.

Hence it follows that with an acid slag a grey iron may be expected; with neutral slag, a white or mottled iron; with sesquibasic slag light grey or mottled, only under special conditions white iron, and this pig containing less silicon being specially suitable for puddling; with bibasic slag a grey pig varying from the darkest shade to No. 2, No. 1, No. 2ˣˣ, and kish cinders. With a tribasic slag the iron is invariably a No. 1 iron, Scotch grey.

The fusibility of the slag depends on their type and is given as follows:—

Acid.—Fusible.
Sesquiacid.—Moderately fusible.
Neutral.—Very fusible.
Sequibasic.—Very fusible, but less than preceding one.
Bibasic.—Fusible.
Tribasic.—Fusible, but less than preceding one.

The higher grades of iron containing most silicon and total carbon correspond to higher temperatures in a furnace and are accompanied by the more basic slags. Blast-furnace practice therefore corroborates the observation that neutral silicates are more fusible than either more basic or more acid ones.

The author works out in detail an example of the charges requisite to yield a given type of slag with a given sample of ore and coal, and draws attention to the necessity of taking into consideration the *ash* in the case of inferior cokes and anthracite; in some cokes this may amount to 15 per cent.

Actual analysis shows that the slag produced agrees very closely with the product for which the charges were calculated. The failure to obtain, within certain limits, a desired grade of iron with a given slag, is a useful indication to the iron-master of abnormal temperature, blast pressure, &c., or of an unnoticed change in the composition of the ore.

Numerous analyses of slags are inserted in the body of the original paper.—P. J. H.

Outbursts of Gas in Metalliferous Mines. B. H. Brough. School of Mines Quarterly, **12**, 13—22.

The author gives an account of a number of cases in which gas has been liberated in metalliferous mines and in some of which serious explosions have occurred. He shows that these outbursts of gas are not always due to the same cause, and he gives the following explanation to account for the formation of the gas in the various cases described:—(1.) The decomposition, in a mine, of timber in contact with water or moist air may produce fire-damp which would accumulate in cavities that are ultimately broken into. (2.) In iron mines where the iron is not entirely in the state of peroxide, water might be slowly decomposed and hydrogen produced. (3.) Fire-damp may be liberated from beds beneath the ore-deposit and find its way through fissures into the workings, the gas being given off from rocks enclosing bitumen in the same way as the natural gas of the United States and other countries. At some of the Derbyshire mines, the gas is derived from the Yoredale shales which are of a bituminous character. (4.) Fire-damp may be produced from the decomposition of organic matter in the same way as the hydrocarbon met with in salt mines. (5.) In some cases explosions have been caused by outbursts of sulphuretted hydrogen produced by the action of acid waters on pyrites ore. (6.) The outbursts of carbon dioxide met with at Foxdale, Freiberg, and Massa Maritima, may have been caused by the action of acid water, produced by the oxidation of pyrites, on limestones and other metalliferous carbonates.—A. K. M.

The Precipitation of Metallic Sulphides by Natural Gas. J. F. Kemp. Eng. and Mining J. 1890, **50**, 689.

The investigations of many distinguished observers tend to indicate that there are two possible and probable varieties of natural gas and petroleum. The two differ genetically, the one having probably been derived from animal organisms, the other from vegetable. The hypotheses of origin are numerous, and will be found cited or abstracted in S. F. Peckham's Report on Petroleum in Vol. X. of the Tenth Census, and fully set forth and discussed by E. Orton in the Geology of Ohio, **6**, 60—83. Suffice it to say that the oil and gas in sandstone receptacles, but mostly originating from bituminous shales, especially as found in Pennsylvania, have been generally attributed to an original vegetable tissue; while, on the other hand, the oil and gas from limestone have been generally referred to animal tissue. The latter have disagreeable odours (Enniskillen, Canada; Findlay and Lima, Ohio), and are marked by the presence of sulphur compounds. Their importance and general distribution have been of later development. It is not here intimated that the vegetable remains lack sulphur. The general presence of this element in coals, and in illuminating gas derived from coal, proves the contrary, but as shown in the accompanying table, it is a curious fact that in the published analyses of natural gas from Pennsylvania and other sandstones, sulphur does not appear, while in those from Ohio and Indiana limestones it does.

Analyses of Natural Gas.

	CH_4	C_2H_6	N	H	C_2H_4	O	CO_2	CO	H_2S	Total.
Shale and sandstone gas:										
[1] West Bloomfield, N.Y.	82·41		4·31	..	..	0·23	10·11	..	..	*100·00
[2] Fredonia, N.Y.	90·05		9·54	..	..	Trace	0·41	..	..	100·00
[3] Burns Well, Butler County, Pa.	75·44	18·12	..	6·10	..	..	0·34	Trace	..	100·00
[3] Leechburg, Westmoreland County, Pa.	89·65	4·39	..	0·56	..	..	0·35	0·26	..	95·21
[3] Harvey Well, Butler County, Pa.	80·11	5·71	..	13·50	..	..	0·66	Trace	..	99·99
[3] Cherry Tree Spring, Indiana County, Pa.	60·27	6·80	7·32	22·50	..	0·83	2·28	..	..	100·00
[4] Sheffield Well	90·64		9·06	..	..	Trace	0·30	..	..	100·00
[4] Kane Well	90·01		9·79	..	..	Trace	0·20	..	..	100·00
[4] Wilcox Well	90·38		9·41	..	..	Trace	0·21	..	..	100·00
[4] Lyons Run Well	97·30		2·02	..	..	Trace	0·28	..	..	99·60
[5] New Well, Knox County, O.	81·40	12·20	4·80	..	..	0·80	0·30	0·50	..	100·00
Limestone gas;										
[6] Findlay, O.	93·35	..	3·41	1·64	0·35	0·39	0·25	0·41	0·20	100·00
[6] Fostoria, O.	92·84	..	3·82	1·89	0·20	0·35	0·20	0·55	0·15	100·00
[6] St. Mary's, O.	93·85	..	2·98	1·74	0·20	0·35	0·23	0·44	0·21	100·00
[7] Muncie, Ind.	92·67	..	3·53	2·35	0·25	0·35	0·25	0·45	0·15	100·00
[7] Anderson, Ind.	93·07	..	3·02	1·86	0·49	0·42	0·26	0·73	0·15	100·00
[7] Kokomo, Ind.	94·16	..	2·80	1·42	0·30	0·30	0·29	0·55	0·18	100·00
[7] Marion, Ind.	93·58	..	3·42	1·20	0·15	0·55	0·30	0·60	0·20	100·00

* Including 2·94 "illuminating hydrocarbons," not mentioned in the table.

[1] Henry Wurtz. A. J. S., 2nd Series, **49**, 336.

[2] Quoted by Edward Orton, Econ. Geol., Ohio, **6**, 409. No authority given.

[3] S. P. Sadtler, Amer. Chem. **7**, 97. Also trace C_3H_8.

[4] F. C. Phillips, for 2nd Geol. Surv., Pa. Quoted by Orton; l. c., p. 409.

[5] E. W. Morley. Orton, l. c., p. 416.

[6] C. C. Howard. Mineral Resources U.S. 1888, 490. From Trenton limestone.

[7] Quoted by Orton, l. c., p. 137

Thus the sulphuretted hydrogen in the limestone gas runs from 0·15 to 0·20 per cent. This may have an important bearing on the origin of ore deposits, as it indicates the form assumed by much of the sulphurous matter in limestones. Experience has shown that natural gas collects especially at the summits of anticlinals which may be very gentle, and along arrested anticlinals or monoclinals (see Orton, Geol. Ohio, 6). When in large quantities, it favours porous or fissured limestone which may have been brought into this condition by dolomitisation. In Ohio almost all the limestones in the State are more or less petroliferous, the Trenton being the principal productive source. The Enniskillen field, in Canada, has been referred by Hunt to the corniferous, and the oily Niagara limestone of Chicago is familiar to all.

A still wider geological range could be easily substantiated, but the above will serve to illustrate the frequent presence of oil and gas in limestone. With such imprisoned sulphurous material, even though dispersed, a precipitating agent is at hand for any of the common metals that might circulate through the rock in solution. The precipitating agent is especially abundant in the fissured and porous portions, which are likewise most open to circulations. C. C. Howard states that in 100 cub. ft. of Findlay gas there are 125·8 grains of sulphur (Geol. Ohio, 6, 137). If the calculations be made for the famous Karg well, which proved approximately 12,000,000 cub. ft. of gas daily, it will be found that it is equivalent to 2,630 lb. of sulphur. Reducing this to the corresponding amounts of pyrites, blende, and galena, it is equivalent to 4,915 lb., 8,733 lb., and 19,552 lb. respectively. It is understood, of course, that these figures are only illustrative, but they show forcibly the potential precipitating power which may be stored up under favourable conditions. The Karg well is only one among numerous productive wells in a restricted territory. In Indiana (Mineral Resources, 1888, 502), in an estimated area of 2,525 sq. miles, the daily production of gas is thought to be 700,000,000 cub. ft. of a sulphur content, as shown by the table, somewhat less than in the above calculation.

It is reasonable to infer that, in other districts where metalliferous circulations have passed through limestones, similar gases have aided in their precipitation. Where masses of galena, pyrites, blende, or other sulphides are found disseminated through limestones, sulphurous gases and oils may have played an important rôle in their formation. Except as the result of special local study, caution should be observed in citing illustrations; with due reservation, therefore, it is merely suggested that the Saucon Valley blende deposits near Bethlehem, Pa., exhibit the sulphide filling innumerable cracks and small fissures in magnesian limestone along the shattered crest of an anticline (Cleve, F. L. Mineral Resources, 1882, 361. Drinker, H. S. On the Mines and Works of the Lehigh Zinc Co. Trans. Min. Eng. L. 67. Hall, C. E. Rept. D3., 2nd Geol. Surv., Penn., 239). The blende deposits of south-west Missouri have abundant bitumen (inspissated petroleum?) associated with them (Schmidt and Leonhard. Mo. Geol. Surv., 1874, 384), which is at least suggestive.

Light may be thrown on the chemistry of certain phases of the replacement process which figures so largely in the modern explanations of ores. Lead, for example, circulating as sulphate or chloride in solution would be precipitated as sulphide by sulphurous gas or oil. The resulting sulphuric or hydrochloric acid formed by the reaction would at once be taken by the calcium carbonate present, which would be removed as sulphate or chloride. The same is true of zinc or iron, for although they are precipitated by sulphuretted hydrogen only in alkaline solutions, calcium carbonate is at hand to neutralise at once the free acid resulting from the reaction. In this way a molecular replacement might easily result.

The filling of fissure veins in limestone as well as other rocks is usually attributed to the evaporation of standing solutions, or to the lowering of the temperature and pressure of solutions of metallic sulphides in alkaline carbonates or alkaline sulphides, or both, as they approach the surface. The evolution of sulphurous gases through such fissures would also cause precipitation in rising or standing solutions, and Chamberlain has, indeed, cited such a method for the gash veins of Wisconsin (Chamberlain, T. C., Wisc. Geol. Surv. 4, 367).

It would be interesting to note in particular instances whether bodies of disseminated ores may not follow in their distribution the laws now fairly well understood for natural gas and oil, for if they do, some hints would be afforded for prospecting.

PATENTS.

Improvements in the Treatment of Tin Refuse or Slag. T. Teagne, Devoran. Eng. Pat. 19,687, December 7, 1889. 4*d*.

The natural alloys of tin and other metals resulting from the refining of smelted tin in the ordinary manufacturing process, and known as hard-head, are melted with copper, whereby an exceedingly hard bronze is produced, suitable for machine bearings, wire, &c. A good proportion of hard-head is 10 per cent.—H. K. T.

Improvements in Galvanising Apparatus. J. Lysaght, Bristol. Eng. Pat. 20,587, December 21, 1889. 6*d*.

The object of this patent is to facilitate the withdrawal of the sheets, &c., from the galvanising bath and to automatically cleanse them, reducing the use of hand labour to a minimum by mechanical appliances. The sheets are raised by a pair of rolls working in the molten metal, and are brought upwards against a set of revolving discs working on a horizontal shaft. These discs, which have sharp points projecting from them, deflect the sheets over other discs with blunt agate points, by which they are carried forward to a pair of grooved rolls, which in turn force them through a pair of cylindrical revolving brushes against which jets of water are directed. The sheets are then passed through a pair of rubber rolls similar to those of a wringing machine, and finally through a heated chamber to dry them. Five drawings are given.—A. W.

Improvements in or connected with the Manufacture or Production of Aluminium. W. White, Cheshunt. Eng. Pat. 859, January 16, 1890. 4*d*.

In the manufacture of aluminium practically pure fluoride of aluminium is used instead of cryolite, which contains impurities. The fluoride is prepared by adding hydrofluoric acid to aluminium hydrate and evaporating to dryness. It is then heated with sodium or potassium or a mixture of these, keeping an excess of aluminium fluoride present as it helps by combining with the sodium fluoride formed to produce a more suitable flux for the metal. The flux is afterwards treated with sulphuric acid to produce hydrofluoric acid, which is again utilised for dissolving a fresh quantity of aluminium hydrate.—A. W.

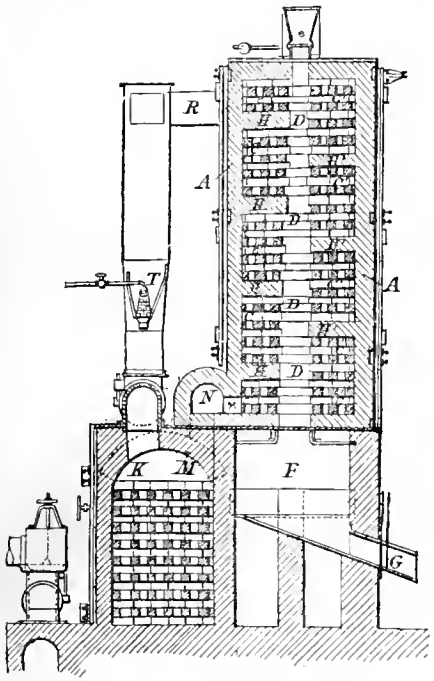
Improvements in and connected with the Recovery of Zinc from Galvanised Iron and Steel. H. Grimshaw, Manchester. Eng. Pat. 1053, January 21, 1890. 4*d*.

This invention is for the purpose of recovering zinc from galvanised iron and steel without injury to the iron or steel. The coated metal is immersed in a solution of sulphate, nitrate or chloride of zinc containing a small quantity of the free acid, and maintained at a temperature of 200° F. Fresh acid is added from time to time and the saturated solutions of zinc salts are drawn off and the zinc recovered by known means.—H. K. T.

Improvements in the Reduction of Metallic Ores and in Apparatus therefor. J. T. King, Liverpool. From C. Adams, Pittsburgh, U.S.A. Eng. Pat. 1443, January 28, 1890. 1*s*. 1*d*.

This invention is one in which metallic ores are reduced by means of carbonic oxide or other gaseous fuel. Its chief feature consists in causing the heated gas to travel

through the ore in a horizontal direction, by which means much less force is required to drive the gas and the ore is more thoroughly permeated. The furnace in which this principle is carried out is represented in the accompanying



THE REDUCTION OF METALLIC ORES.

Figure. A is the furnace in which D is a vertical space down which the ore passes, c, c^1 a checkerwork of firebrick separated by horizontal shelves or diaphragms H H_1. The carbonic oxide first enters a previously heated regenerator K, then passes up the conduit M N into the checkerwork c_2. It then passes horizontally through the ore in D into the checkerwork c^1, as it experiences less resistance in taking this path than in passing vertically upwards through the ore in D. In c^1 it moves vertically upwards until it meets the obstruction H^1, when it again crosses over into C. In this way the heated carbonic oxide travels backwards and forwards until it reaches the exit R, whence it is led into a second regenerator where it is burnt. The reduced ore collects in a chamber F and is removed periodically through the exit G. When iron ore is being reduced the chute G communicates with an open-hearth furnace.—H. K. T.

Improvements in Apparatus for the Reduction of Argentiferous or other Zinc Ores. O. Lumaghi, St. Louis, U.S.A. Eng. Pat. 5407, April 9, 1890. 8*d*.

THIS is a modification of the Belgian zinc furnace. The retorts are charged at the lower ends, which are then closed with circular discs, having small tapping-holes which, however, are luted with clay in the early stages of the operation. The zinc vapours escape from the upper ends of the retorts through holes about 2 inches in diameter, which have been bored in the centre of what is generally the closed end of the retort. A condenser of the usual type is fixed to this end of each retort, but in a position slanting in the opposite direction. Thus it is maintained that both the retort and condenser sloping downwards from their point of contact the distilled zinc in the condenser cannot flow back into the retort, and any lead or other metal that may have become liquefied during the process will not contaminate the zinc, but will find its way to the other end of the retort, whence it may be readily tapped. Afterwards an air current is passed through the retort to obtain the "remaining zinc to be recovered in the form of oxide," and to roast anything left in the retort that may require it. The precious metals are recovered partly from the liquefied metal tapped from the retorts, and partly from the oxide of zinc.—A. W.

Improvements in the Production of Refractory Linings for Converter Bottoms, and in Apparatus therefor. B. Versen, Dortmund, Germany. Eng. Pat. 8295, May 28, 1890. 8*d*.

THIS invention consists of machinery for mechanically stamping converter bottoms. The converter is placed on a rotating table, and a stamper, provided with suitable mechanical motions, is brought down upon it.—H. K. T.

Improvements in a Process of and Composition for Softening and Subduing Refractory Ores. J. L. Hopper, Sarcoxie, U.S.A. Eng. Pat. 15,859, October 7, 1890. 4*d*.

THE ore is heated to a red heat and then immersed in a bath made up of the following ingredients :—

Pure water	10 gallons.
Common salt	5 lb.
Saltpetre	1 lb.

It is thus disintegrated and rendered easily reducible to powder. "The strong acid effect produced by the saltpetre" readily disintegrates the most refractory ores with but one heating, which if salt and water only were used would require "several heatings and baths to properly subdue them."—A. W.

Improvements in Tempering-Fluid for treating Steel. E. Tweedy, Danbury, U.S.A. Eng. Pat. 15,833, October 7, 1890. 4*d*.

THE fluid consists of water or oil mixed with oxide or carbonate, or both oxide and carbonate of iron, and an organic ingredient such as glucose. The mixture may be prepared in any way, but preferably the oxide and glucose are mixed together first in the proportion of one part of the former to two parts of the latter, and one ounce of this mixture is added to two gallons of water. When steel is heated to a dull red heat and quenched in this liquid, it is stated to be hardened to a greater depth than usual, and to be improved in other respects. Oxides or carbonates of manganese, cobalt, or nickel, may be substituted for those of iron, but they are less effective.—A. W.

Improvements in Compound Gold Wire. L. L. Burdon, Providence, U.S.A. Eng. Pat. 18,604, November 18, 1890. 8*d*.

THIS invention consists in the production of a compound bar having gold of a low grade in the centre, but of high grade at the surface. Such a bar when drawn furnishes wire suitable for the manufacture of pins, rings, &c. The compound bar may be produced by forming an external seamless tube of high-grade gold, within which is placed a core of lower grade and more fusible alloy, the two being made to unite by heating until the central portion fuses. Or a compound "disc" may be made, and this, by suitable machinery, converted into a tubular form, which, when drawn, gives a hollow wire.—H. K. T.

Improvements in the Reduction of Ores. H. W. Lash and J. Johnson, Pittsburgh, U.S.A. Eng. Pat. 19,163, November 25, 1890. 4*d*.

THIS is a process in which carburised iron is produced in a cupola furnace, instead of in the usual blast furnace. The ore is reduced to a fine powder, and mixed with powdered charcoal or coke, and the two incorporated together with water or oil until a thick coherent paste is produced. This is charged into a previously-heated cupola furnace, together

with coke, the latter being added in sufficient quantity to maintain the temperature and to prevent clogging. If desired, a flux such as limestone may be incorporated with the mixture or added along with the fuel. As the molten metal sinks down it is run off into an open-hearth furnace, and used as a highly carburised metal for the production of steel.—H. K. T.

XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

PATENTS.

Improvements in the Process for Obtaining Zinc by Electrolysis. A. S. Elmore, Rothwell. Eng. Pat. 17,205, October 30, 1889. 4*d*.

Porous cells are placed in a bath of zinc sulphate, or the bath is divided by porous partitions, an overflow pipe being attached to the porous cell or corresponding compartment to keep the level of the liquid in it slightly below the level of the liquid in the bath, and thus increase the flow through the pores. An anode of iron is placed in the porous cell and a disc or cylinder of suitable material serves as the cathode in the other compartment. The cathode is made to revolve, and as the zinc is deposited upon it, it is acted on by a burnisher pressed down by a weight or spring. This burnishing makes the deposited metal compact and close in texture.—B. T.

Improvements in Electric Battery Carbon and Carbon Compound Elements and their Connections. J. V. Sherrin, Ramsgate. Eng. Pat. 17,831, November 8, 1889. 6*d*.

To prevent corrosion of the terminals of a battery, the carbon is wrapped round with a piece of platinum foil, and a brass clamp fixed on with a set screw. The conducting wire is soldered or fixed in any convenient way to the brass clamp. Details are given of several kinds of connectors.
—B. T.

Improved Means for the Prevention of Polarisation in Electric Batteries. H. Badcock, W. Grunsell, and A. Walker, Lymington. Eng. Pat. 19,199, November 29, 1889. 6*d*.

Two tanks are provided for the exciting fluid, one placed above the other, and the battery mid-way between the two; a pipe leads from the bottom of the upper tank to the bottom of the battery, and an overflow pipe from the top of the battery to the top of the other tank. If then a tap in the first-mentioned pipe be opened the exciting fluid will pass from the top tank through the battery into the lower tank, whence it can again be pumped up into the top tank to recirculate.—B. T.

An Improvement in or Connected with Incandescent Electric Lamps. H. Gardner, London. From W. Reid, New York, U.S.A. Eng. Pat. 58, January 2, 1890. 6*d*.

A reflector—preferably of diamond or lozenge section—is placed between the limbs of the filament, "to diffuse and improve the light, and to soften the glare."—E. T.

Improvements in and Connected with Primary Batteries. M. Sappey, Paris, France. Eng. Pat. 488, January 10, 1890. 8*d*.

An elaborate clockwork contrivance electrically governed for automatically emptying the spent liquids from and supplying fresh liquids to a two-fluid primary battery.
—B. T.

Process of Generating Electricity by Gas Batteries. O. Dahl, Allegheny, U.S.A. Eng. Pat. 761, January 15, 1890. Internat. Conv. June 17, 1889. 8*d*.

A suitable furnace is brought to a sufficient temperature by means of an air blast, the gaseous products obtained (producer-gas) being stored for future use. Steam is then passed through the incandescent fuel and is decomposed with the production of hydrogen and carbon dioxide, the temperature not being allowed to rise high enough for the production of carbon monoxide. The gases so obtained are led through purifiers, which remove all but the hydrogen, to a gas-holder. When the furnace has become too cool to effect the decomposition of the steam, air is once more turned on, and the process repeated.

Sodium manganate is heated till it loses a portion of its oxygen, which may be replaced by heating the reduced compound in presence of air. The oxygen obtained is stored in another gas-holder.

The two gases thus produced are employed in any suitable gas battery for the production of electric currents.
—E. T.

Improvements in Means for the Electrolytic Generation of Chlorine and Compounds of Chlorine with Earthy Bases, more especially intended for Bleaching Purposes. D. G. FitzGerald and A. C. Falconer, London. Eng. Pat. 1246, January 23, 1890. 4*d*.

The inventors make use of anodes of "lithanode" in the place of platinum or carbon as hitherto used, and place these anodes preferably in contact with the earthy chlorides to be decomposed. These anodes are not attacked by chlorine and do not become disintegrated by use.—B. T.

Improvements in the Coating of Iron, Steel, Nickel, Zinc, or Tin for the prevention of Corrosion. A. E. Haswell and A. G. Haswell, Vienna, Austria. Eng. Pat. 1355, January 25, 1890. 4*d*.

This invention consists in coating metallic articles by electrolysis with a thin layer of a metallic oxide, such as dioxide of manganese, sesquioxide of molybdenum, or dioxide of lead.

For the production of the manganese deposit the article is connected with the positive pole of a battery and immersed in a bath containing 50 to 100 grms. of manganese nitrate or sulphate and 2 kilos. of ammonium nitrate in 100 litres of water. For the production of the molybdenum deposit the article is connected with the negative pole, and is immersed in a bath of 100 grms. of ammonium molybdate and 2 kilos. of ammonium nitrate in 100 litres of water.

For the binoxide of lead deposit a bath of ½—1 kilo. of lead nitrate and 1—2 kilos. of ammonium nitrate per 100 litres of water is used, the article being made the positive electrode. The electric current required for the above depositions is weak, amounting to 0·3 to 0·5 ampère per square decimetre.—H. K. T.

Improvements in or Relating to Electric Accumulators. A. J. Boult, London. From G. G. di Giovanni, Turin, Italy. Eng. Pat. 1629, January 30, 1890. 8*d*.

Sheets of lead are passed between rollers which produce indentations or cells on each face of the sheet, the walls of such cells being left quite thin. The rolling produces small ribs or roughnesses on the bottoms of the cells. When the active material has been applied in any way to the plate, the whole is pressed, the cell walls being thus flattened and expanded so as to hold the active material safely. The lugs of the similar plates are fastened together by a long bolt, the contact faces of adjacent lugs being amalgamated to give better connexion. Combs and other devices for separating the plates are also described.—E. T.

Improvements in or Relating to Electric Accumulators. W. P. Thompson, London. From J. Peral, Cadiz, Spain. Eng. Pat. 8800, June 7, 1890. 8*d*.

The plates are made up of a stout leaden frame with ribs of a section—

the ribs being also connected across by smaller ribs of diamond section to increase the stiffness and conductivity of the plate. The plates are then subjected to a side pressure so that the notched edges of the transverse ribs turn outwards and hold the active material firmly in position, thus—

Two ventilation tubes are provided to each cell, and are so connected that air can be forced through the cells to expel accumulated gases. An automatic cut-out is provided to cut each cell out as it becomes fully charged.—B. T.

Improvements in the Method of and Apparatus for Depositing Metals by Electro-Deposition. G. H. Felt, New York, U.S.A. Eng. Pat. 8933, June 10, 1890. 8*d*.

The inventor states that if clay be treated with dilute sulphuric acid and a little nitrate of mercury added, aluminium alloyed with mercury may be electrically deposited. The clay is either added direct to the cathode compartment of a cell containing the sulphuric acid and mercury salt, or the solution is prepared beforehand. In the apparatus illustrated and described in the specification the anode is of amalgamated zinc.

The method is to be applied also to other metals.—E. T.

Improvements in Secondary Batteries and in Electrodes therefor. H. H. Lake, London. From G. A. Johnson and S. L. Holdredge, Boston, U.S.A. Eng. Pat. 12,830, August 15, 1890. 8*d*.

Rectangular strips of the active material are enclosed in wide shallow boxes of lead, the sides of the boxes being perforated to allow of access for the electrolyte. Several types of boxes are described, one being formed of plates of lead with parallel and equi-distant ribs of the same metal, two sheets of lead being used to form each plate and burnt together with the ribs inside, and coinciding with each other so as to form a series of shallow boxes into which the active material is forced.—B. T.

Improvements in the Manufacture of Electrodes for Primary and Secondary Batteries. D. Pepper, jun., Philadelphia, U.S.A. Eng. Pat. 13,003, August 19, 1890. 6*d*.

The active material is moulded round cores of fusible metal of suitable size and shape which extend some distance into the plate. The fusible metal is then removed and the metal which is to act as the support and metallic connexion of the finished plate is poured into the apertures, lugs of any desired shape being provided for.—B. T.

Improvements in the Manufacture of Electrodes for Primary and Secondary Batteries. D. Pepper, jun., Philadelphia, U.S.A. Eng. Pat. 13,013, August 19, 1890. 4*d*.

About 12 per cent. of a soluble and fusible salt, such as salts of ammonia, soda, potash, or magnesia, is added preferably to litharge, the two are thoroughly mixed, placed in a mould, and heated until the fusible salt is fused and a solid plate formed which may be used as an electrode in an electrolyte of sulphuric acid. For the positive plate oxidising salts, such as sodium nitrate, potassium chlorate, &c., are added to form the litharge into peroxide of lead.

—B. T.

Improvements in the Electrolysis of Melted Haloid Salts. G. O. Rennerfelt, Stockholm, Sweden. Eng. Pat. 13,024, August 19, 1890. 4*d*.

To remove the melted metal from the cathode compartment a pipe is led from this compartment to a vessel serving as the receptacle for the melted metal, and thence is carried on to an exhausting apparatus by means of which the pressure at the cathode is made lower than the ordinary atmospheric pressure, so that the molten metal is carried over from the cathode.—B. T.

An Improved Battery Compound. C. M. Reed, Boston, U.S.A. Eng. Pat. 13,807, September 2, 1890. 4*d*.

The new fluid is formed from chromium trioxide and ammonium chloride dissolved in water containing a little sulphuric acid in proportions varying according to the purpose for which the battery is to be used. This compound may be used in either a single- or a double-fluid battery.

—B. T.

An Improved Method of Obtaining Metallic Sodium. L. Grabau, Hanover, Germany. Eng. Pat. 16,060, October 9, 1890. 4*d*.

In the usual method of obtaining sodium by the electrolysis of fused sodium chloride great loss of metal occurs owing to the formation, at the red heat necessary for the operation, of subchloride of sodium as shown by H. Rose and Bunsen, the subchloride being partially oxidised at the surface of the bath, partly diffusing to the positive electrode where it combines with the liberated chlorine. To obviate these difficulties the author uses a mixture of 1 mol. of potassium chloride to 1 mol. of sodium chloride; 1 mol. of the chloride of either barium, strontium or calcium being added for every 3 mols. of the mixed alkaline chlorides. Such a mixture fuses at a temperature considerably below a red heat, and the subchloride is not formed if the mixture be kept at its fusing point. The resulting sodium contains about 3 per cent. of potassium but is free from alkaline earthy metals. Strontium chloride is preferred to calcium chloride owing to the difficulty of completely expelling moisture when the latter salt is used.—H. K. T.

Improvements in Insulating Cells for Electric Batteries. S. C. C. Currie, Philadelphia, U.S.A. Eng. Pat. 16,322, October 14, 1890. 8*d*.

To prevent leakage the cells are provided with a depending rim all round, this rim not being in contact with the floor or support for the cells, but the base of the cells resting upon a pillar of suitable material with a cup-shaped recess or moat formed in and running all round its sides, in which recess an insulating fluid can be placed. The depending rim does not touch this supporting pillar, so that all leakage from this cell to earth must take place across the insulating fluid.—B. T.

Improvements in the Method of and Apparatus for Casting Frames or Supports for Battery Plates or Elements. H. H. Lloyd, Camden, U.S.A. Eng. Pat. 16,324, October 14, 1890. 8*d*.

To prevent any dross or scum being ladled into the mould with the melted metal, the latter is forced by compressed gas right from the bottom of the crucible, where such contamination is impossible, the stream of melted metal being led through pipes to the mould, without being exposed to the air at all. The compressed gas may be air, but is preferably water or other gas which will have, if any, a reducing action.—E. T.

Improvements in Secondary Batteries. C. W. Kennedy and H. Groswith, Philadelphia, U.S.A. Eng. Pat. 16,571, October 18, 1890. 8*d*.

Lead plates are cast with small knobs arranged in parallel rows upon one side and with a thickened flange or edge on the other side, so that when two of these plates are bolted together with the knobs outside, the flanges coincide and leave an empty space between the plates. The finished plate consists of two of these plates bolted together as above, the space between being filled with active material and holes being bored through the lead from the outside so as to leave a burr on the inside, which serves to retain the active material in position. Any suitable number of these plates are used in each cell, the complete plates being bolted together by insulated bolts and spaced apart by ebonite distance pieces. A plate is also described, made up of a body of very thin steel or other metal, coated with an unbroken film of lead.—E. T.

XII.—FATS, OILS, AND SOAP MANUFACTURE.

Indian Grass Oils. F. D. Dodge. Amer. Chem. J. **12** 533—564.

See under XX., *page* 158.

PATENTS.

A New and Improved Manufacture of Soap. C. Billing, Scaforth. Eng. Pat. 13,700, August 30, 1889. 6*d*.

By incorporating an ordinary soap with a mixture of mineral hydrocarbon oils (preferably boiling at about 200° F.) and turpentine, considerable advantages are said to be obtained. The paraffin retards the volatilisation of the turpentine, and the latter acts as a solvent to the former. A larger amount of paraffin may be used in a soap without separation of the paraffin taking place when treated with water. No other method, so far as the inventor is aware, allows a greater addition than 3 per cent of paraffin oil to soap without making the soap soft and friable, and giving rise to separation of paraffin on dissolving with water.—K. E. M.

Improvements in the Manufacture of Sheep Dip. G. Craig, Dalry. Eng. Pat. 889, January 17, 1890. 4*d*.

See under XVIII. *C., page* 156.

Improvements in Soap and Soap-Powder for Use with Hard and Sea Waters. H. Grimshaw, Manchester. Eng. Pat. 983, January 20, 1890. 4*d*.

Alkaline phosphates are incorporated with soap or soap-powder.—K. E. M.

Treatment of Press and Extraction Residues of Oil Manufacture for Obtaining Valuable Products therefrom. H. Noerdlinger, Stuttgart, Germany. Eng. Pat. 1109, January 21, 1890. 6*d*.

See under XVIII. *A., page* 155.

Improvements in the Treatment or Utilisation of Salt Obtained from Spent Soap Lyes in the Recovery of Glycerin therefrom. C. W. Hazlehurst and S. Pope, Runcorn. Eng. Pat. 1126, January 22, 1890. 4*d*.

The organic impurities in the salt obtained by the glycerin recovery process from spent lyes are destroyed by heat in presence of air.—K. E. M.

Improvements in the Process of Cleaning and Extracting Oil and Grease from Cotton-Waste and other Fibrous Materials. D. Barnett, St. Peter's Park. Eng. Pat. 1652, January 30, 1890. 8*d*.

See under V., *page* 134.

Improved Process and Apparatus for the Manufacture of Kneaded or Agglomerated Soaps. A. des Cressonnières and E. des Cressonnières, Brussels, Belgium. Eng. Pat. 2416, February 14, 1890. 8*d*.

With a view to save labour, time, and interest on capital in the manufacture of kneaded soaps, the inventor substitutes for the soap frames, cutting machines and all processes necessary for the manufacture of dry soap shreds, used for milled soap from a soap-paste, a continuous apparatus which cools, dries and cuts up into shavings the liquid soap. The latter flows over a series of hollow cylinders contained in a chamber, where it meets with currents of air which cool the soap and deprive it of moisture during its passage between the cylinders, these rotating in contrary directions and each successive cylinder increasing in speed. On leaving the last cylinder the soap is cut into ribbons and finally dried on endless travelling wire-webs which convey it to the pressing apparatus.—K. E. M.

An Improved Process for Producing Ozonised Oils. F. Piekenbrock, Berlin, Germany. Eng. Pat. 4137, March 17, 1890. 4*d*.

See under XX., *page* 159.

New or Improved Machinery or Apparatus for Crushing and Blocking or Moulding Toilet Soap. A. and A. Beyer, Paris, France. Eng. Pat. 4939, March 29, 1890. 8*d*.

The improvements consist in the combination of a crushing and moulding apparatus for toilet soap to form a single machine: a new method of mounting the crushing cylinders and of regulating the distance between them and a new arrangement of scrapers, which can be placed on different sides of the uppermost crushing cylinder dividing the soap into ribbons. For details of these improvements the original drawings must be referred to.—K. E. M.

An Improved Method of and Apparatus for Extracting and Purifying Perfumes, Oils, and other like Substances. H. H. Lake, London. From "La Société Anonyme des Parfumes Naturels de Cannes," Paris, France. Eng. Pat. 5940, April 18, 1890. 1*s*. 3*d*.

See under XX., *page* 159.

Improvements in the Manufacture of Cod-Liver Oil. C. A. Jensen, London. From P. Möller, Christiania, Norway. Eng. Pat. 13,803, September 2, 1890. 4*d.*

According to the inventor the unpleasant taste of cod-liver oil is due to products of oxidation, mainly oxy-acids, which cannot be avoided by the process of manufacture at present in vogue. To prevent the objectionable effect of oxidation the fresh cod-liver is treated in a closed instead of an open vessel and an inert gas or fluid is forced through it to expel contained air.—K. E. M.

Improvements in and Relating to Lubricants and Joint-Making Material. A. Purvis, South Shields. Eng. Pat. 13,936, September 4, 1890. 4*d.*

Two cwt. of Japanese tallow, 3 cwt. of Russian tallow, 108 lb. of lard oil, 108 lb. of castor oil, 2 cwt. of specially prepared olive soft soap, 10 lb. of carbonate of lime, 10 lb. of carbonate of soda are submitted to a very high temperature (preferably 210° F.), thoroughly mixed with ½ cwt. of finely pulverised mica or kaolin (china clay), or a mixture of these, cooled, re-heated after 24 hours' standing, and 20 lb. of oxide of zinc added; then all steam and water is forced out by hydraulic pressure. The lubricant is stated to minimise the effect of water on the bearings of machinery, and will not become fluid in hot climates or in the engine-room.—K. E. M.

XIII.—PAINTS, PIGMENTS, VARNISHES, AND RESINS.

Studies upon Resins. L. H. Friedburg. J. Amer. Chem. Soc. 1890, **12**, 285—291.

The author commences a series of studies on resins with an investigation of copal.

Copals are either *soft*, like damar, and soluble in ether, *half-hard*, or *perfectly hard*, in which case they can only be entirely dissolved after some chemical change. Soft copals are found mainly in Sumatra, Java, Moluccа, the Philippines, and Australia. Hard copals are imported from Zanzibar and the African coast viâ Calcutta, and from Madagascar, Mauritius, and Bourbon viâ Bombay. The last kind probably comes from a tree, *Hymenæa verrucosa*, known in the Mauritius as a *copallier*. The *Hymenæa courbaril* furnishes a similar product (H. Violette, Fabrication des Vernis, 302—304). The growers mix together hard and soft copals pell-mell, and ship them as hard copal and the dealers assort them; so that judgment must be exercised in order to secure a uniform quality. Hard copal is insoluble as a whole in alcohol, ether, and turpentine, but becomes soluble in the last two liquids on heating. In making varnishes, copal is melted and heated up; turpentine is boiled at the same time, and slowly run into the copal. If the copal is not hot enough, or the turpentine run in too fast, a clear solution is not obtained. Many patents for modifications of the process have been taken out (see Ure's Dictionary, 7th Ed., 1055), but the chemical reactions are not understood. The author has studied the decomposition of copal by heating in a flask with a Liebig's condenser. A light flowing distillate, probably containing Wallach's *limonen* (Annalen, **252**, 108), is obtained from 100° C. to 185° C.; then white vapours, only partially condensible, come off, till 215° is reached, when the mass becomes very dark, boils quietly without any visible vapour, and the thermometer falls suddenly and rapidly to 170° C.

It seems to follow that up to 215° fractional distillation takes place, but above that temperature real decomposition sets in. When copal is heated to 182°, one-third part by weight distils off, and on cooling a brilliant, hard, glassy translucent mass is obtained, easily soluble in cold or warm turpentine.

Distillation by means of steam under 45 lb. pressure yielded the terpene compound and a residue insoluble in turpentine. Copal may be dissolved in the liquid produced by its own destructive distillation, but this is an evil-smelling product. It may also be dissolved in aniline and its homologues, nitrobenzene, chloroform, phenol (patented process), and cyneol (for this substance, see Annalen, **225**, 295).

Benzaldehyde has a peculiar action on copal. The copal first dissolves perfectly, but soon thickens to a light amber-coloured jelly. When the ground copal is treated in a flask with benzaldehyde, after clear solution, the jelly state is reached at 80° C. Then thick yellowish fumes, benzaldehyde, water, &c. distil off, and finally an oil which condenses in thick white crystals, soluble in ether and benzaldehyde.

The products showed an increase of 8 per cent. over the original substance. The distillate probably absorbs atmospheric oxygen. This reaction will be further studied.

Turpentine inverted at 270° C., "seemed to be a solvent." Glacial acetic acid dissolves copal partially. Copal takes up carbon disulphide in large quantities as a colloid, and is also partially soluble in it, yielding (1) a plastic mass, which becomes hard on exposure to air; and (2) a solution which evaporated on the water-bath, yielded a gummy light-yellow coloured mass of aromatic odour. Glycerin is not etherified by copal when heated with it under atmospheric pressure. Increased pressure has not yet been tried. Concentrated sulphuric acid oxidises copal, sulphur dioxide being given off. Chromic acid, even at the boiling point, does not act on it. Potassium dichromate and sulphuric acid together act on copal energetically, yielding a product smelling like leaves of *Asperula odorata*. Caustic soda, 40° B. does not act appreciably on copal. Potassium permanganate attacks it at the boiling point. Nitrosylsulphuric acid acts on copal without violence, yielding a mahogany-coloured product, probably a nitro-compound, insoluble in water, soluble in alkalis. Sulphur introduced into boiling copal yields sulphuretted hydrogen, and the mass becomes hard and black.

Reducing substances give a very strong reaction with copal.

Alcoholic ammonia acts strongly on copal when warm. The solution produced deposits sulphur, and a white solid compound when neutralised by acids. The residue in alcohol, when boiled with water, puffs up to a porous mass, which, when dried, is found to be entirely volatile, and is probably an ammonium salt. Aqueous ammonium sulphide partly dissolves copal at the boiling point to a blood-red solution, which becomes lighter on cooling. Grape sugar in alkaline solution acts violently on copal. Potassium ethylate acts on copal on heating moderately. Strong hydrochloric acid attacks it slightly. Zinc dust heated with the substance gives condensible and non-condensible hydrocarbons. Iron dust, and zinc and hydrochloric acid do not act on it.

The author thinks crude copal consists of three typical compounds: (1) a terpene; (2) an easily-oxidisable compound not a terpene; and (3) an acid which may be homologous to abietinic acid, and which forms the amorphous, vitreous, translucent mass.

The experiments are to be repeated quantitatively.

—P. J. H.

PATENTS.

Improvements in the Manufacture of White Pigments, principally composed of Sulphate of Lead. J. E. Wood, Shirehampton. Eng. Pat. 19,910, December 11, 1889. 4*d.*

The raw material, consisting mainly of lead sulphate often mixed with lead oxide and zinc salts, is washed with a solution of sodium carbonate containing about 5 per cent. of the weight of the pigment operated on, of the dry salt. The result is to transform some lead oxide and sulphate and the zinc salts into carbonates of the metals. This is said to improve the material as a pigment, causing it to dry more readily, but removing the tendency to set hard, as lead sulphate paints are stated to do. The colour is also said to be improved.—B. B.

An Improved Method of making Paints and Varnishes, and the Treatment of Gums and Resins for the same, for Preservative, Decorative, and Artistic Purposes; also for preventing the Plates of Iron and Steel Ships from Corrosion and the Bottoms of Ships from Fouling. R. Mullard, London. Eng. Pat. 20,707, December 24, 1889. 6*d*.

Any suitable gum or resin capable of combining with bases to form the bodies generically termed resinates is boiled with ammonium, potassium or sodium hydrate and the resulting solution precipitated hot with a suitable metallic salt, such as those of copper and lead. The resulting resinate is then dissolved in any suitable solvent, such as turpentine or naphtha, and may be used direct as a varnish, or it may be dissolved in linseed oil and mixed with the ordinary ingredients of an oil varnish. Paints may be prepared by adding to the resinate linseed oil, turpentine and a pigment, which is preferably one containing the same metal as that forming the base of the resinate.

Anti-corrosive mixtures may be made from resinates of which iron is the base mixed with "oxide of iron," asphaltum, coal-tar, or pitch; "benzole" may replace turpentine as a solvent. Anti-fouling compositions may be formed by adding carbolic or cresylic acid or beechwood creosote.—B. B.

An Improved Process and Composition for producing Printing Ink. C. Huelser, London. From G. Callman, Weimar, Germany. Eng. Pat. 20,830, December 28, 1889. 4*d*.

See under VI., *page* 135.

Improvements in Compositions to be used as Paints. W. H. Barnes, London. Eng. Pat. 764, January 15, 1890. 4*d*.

"Bright Varnish," such as is used for mast yards and other woodwork (otherwise known as "pine varnish") is taken as a basis for various paints in place of ordinary drying oils, such as linseed oil; the presence of these latter materials must be avoided save with certain exceptional samples of bright varnish. Paints made therewith dry with a glossy surface unless specially treated as described below. The patentee finds that the cheapest and darkest samples of bright varnish are generally best for his compositions, but he uses the following test to make sure of their suitability: 1½ fluid oz. are mixed with 1 fluid oz. of turpentine, and enough zinc white to form a mixture of the consistency of an ordinary paint; this is brushed on a clean piece of iron, and will dry in half an hour to an hour if the varnish be of proper quality. White and red lead added to bright varnish for the production of paints cause it to dry considerably and even become semi-solid; this inconvenience can be remedied by the use of zinc white added dry or ground in turpentine. Various mixtures are quoted in the specification, usually consisting of bright varnish, zinc white, turpentine (or some turpentine substitute), a pigment of the colour of the finished paint, and rosin. Zinc driers are generally used in preference to the common lead driers. When zinc white is inadmissible, the bright varnish may be boiled to drive off part of its volatile constituents, and thinned with turpentine or alcohol.

For flatted paints the varnish is mixed with pigments containing lead and allowed to thicken for about 48 hours; the solidifying process is then checked by the addition of zinc white; whiting or china clay may be added to perfect the power of the paint to dry with a dull surface. Such materials as Stockholm, Bordeaux, or Venice turpentine may also be used in the preparation of such paints.—P. B.

A New or Improved Liquid applicable as an Adhesive Insecticide Paint or Varnish, or the like. J. Jeyes, Stratford. Eng. Pat. 853, January 16, 1890. 4*d*.

Forty parts by weight of common rosin, 17 of caustic soda solution of 30° B., and 180 of water are boiled together "until perfectly combined." The mixture may be used for papering walls or sticking posters. By adding to this mixture 24 parts of dextrin the fluid can be used for adhesive labels. By diluting the original mixture with 4—6 parts of water it can be used for dipping iron goods in to prevent rust, and by adding 1 part of methylated spirit, "turpentine spirit, or benzine spirit, or petroleum spirit," to 3 parts of the original mixture, a varnish is obtained for inside work of houses and for toys. The composition is claimed as an insecticide in the provisional, but this claim is omitted in the complete specification.—B. B.

Mould for Vulcanising India-rubber Tyres and Rings. A. J. Ruth, Hyde. Eng. Pat. 1268, January 24, 1890. 6*d*.

Rings provided with top and bottom grooves are laid one upon the other to form a series of annular matrices for moulding such articles as india-rubber tyres. Before building up these rings into a series they are filled with a plastic mixture of the rubber to be vulcanised in the ordinary way, then placed in position, clamped so as to form steam-tight joints, and the tyres vulcanised by admitting steam to channels provided in the rings for that purpose. Tyres of several sizes may be turned out simultaneously by using rings having several concentric grooves instead of one only.—B. B.

Improvements in or Pertaining to Drums or Vessels with Covers for Containing Substances, such as Anti-fouling Compositions and Paints, having Constituents Liable to Settle. V. B. Lewes, Greenwich. Eng. Pat. 1757, February 1, 1890. 6*d*.

The vessel containing the anti-fouling composition is provided with a vertical central rod attached to its cover, the rod carrying arms or a screw blade at its lower part. The cover is screwed on to the vessel, and in the act of unscrewing it to empty the vessel the vertical rod with its attachments is revolved, thus stirring up the contents. In one form illustrated, the cover is not screwed on to the vessel, but, instead, the vertical rod at its lower end screws on to a pin projecting from the bottom of the vessel, the object of either arrangement being simply to ensure the revolution of the vertical rod and its blades on opening the vessel.—B. B.

Medium for Use with Chemical and Earth Colours. E. Schmahl, Berlin, Germany. Eng. Pat. 13,719 September 1, 1890. 4*d*.

"This invention relates to a process for the production of a binding composition or medium for adding to earth and chemical colours instead of the oil and glue or size ordinarily used for the purpose." The mixture consists of the following ingredients, variation in the proportions being permissible:—10 parts of linseed oil, 10 of borax, 5 of dextrin, 2 of glue or size, and 6 of rye or maize flour. The advantages claimed are greater durability and less smell than those of ordinary paints, and freedom from tendency of the colours to run into one another when applied to woven fabrics.—B. B.

Improvements in the Manufacture of Linoleum, Lincrusta, Cere-Cloth, and the like. G. Schüler, Stettin, Germany. Eng. Pat 15,170, September 25, 1890. 4*d*.

Drying linoleum depends upon the oxidation of the linseed varnish, serving as agglutinant. The inventor effects this oxidation by mixing the material with chemicals which deliver oxygen at moderate heat, such as chloride of lime or chromic acid. The mass is then laid on the tissue, and the

linoleum or other substances heated by being passed over hot rollers or plates. The quantity of chloride of lime, for example, used is 8 to 10 per cent. of the varnish. It is stated that this process has a very favourable influence on the quality of the products.—H. S.

Improvements in Floor-Cloth, Applicable also to American Leather-Cloth and to Leather used for Upholstering or other Purposes. A. Frampton, London. Eng. Pat. 16,058, October 9, 1890. 4*d*.

A LAYER of felt, feltine wool, hair, cotton, paper, or india-rubber cork, is attached to the underside, or inserted between two layers of floor-cloth or American leather-cloth, &c., by means of glue. This considerably increases the durability of the cloth, and renders it soft and elastic.—H. S.

An Improved Ink for Printing and Similar Purposes. H. H. Lake, London. From W. G. Fuerth, Newark, New Jersey, U.S.A. Eng. Pat. 16,689, October 20, 1890. 4*d*.

See under VI., *page* 136.

XIV.—TANNING, LEATHER, GLUE, AND SIZE.

PATENTS.

Improvements in and Connected with the Recovery of Tannin from Waste Leather. H. Grimshaw, Manchester. Eng. Pat. 981, January 20, 1890. 4*d*.

THE waste leather is steeped in an alkaline solution of an alkali or alkaline earth the tannate of which is soluble. A solution of hydrate or carbonate of soda is preferable, and may suitably contain about 10 per cent. of soda. The treatment is continued until the tannin is removed from the leather and is in solution in the form of tannate. The tannin may be removed from the solution by any known means, and the untanned leather waste may be employed for various purposes, such as those for which hide clippings, &c. are generally used.—B. H.

Improvements in Preparing and Waterproofing Skins for Various Purposes. W. Dyshko, St. Petersburg, Russia. Eng. Pat. 16,017, October 9, 1890. 4*d*.

THIS invention is for a waterproofing composition composed of the following ingredients:—Colophony, 1 part; blubber, 1 part; wax, 2 parts; oil of turpentine, 1 part. In the manufacture of waterproof boots not only is the upper leather treated with the composition but the soles, insoles, and side linings, and also a piece of kid which is placed inside the boot between the upper and the side linings.

—B. H.

XV.—MANURES, Etc.

Report on the Progress in the Manufacture of Artificial Manures. Chem. Ind. 1890, **13**, 386—387.

THE manufacture of artificial manures is becoming more and more troublesome, inasmuch as the better kinds of raw material are getting constantly scarcer and necessitates the employment of ferruginous and aluminous materials, in which the problem of making the phosphoric acid soluble and non-revertable has not yet been solved. German manufacturers have striven and succeeded in producing a better material than the manufacturers of other nations, but then the question of cost has led even their fellow countrymen to avail themselves of the cheaper and inferior foreign products.

The mixing machine of Lorenz of Hanover has an arrangement of knives in a narrow deep vessel, which ensures a more thorough stirring up and mixes the materials more quickly and more intimately with the acid, than the old mixing machine. The same inventor has introduced what promises to be a successful mixer for dry materials.

—D. A. L.

Bone Meal. J. König. Landw. Versuchsst. 1890, **38**, 81.

THE author proposes to fixedly define the various sorts of bone meal in the following manner:—

(*a*.) "Normal bone meal" or "Bone meal, No. 0" he terms that which is obtained from whole bones previous to preparation for extraction and containing 4—5·3 per cent. of nitrogen and 19—22 per cent. of phosphoric acid. After extraction with chloroform, the relation of nitrogen to phosphoric acid should be 1 to 4, and up to 5·5.

(*b*.) Bone meal containing 3 to 4 per cent. of nitrogen, and 21 to 25 per cent. of phosphoric acid, and in which, after extraction with chloroform, the relation between nitrogen and phosphoric acid is 1 to 5·5 up to 8·5, to be designated merely "bone meal."

(*c*.) Bone meal containing 1 to 3 per cent. of nitrogen and 24 to 30 per cent. of phosphoric acid, and in which the relation of nitrogen to phosphoric acid after treatment with chloroform is 1 to 8·5 up to 30 to be considered as "deglutenised bone meal."

(*d*.) To the class of "crude bone meal" belongs the material obtained by merely crushing the bones, and the purity of which may be judged by its outwards appearance.

(*e*.) Meals containing, after treatment with chloroform, less than 1 per cent. of nitrogen, and in which the relation of nitrogen to phosphoric acid is higher than 1 to 30, cannot be considered as bone meals, but may be termed "mixed manure meals."

The manure obtained from flesh may be called "flesh meal" or "flesh manure meal."—T. L. B.

Application of Thomas Slag to Fruit Trees. Tschaplowitz Gartenflora, 1890, **39**, 348—353.

VARYING quantities of mixtures containing 4 parts of Chili saltpetre, 3 parts of potassium sulphate, and either 60 parts of 18 per cent. "Thomas" slag, or 30 parts of 18 per cent. superphosphate were applied to fruit trees on a shallow sandy soil with clayey sub-soil. In some few cases one or the other phosphate showed superiority, but on an average the double quantity of slag proved as effective as the single allowance of superphosphate, both being beneficial.

—D. A. L.

XVI.—SUGAR, STARCH, GUM, Etc.

Leopard-Tree Gum. J. H. Maiden. Trans. Australasian Assoc. Advance. Science, 1890, 379—380.

Flindersia maculosa, found in New South Wales and Queensland, belongs to the natural order *Meliaceæ*, and owes its name of "spotted or leopard tree" to the peculiar markings on its bark; it is also known as "dogwood" and as *F. strzeleckiana*. Large quantities of clear, amber-coloured, pleasant tasting gum exude from the stem and branches during the summer, sometimes exuding very rapidly, at other times remaining in a liquid state on the tree for some little time. It is eaten by the natives, is commonly used by bushmen as a remedy for diarrhœa,

and it makes a good adhesive mucilage. Of two samples in the Technological Museum, Sydney, one is a most valuable gum, clear, of excellent quality, completely and readily soluble in cold water, yielding a practically colourless solution with a faint cloudiness like that assumed by aqueous solutions of gum arabic. The other sample, apparently contaminated with dust while exuding, and consequently of reduced value, is dull and dirty looking, almost colourless, very brittle with a bright fracture, and is regarded as most frequently the product of half-dead trees.

The two samples have the following composition:—

	Arabin.	Water.	Ash.	Total.
Sample 1.....	80·20	16·49	2·76	99·45
Sample 2.....	80·08	16·40	2·63	99·11

metarabin being absent in both cases; leopard tree gum is therefore to all intents and purposes a good gum arabic. This is the only Australian species of *Flindersia* known to the author to yield gum.—D. A. L.

On the so-called "Sulphite Lye" and on the Rotation of Gluconic, Galactonic and Rhamnonic Acids. F. Weld, J. B. Lindsay, W. Schnelle, and B. Tollens. Ber. **23**, 2990—2992.

See under XIX., *page* 156.

The Manufacture of Rice Starch. J. Berger. Chem. Zeit. **14**, 1410, 1557—1558, and 1571—1574.

Rice starch has replaced wheaten starch to a considerable extent in Germany, where the annual production is, at present, about 40,000,000 kilos.

The raw material employed is obtained from rice-cleaning and polishing mills, and consists of the broken grains. The composition of various samples of this waste is given below:—

	East Indian Rice.			Russian Rice.	Egyptian Rice.	Persian Rice.
	Per Cent.					
Water	12·10	13·20	13·23	12·70	11·84	10·80
Starch	76·25	74·90	77·14	75·81	78·30	73·20
Protein	8·95	8·79	6·87	7·94	6·70	11·21
Fat	0·42	0·71	0·35	0·40	..	0·75
Gum and sugar	0·86	1·20	0·95	1·21	..	1·45
Fibre	0·32	0·40	0·36	0·44	..	0·81
Ash	1·10	1·80	0·80	1·45	1·16	1·78

The value of a sample for starch manufacture depends on the amount and quality of the starch it contains, and on the percentage of proteins, and the solubility of the latter in soda solution. The following scheme of analysis is suggested:—

1. The total percentage of starch is estimated by Lintner's process. 1·2 is subtracted from the result, in order to correct for the gum and sugar which are included in it.

2. The total nitrogen is estimated, then—

$$N \times 6{\cdot}25 = \text{proteins.}$$

3. The soluble proteins are determined by digesting a known weight of rice with soda solution at 1° B. From the solution the proteins are precipitated by neutralisation with an acid and weighed.

4. The residue of rice from 3 is ground up with weak lye, filtered through silk, and centrifugated. A paste is made of 6 grms. of the purified starch and 100 cc. of water. The paste is tested for consistency, &c.

The nitrogenous bodies present in rice are not nearly so easily separated from the starch as in the case of wheat. The application of soda solution is always necessary in order to dissolve more or less of the proteins, and render the starch soft enough for grinding. The operation is usually carried out in shallow tanks of 4—5 cbm. capacity. The rice is piled on a perforated shelf fixed in the tank, and covered with soda-lye at 0·5 to 1° B. The mixture is stirred a few times, and after about 18 hours the lye is run off and replaced by a fresh portion, which is allowed to remain for 12 hours, by which time the starch is generally sufficiently softened. The great importance of this softening process is not sufficiently recognised, and in consequence it is often negligently performed. Apart from this, however, the above method is faulty. Carried on, as it is, in open vessels, with only very occasional stirring, but little of the nitrogenous bodies are dissolved; further, owing to the length of standing, fermentation is liable to set in, especially in warm weather. The evil effects of fermentation are noticeable in all the after-processes. It causes the mass to froth excessively in the grinding mill and centrifugating is rendered very difficult. The starch does not separate in a state of purity, and comes from the centrifugals in flabby lumps. For the same reason it refuses to deposit in the settling tanks. The protein assumes a slimy condition and retains much starch. Even if the fermentation be stopped by means of sulphurous acid, it easily recommences during the drying of the starch, so that the latter becomes more or less mouldy.

The author therefore recommends that the extraction and softening of the rice be effected by a continuous current of lye. By this means the time of treatment is considerably shortened. The action is also rendered more energetic by using a stronger solution of soda, say, at 1½° B. In such case, however, it is necessary to cool the liquid, otherwise the starch might suffer. In the old process, 2 cbm. of soda-lye are required for 1,000 kilos. of rice, which corresponds to a quantity of sodium hydrate equal to 1—1¼ per cent. of the weight of the rice.

After soaking the rice is ground. This operation is in most cases effected between mill-stones of about 1,200—1,400 mm. diameter, and 300—100 mm. in thickness, making 120—140 revolutions per minute. The process must be most carefully watched in order to avoid incomplete grinding. All lumps, &c. are rejected by the sieves in the course of the working, and pass into the waste. It is therefore customary in most manufactories to pass the rice through two mills, arranged side by side, so that the cream of starch drops directly from the first into the second mill. During grinding the rice is moistened with lye of the same strength as that used for softening, about 200 litres being required per 100 kilos. of original rice. The creamy mass flowing from the mill contains about 20—28 per cent of solid matter. 200 cwt. of rice may be ground in a double mill in 24 hours. The ground mass is lifted into high-lying tanks from whence it is distributed to the sieves and other apparatus. The pure starch is separated from the impurities by means of sieves, centrifugal machines, settling tanks, and filter-presses.

Sieves.—Rotating cylindrical sieves are almost exclusively employed. They are constructed as follows: A shaft 4—5 metres in length is provided at intervals of 1 metre with three rods of equal length, arranged symmetrically at right angles to the shaft. The ends of these rods carry six wooden boards parallel to the shaft. The framework thus formed is covered with the finest silk gauze. The cylinder is so arranged that one end lies about 15 cm. higher than the other. The liquid to be strained is fed into the upper part of the apparatus. The filtrate is collected in a wooden casing which completely surrounds the cylinder. The lower end of the cylinder projects beyond the outer box, into a tank into which the impurities remaining on the sieve are washed. The shaft of the cylinder is hollow, and is pierced by numerous holes through which water can be forced. By this means the walls of the cylinder are kept clean, and the

passage of the impurities to the lower end is facilitated. The waste obtained contains very little starch, and may be used as cattle food. The starch-milk passing through the sieve still contains much protein, which may be separated by centrifuging or by treatment in settling tanks. The former process requires less time and space but more power than the latter.

Centrifugal Machines.—The drum of the centrifugals usually employed consists of copper or iron, and has a diameter of 800—900 mm. and a depth of 340—400 mm., the removable head having a height of 150 mm. The drum is not perforated and makes about 1,400 revolutions per minute. When charged the apparatus is kept running for 15—25 minutes according to circumstances. The starch and gluten adhere to the walls of the drum in layers, the starch being innermost, and are separated by scraping, each being ground up with water and again centrifuged.

Settling Tanks act similarly to centrifugal machines, the starch settling to the bottom, whilst the gluten remains suspended in the water and is drawn off.

Filter-presses are only employed to remove soluble impurities.

When the various processes are employed in the order given, the yield of starch of the first quality is about 60 per cent. (calculated as absolutely dry starch on the rice), whilst 7—10 per cent. are left in the various by-products and may be recovered by repeated centrifuging, &c. The total yield is about 85—90 per cent. of the starch contained in the rice.

Moulding the Rice.—Formerly this was almost exclusively done in wooden boxes with perforated bottoms covered with filtering cloth. The boxes are set up in rows, and the starch mixed with water or weak soda-lye (0·1° to 0·3° B.) being charged into the first box, overflows into the next, and so on. In order to make the water drain out more thoroughly the boxes are repeatedly lifted from their supports and dropped again. After about 24 hours the blocks of starch, still containing 42—44 per cent. of water, are removed and cut into rectangular pieces. Various forms of high pressure filtering moulds are now employed, and with these the starch-milk used for filling must not exceed in specific gravity 1·2—1·25, otherwise the finished product exhibits a rough fracture, which detracts from its appearance.

Preliminary Drying of the Starch.—Blocks of starch containing 40—45 per cent. of water, when dried become covered with a yellow crust, owing to the separation of traces of dextrin, &c. This crust is about 10 mm. thick, and is cut off when the blocks are partially dried, *i.e.*, contain 25—28 per cent. of water. The remaining starch may be now completely dried without any further development of yellow colour taking place. All attempts hitherto made to avoid this crust formation have failed. The crust constitutes about 22—30 per cent. of the total starch. The shavings are stirred up with water, centrifuged once, or filtered, and mixed with the following batch of pure starch. Large masses of starch when dried fall into more or less irregular rod-like pieces, the size, shape, and smoothness of surface of which depend greatly on the rapidity of drying and the solidity of the blocks before drying. Starch is generally coloured in order to hide its slightly yellow tint, ultramarine being usually employed for the purpose. The blocks remain in the drying chamber for 14—21 days according to the temperature, which ranges from 30°—50° C. The dried starch contains about 12 per cent. of water, but on exposure to air it absorbs moisture up to 15 per cent., which is the commercially recognised standard. If it be desired to obtain the starch in large lumps, the blocks after scraping are cut up into smaller pieces, which are then slowly dried in the air.

Waste Products.—These consist of gluten and impure starch. They may be mixed and used for cattle feeding; or more or less separated and utilised, the starch for feeding and the gluten for manurial purposes.—H. T. P.

Gums from Two Species of Ceratopetalum. J. H. Maiden, Trans. Australasian Assoc. Advance. Science, 1890, 381—383.

The genus *Ceratopetalum* belongs to the natural order *Saxifragæ*, and is endemic in New South Wales.

C. gummiferum is generally of bushy size but occasionally develops to a small tree; it bears a reddish persistent showy calyx and constitutes the "Christmas bush" of Sydney and has been known as the "officer plant."

C. apetalum, a gully tree only found in moist situations, is tall with smoothish bark, bright-looking foliage, and an abundance of white flowers, and is locally known as "coach-wood," "lightwood" and "leatherjacket."

C. gummiferum yields a transparent ruby-coloured gum with bright fracture, a powerfully astringent taste, and sticks to the teeth. To obtain this gum in considerable quantities ring-barking, or wounding the tree, or mere cutting down is of little avail; the tree must be cut into logs or pieces so that the timber is open at both ends, the gum exudes in small drops and thin pieces which dry very quickly. A cake obtained from draining a severed log was at first exceedingly tough, but after two or three months' exposure to the air, fractured between the fingers with a bright fracture. The gum is odourless and dissolves partially in cold water with a deep orange-brown colour, leaving a bulky gelatinous residue. The ash is white.

The gum from *C. apetalum*, obtained by wounding or felling the tree, is similar to *C. gummiferum* gum; it, however, smells of and may be regarded as an available source of coumarin, which is also plentiful in the bark. This gum swells considerably in cold water, to which it imparts a pale orange-brown colour and the coumarin odour. The ash is dark brown, bulky, and difficult to ignite; it contains a large proportion of manganese but only a little iron.

The *ceratopetalum* gums are astringent and may be described as kinos or kinoid gums; they resemble ruby kinos in colour and texture but differ from them by swelling up and being only partially soluble in water. Definitions of kinos take cognisance of tannic acid but do not allude to any gummy constituents, and if applied in this case would be the first instance of kinos being recorded from the *Saxifragæ*. However, in the kinos of *Eucalyptus* known to the author, all the gum is present as arabin, whereas the gum in the case of the *ceratopetalum* is present as metarabin; this is suggested as a possible objection to their being regarded as kinos, but in any case they form a connecting link between the kinos and metarabin gums and are a remarkable group. The composition of the gums is as follows:—

	C. gummiferum.	*C. apetalum.*
Tannic acid (estimated as gallotannic acid)	16·76	6·35
Phlobaphenes (soluble in alcohol)	19·5	12·21
Phlobaphenes (insoluble in alcohol together with metarabin).	41·6	52·09
Coumarin	Absent	Variable 2 to 3
Accidental impurity	2·5	2·0
Moisture	16·7	20·47
Ash	1·8	3·44

The residue from the treatment of *ceratopetalum* gums with water consists almost entirely of phlobaphenes and metarabin, the former in largely preponderating proportions; in fact by boiling with water to begin with the numbers for tannic acid in gums of this genus would be returned at between 40 and 50 per cent.; actual experiment gave 49·78 in *C. gummiferum*; 41·14 in *C. apetalum*. Owing to the difficulty of separating the phlobaphenes insoluble in alcohol from the metarabin, entirely satisfactory results have not been obtained in that direction, but from various experiments and observations, the conversion of the phlobathene into

tannic acid, and the metarabin into arabin, the physical appearance of the gums in water and in alcohol, &c., the author estimates the metarabin present at about 8 to 10 per cent.—D. A. L.

PATENTS.

An Improved Knife for Slicing Sugar Beets, Sugar Canes, and the like. R. Bergreen, Bitterfeld, Germany. Eng. Pat. 20,573, December 24, 1889. 8*d*.

The knife is provided with a toothed or saw edge, and is fixed on an iron plate which may be inserted in the cutting box of the machine used for the purpose of cutting such materials. The knife, machines, and various arrangements and combinations thereof, are described in detail with reference to drawings.—A. J. K.

An Improved Method of Saccharification of Amylaceous Materials. E. Carez and "La Société Général du Maltose," Brussels, Belgium. Eng. Pat. 3606, March 6, 1890. 4*d*.

The feculant or amylaceous material is treated before saccharification with either benzene, light petroleum oils, or bisulphide of carbon to dissolve out the fatty or oily impurities. The liquid is drawn off to decant the oil and the solvent used over again. As some of the solvent remains in the material under treatment, this is expelled by a current of steam or hot air, and the material is then saccharified by the usual process. By this means the amount of bone-black required for purification is greatly reduced and an improved product obtained.—A. J. K.

A New or Improved Method of Cleaning, Treating, or Preparing Kauri Gum for the Market. J. C. Firth, Auckland, New Zealand. Eng. Pat. 17,009, October 24, 1890. 4*d*.

Kauri gum has hitherto been prepared for market by scraping off the outer crust by hand. In the improved process revolving or reciprocating wire (preferably steel) brushes are used, followed by buffs or similar devices. The dust is removed by fans passed through a machine known in flour mills as a "purifier," and thus purified, the recovered finely divided gum being available for use being freed from worthless débris.—B. B.

XVII.—BREWING, WINES, SPIRITS, Etc.

Contributions to a Knowledge of the Bacteria occurring in Wort and Beer. A. Zeidler. Wochenschr. f. Brau. 1890, **7**, 1214.

The author finds that the bacterium known as *Bacterium termo* is quickly destroyed when alcoholic fermentation sets in. Also that the stability of pressed yeast is dependent upon the bacteria present in it. When fresh cells of the above wort bacterium occur in the yeast, it quickly decomposes, whilst it is fairly stable when only those bacteria are present which accompany fermentation. Pressed yeast is but little affected by the acetic ferment.—A. L. S.

On the Possibility of Economising Hops in Brewing. M. Issleib. Allgem. Brau. u. Hopfenzeit, 1890, **30**, 2173.

As a part of the aromatic oils of the hop are volatilised during the boiling of the wort, at the same time a large portion of the hop bitter is destroyed, the author proposes to extract the hop bitter by water, then distil off the essential oil, and add these at the conclusion of the boiling. A great saving in hops is said to be thereby effected.

—A. L. S.

Malt Analysis. F. Schwackhöfer. Mitth. d. österr. Versuchsstat. f. Brau. u. Malz. in Wein, 1890, Heft. 3.

The results of 152 analyses of malt made at the Austrian laboratory for brewing and malting from October 1887 to December 1889:—

	Water, Per Cent.		Extract, Per Cent. on the Dry Substance.		Maltose, Per Cent. on the Dry Substance.		Rates of Maltose to Non-maltose.	
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
54. Pilzen malts.	10·48	1·60	82·86	73·43	59·93	47·42	1:0·35	1:0·64
59. Vienna Lager malts.	9·32	0·74	82·51	74·50	56·63	39·27	1:0·37	1:0·95
39. Bavarian malts.	6·18	0·38	80·72	73·45	54·33	38·61	1:0·43	1:0·95

—A. L. S.

PATENTS.

Apparatus for Collecting for further Utilisation the Excess of Carbonic Acid Generated during the Manufacture of Beer. L. Haas, Rierbach-Zurich, Switzerland. Eng. Pat. 20,630, December 23, 1889. Internat. Conv. June 27, 1889. 8*d*.

The carbonic acid generated in the casks is forced by its own pressure into a gas-holder.

The carbonic acid given off from the fermenting vessel is collected in bells suspended over the fermenting liquid and just dipping into it. The gas is drawn off by means of a pump and led into the gas-holder.

The carbonic acid in the gas-holder is drawn off and compressed into suitable receivers.—A. L. S.

New or Improved Process and Apparatus for Ageing Liquors. W. P. Thompson, Liverpool. From J. A. H. Hasbrouck, Plainfield, U.S.A. Eng. Pat. 667, January 14, 1890. 8*d*.

The process consists in exposing the liquor in a state of spray at a temperature of 100° F. to the action of oxygen under a slight pressure.

The apparatus consists of a wooden barrel-shaped vessel, mounted so as to be capable of rotation about its longer axis. A coil of block tin passes through the vessel, through which steam may be passed. Inside the vessel are a number of wooden arms at right angles to each other, and having spoon-shaped hollows at each end. All the wood inside is charred.

To use the apparatus it is partly filled with new liquor, and oxygen admitted under a pressure of about 5 lb. per square inch. The vessel is then closed and revolved for some days, the temperature being kept at about 100° F., by the steam coil. As the vessel revolves, the arms with their spoon-shaped hollows agitate the liquor and expose it to the action of the oxygen. After a few days the oxygen becomes vitiated, and it is allowed to escape and fresh oxygen admitted. The process is then continued until the required age has been reached. The inventor finds that 25 days' treatment is about equivalent to a year's natural ageing.—A. L. S.

Improvements in Corn Product for Brewers' Use and in the Manufacture thereof. H. Bates, jun., Indianapolis, U.S.A. Eng. Pat. 16,951, October 23, 1890. 4*d*.

In order to obtain maize in a condition suitable for brewing it is first hulled and degerminated. The corn is then placed in a tank of warm water, the water not being sufficiently hot to gelatinise the starch; the exact temperature and duration of soaking varies with the character of the corn; as a rule the temperature may be from 70—100° F. The granules, when sufficiently soaked, are crushed between cold rollers and then dried.—A. L. S.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

(*A.*)—CHEMISTRY OF FOOD.

On the Constitution of Butter. J. A. Wanklyn.

See pages 89—91.

The Composition and Digestibility of Green Fodder and of Ensilage, with Notes on Artificial Digestion as an Analytical Method. D. Wilson and P. R. Harper.

See pages 115—119.

PATENTS.

An Improved Method of and Apparatus for Preserving Milk. E. Edwards, London. From A. Seidenstiekel, Wülfel, Germany. Eng. Pat. 19,281, November 30, 1889. 11*d.*

Milk is heated to and sustained at a temperature of 69° C. for 30 minutes or of 75° C. for 15 minutes, or during hot weather at 96° C. for 10 to 12 minutes in a tinned copper vessel previously sterilised by steaming, in which steam of suitable temperature is caused to circulate through three concentric coils of tinned copper piping, one near the periphery, the other two of smaller piping near the centre, vanes attached directly to and also to arms connected with a rotating central shaft keep the milk in agitation; the temperature, as indicated by a thermometer provided for the purpose, is regulated by shutting off or admitting steam. After sufficient exposure to the desired temperature the milk passes to a cooler, also previously sterilised by steaming where it is caused to flow over the outside of a corrugated cylinder through the interior of which a stream of cold water is circulating. The cool sterilised milk is then directly transferred to special sterilised cans for transport, furnished with a tightly-fitting cover provided with tubes passing inside to permit of steaming, one of which terminates just beneath the cover, whilst the other extends to the bottom of the can; when filled with milk the exterior openings of the tubes are closed hermetically by means of sterilised screw stoppers. All the apparatus here described is easily disconnected for cleansing purposes.

It is asserted that by this method milk may be preserved during several days, and that its natural flavour, odour, and appearance are retained.—D. A. L.

A New or Improved Alimentary Liquid. J. H. Hooker, Winslow, Bucks. Eng. Pat. 192, January 4, 1890. 4*d.*

Milk, peptonised or otherwise, and preferably with the cream removed, is boiled, cooled, and mixed with cane sugar or other saccharine matter—about 4 lb. per gallon—and with pure lime or lemon juice or the two mixed—about six fluid ounces per gallon—or an equivalent quantity of an innocuous, agreeably flavoured and suitable vegetable acid; alcoholic fermentation is induced by the addition of brewers' yeast—about two fluid ounces per three gallons of the mixture—and the fermented liquid fined by means of isinglass or otherwise, is stored in wooden casks and treated in the same way as ordinary wine.—D. A. L.

Improvements in the Method of Producing Infusions of Tea and similar Solutions Free from Tannin. H. Grimshaw, Manchester. Eng. Pat. 982, January 20, 1890. 4*d.*

The tannin present is absorbed by means of suitable animal substances, such as horn shavings, dried albumen, hide clippings, and the like. It is preferable to add the material to the tea in the dry condition before the infusion is made. But it may, also, be added to the infusion or the infusion may be passed or filtered through a layer of the substance. The quantity of animal substance to be added to the tannin-containing material must be determined by the amount of tannin contained in it. In the case of tea the proportion may vary from one to two parts of animal substance to ten parts of tea.—B. H.

Treatment of Press and Extraction Residues of Oil Manufacture for obtaining Valuable Products therefrom. H. Noerdlinger, Stuttgart, Germany. Eng. Pat. 1109, January 21, 1890. 6*d.*

In the production of oils, by-products consisting of oil-cakes or oil-cake meals are obtained. These on account of the high percentage of fatty acids are, notwithstanding their great wealth of nutritious elements, only suited for horse and cattle food. The object of the inventor is to obtain food-substances suitable for human consumption.

The fat in—

Rapeseed cake contains about	10	per cent.	of	free acid.
Palm-nut cake	„	14½	„	„
Cocoa-nut cake	„	16⅝	„	„
Earth-nut cake	„	18	„	„
Sesamé cake	„	41	„	„
Poppy-seed cake	„	51	„	„

The cake is extracted by means of alcohol. Strong alcohol is employed to dissolve the fatty acids and some of the sugar; when it is desirable to dissolve more sugar, weaker alcohol is used. When only sugar is to be extracted water is chosen as a solvent. From the alcoholic solution the sugar and fatty constituents are separated by distilling off the solvent, when the sugar-syrup sinks to the bottom and the fatty constituents float on the top. The latter may be used for the manufacture of soap and the lixiviated cake forms a meal very rich in nitrogenous substances which is suitable as food for those suffering from diabetes. By well-known mechanical treatment the coarse-grained particles of indifferent flavour may be separated from the fine-grained meal of good flavour. The latter contain about 50 per cent. of protein compounds.—K. E. M.

(*B.*)—SANITARY CHEMISTRY.

Fluorides as Agents for Softening Waters. C. A. Doremus. J. Amer. Chem. Soc. 1890, **12**, 303.

Sodium fluoride has been found, by experiments made in the laboratory on a somewhat large scale, to be an excellent softening reagent. The magnesium compounds are completely precipitated by its use.

Other fluorine compounds may also be employed for the same purpose. No patents seem hitherto to have been taken out for their commercial use. They possess advantages over lime, soda-ash and caustic soda.—P. J. H.

On the Use of Galvanised Iron for Artesian Wells and for the Conveyance of Drinking Water. R. Haines, J. Franklin Inst. 1890, **100**, 393—401.

The author analysed a sample of water from an artesian well, recently sunk, 78 ft. deep, of which both the outer and inner casing were made of galvanised iron. There was no source of sewage contamination near the well, yet its composition showed per 100,000 parts 0·473 parts free ammonia and 0·008 albuminoid ammonia, only faint traces of nitrates being present, but there was a large amount of zinc in solution. The solids consisted of:—

	Grains per Gall.
SiO_2, Al_2O_3, and Fe_2O_3	0·85
NaCl	0·77
$CaCO_3$	1·30
$(NH_4)_2CO_3$	1·25
$ZnCO_3$	6·52
Total solids	10·69

The analysis shows that the free ammonia has evidently been increased by reduction of nitrates of iron and zinc, and that the water undoubtedly had been previously contaminated by animal sewage.

On heating the sample the zinc separated out as a film on the surface. The author considers that the oxide and carbonate of zinc have combined with the ammonium carbonate to form the double zinc and ammonium carbonate, which is insoluble in water, but very soluble in ammonium carbonate, the excess of ammonium carbonate in the water holding it in solution. This combination of salts is decomposed on heating.

Experiments showed that commercial zinc and chemically pure zinc were rapidly acted on by a cold dilute solution of ammonium carbonate, which after 24 hours' contact gave a copious precipitate with sulphuretted hydrogen on acidifying with acetic acid.

Zinc not being so accumulative as lead, is less injurious to health, and, as is also known, zinc is contained in small quantities in some drinking waters in use.

The author concludes that while under the usual conditions of water supply galvanised iron piping may be used, yet too much confidence should not be placed in it. All the conditions under which this piping is to be used should be carefully considered, including a chemical analysis of the water; and, in the presence in the water of considerable amounts of certain saline substances, such as ammonia salts, chloride of sodium and nitrates, as well as very small amounts of free mineral acids, &c., galvanised iron should not be used at all. Under such circumstances, only pipes coated with a non-metallic interior surface should be used.

—D. A. S.

PATENT.

Improvements in and in the Preparation of Material for Use in the Treatment of Sewage and other Polluted Water and Liquids. F. P. Candy, Balham. Eng. Pat. 16,972, October 24, 1890. 4*d*.

Iron sulphate partially decomposed by heat "so as to form a mixture of oxide, protosulphate, and persulphate of iron, together with a proportion of Nordhausen sulphuric acid" is either exposed to the atmosphere to "weather" or subjected to the action of moist air or steam in a closed chamber; "the mass regains constituents lost in the roasting operations, and is then in a state for use" by adding it in any form and in any desired proportions to the liquid sewage or impure water.—D. A. L.

(C.)—DISINFECTANTS.

PATENTS.

Improvements in the Treatment of Hemp, Flax, Jute, Cotton, and other Substances in order to Preserve the Same. E. T. Truman, London. Eng. Pat. 19,773, December 9, 1889. 4*d*.

See under V., *page* 133.

Improvements in the Manufacture of Sheep Dip. G. Craig, Dalry. Eng. Pat. 889, January 17, 1890. 4*d*.

This invention relates to the class of dips consisting of combinations of phenoloids (phenol, cresol, xylenol, and their homologues) with alkali and sulphur. Suitable crude oil derived from the tar of gas works, blast furnaces, coke ovens, or gas producers, is agitated with a compound of alkali and sulphur, preferably an alkaline polysulphide, heat is applied, and after settling, the compound of phenoloids, alkali, and sulphur is separated from the supernatant oil, and may be further treated until of desired quality.—D. B.

Improvements in the Manufacture of Disinfectants, Antiseptics, Deodorants, Insecticides, and Sanitary Reagents. C. T. Kingzett. Eng. Pat. 1589, January 29, 1890. 4*d*.

Oxidised turpentine is rendered less inflammable, miscible with water, and suitable for general application as a disinfectant, &c. by mixing with soft or hard soap; good proportions being 2 cwt. of the former to 94 gallons of the oxidised oil, whilst of the latter 84 lb. are dissolved in 50 gallons of the oxidised turpentine at about 60° C.

—D. A. L.

Improved Insect Destroyer and Manufacture of the same. W. P. Thompson, Liverpool. From P. Leonardi, P. Zen, and G. Sardi, Venice, Italy. Eng. Pat. 17,256, October 28, 1890. 4*d*.

An insecticide or entomophobe is prepared by extracting chrysanthemum or pyrethrum with alcoholic potash, soda, lime, or preferably ammonia, and digesting with ether, essence of turpentine, benzine, paraffin, wax, olive oil, fatty substances, or other suitable hydrocarbons. Or the chrysanthemum is simply treated with an alkaline nitrate or with ammonia extracted with water, and the ammonia expelled or neutralised. The preparation, either as a spray, or strewed about, or burnt in candles, lamps, &c., or mixed with a nitrate, &c. and made into capsules for burning, may be employed as a general insecticide in rooms, fields, orchards, &c.—D. A. L.

XIX.—PAPER, PASTEBOARD, Etc.

On the so-called "Sulphite Lye," and on the Rotation of Gluconic, Galactonic and Rhamnonic Acids. F. Weld, J. B. Lindsay, W. Schnelle, and B. Tollens. Ber. **23**, 2990—2992.

In the manufacture of sulphite cellulose, a solution is obtained in which mannose and galactose are found. This "sulphite lye," in addition to gypsum and calcium sulphate, contains much organic matter, and, if distilled with sulphuric or hydrochloric acid, furfurol or furfuramide are obtained, hereby proving that penta-glucoses or pentoses (xylose) are present in "sulphite lye." When this liquid, mixed with sulphuric acid, is treated by hydrolysis, then neutralised, concentrated, freed from gum, and phenylhydrazine acetate added, a hydrazone compound is obtained, corresponding to mannose-hydrazone which, when freshly prepared, is for a short time levo-rotatory. When the liquid is evaporated, and the residue heated with nitric acid, precipitates are obtained from which mucic acid can be extracted, hereby proving that galactose compounds are met with in "sulphite lye." The presence of saccharic acid could not be proved, but vanillin was found by means of the phloroglucinol reaction.

The acids obtained by oxidation from glucoses possess a remarkable kind of bi-rotation, as the following table shows:—

	1.	2.	3.	4.
—	$(a)_D$ in Freshly Prepared Solutions.	$(a)_D$ a Week or more Afterwards.	$(a)_D$ when the Fresh Solutions are heated on the Water-Bath for Half an Hour.	$(a)_D$ a Week or more after No. 3.
Gluconic acid .	+ 2 to 3	+20°8 to 19°4	+ 19°	+ 9°5
Galactonic acid	− 10°56	− 46°82	− 57°84	− 53°36
Rhamnonic acid	− 7°67	− 29°21	− 34°30	− 30°12

—H. S.

PATENTS.

An Improvement in Coating Iron, Steel, or other Metal with Lead. J. Makin, Glossop. Eng. Pat. 14,071, October 24, 1884. (Second edition.) 6*d*.

An Improved Compound Lining for Boilers or other Vessels Used in the Manufacture of Paper Pulp from Wood or other Vegetable Fibre. J. Makin, Bellfield. Eng. Pat. 5626, May 7, 1885. (Second edition.) 6*d*.

Boilers of wrought iron or steel, lined with lead, are usually used for boiling wood, &c. with strong acid or corrosive solutions in paper pulp manufacture. To support the lead and to check its propensity to "creep," sheets of iron or other hard metal, perforated with cylindrical or conical holes, are placed in a mould suitably prepared; and on one or both sides coated with lead, applied in a molten state. The boilers lined with such plates resist the action of the heated acids and corrosive substances much better than when lined with lead in the ordinary way.—H. S.

An Improved Film or Skin. J. Williams, Willesden Junction. Eng. Pat. 20,524, December 20, 1889. 4*d*.

Paper is floated on a solution of cuprammonium hydroxide. Hereby one surface of the paper is converted into a jelly-like cupra-cellulose which is dried, and the film thus obtained, separated from the paper by disintegrating the latter with boiling water, the pulp being removed by a stream of water or by revolving brushes. Then the film is dried by being passed round warm cylinders. If treated with dilute acids the film becomes white. The film thus obtained possesses the properties of fine paper, and is capable of resisting the action of water, steam, weak acids, alkalis and most solvents.—H. S.

An Improved Method of Manufacturing Rods of Parchmentised Fibre. R. P. Frist, Wilmington, U.S.A. Eng. Pat. 5841, April 17, 1890. Internat. Conv. February 13, 1890. 6*d*.

Cylindrical bars or rods of parchmentised fibre cannot be obtained by turning in a lathe, as the material springs. The inventor therefore proposes to use a tool consisting of a hollow stem or mandrel, having at its front end four cutting blades which reduce square or polygonal rods to a cylindrical form, whilst the rod continues to pass through the centre of the mandrel.—H. S.

Improvements relating to Apparatus for Boiling Wood-Pulp. F. V. L. Hiorth, Christiania, Norway. Eng. Pat. 15,995, October 8, 1890. 6*d*.

This invention relates to an arrangement for connecting together a number of wood-pulp boilers for the purpose of utilising the gas and heat which are evolved during the process of boiling.—E. J. B.

Improvements in Agitators for Stuff Chests Used in the Manufacture of Paper. H. H. Lake, London. From M. D. Currier, Massachusetts, U.S.A. Eng. Pat. 16,796, October 21, 1890. 6*d*.

The improvements consist in the employment of blades of peculiar construction attached to a revolving shaft in the centre of the stuff chest. By means of these blades a more perfect circulation of the pulp is attained, and consequently a more intimate mixing of its various constituents.—E. J. B.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES AND EXTRACTS.

Concentrated Essential Oils of Lemons, Limes, &c. A. A. Barrett.

See pages 106—108.

Crystalline Constituents of Semen Catapuliæ minoris. Yoshisumi Tahara. Ber. **23**, 3347—3351.

The seeds of *Euphorbia lathyris*, which are still used to some extent for medicinal purposes in Japan, contain æsculetin and another crystalline compound which melts at 193°; the æsculetin can be isolated as follows:—The crushed seeds are freed from oil by pressing extracted with boiling 90 per cent. alcohol, and the solution evaporated; the residue, which consists of a brown solid and an oil, is freed from the latter by washing with ether, then extracted with small quantities of cold water and dissolved in boiling alcohol; on cooling the æsculetin is deposited in brown crystals. It can be purified by repeated recrystallisation from boiling water, with addition of animal charcoal, or by treating the alcoholic solution with lead acetate; in the latter case the precipitated lead compound is washed with alcohol and water consecutively, then decomposed with glacial acetic acid, and the undissolved æsculetin recrystallised from boiling water. The yield is about 0·9 per cent. of the seeds employed.

The identity of the æsculetin obtained in this way with that formed by the decomposition of the glucoside, æsculin, was proved by a number of experiments.

The compound melting at 193° referred to above is deposited in colourless crystals when the clear oil of the seeds is kept for a long time in closed vessels; it is odourless and insoluble in water, but readily soluble in hot alcohol and other organic solvents. Owing to lack of material it has not yet been further examined.—F. S. K.

The Ethereal Oil of Asafœtida. F. W. Semmler. Ber. **23**, 3530—3533.

Hlasiwetz has shown that the ethereal oil of *Asafœtida* contains hexenyl sulphide and hexenyl disulphide (Ann. Chem. Pharm. **71**, 23), and that it is one of the few ethereal oils found in nature, which contain sulphur and no nitrogen.

Two samples of the oil were examined, which were found on analysis to contain 3·29 per cent. and 3·04 per cent. of oxygen respectively, the presence of which has previously been overlooked. When fractionated in vacuo the crude oil yields four products, boiling as follows under a pressure of 9 mm.:—

	Boiling Point.
Fraction I.	65°
Fraction II.	80°—85°
Fraction III.	120°—130°
Fraction IV.	133°—145°

These fractionations as obtained from the two samples examined differed both as regards specific gravity and percentage composition, but nevertheless the two samples appear to contain the same constituents though in different proportions.

When the oil is treated with metallic sodium in vacuo until there is no further evolution of gas and then distilled, a mixture of two terpenes ($C_{10}H_{16}$) results, the specific gravity of which is 0·8602 at 10° C. When treated with bromine one of these yields a liquid dibromide, the other a solid tetrabromide. The fourth fraction is also obtained in small quantity when the crude oil is distilled under the ordinary pressure. A dark blue oil passes over at 268°, which has a specific gravity of 0·9636 at 22° C., and is lævo-rotatory. This product, when treated with sodium in vacuo and then distilled, yields a sesquiterpene, $C_{15}H_{24}$, which consists of a colourless oil boiling at 256°, and combining with hydrochloric acid to form a hydrochloride, $C_{15}H_{24}.2\,HCl$.

Fractions II. and III., obtained as above, consist of the sulphur-containing constituents of the oil, from which the latter derives its unbearable smell. These products are under investigation.—C. A. K.

The Alkaloids of Belladonna. O. Hesse. Annalen, **261**, 87—107.

This contains a *résumé* of the work done on the belladonna alkaloids followed by results recently obtained by the author, who has discovered a new alkaloid, which he names *atropamine*. This may be obtained from the crude alkaloid extracted from belladonna root by adding common salt to the solution in acetic acid, or when the atropamine is present only in small quantity the atropine is first separated, and the alkaloids from the mother-liquor dissolved in acetic acid, and salt added; atropamine hydrochloride crystallises out, and may be purified by recrystallisation from boiling water. The free base, obtained by agitating the hydrochloride with dilute ammonia and ether and subsequent evaporation of the ethereal solution, forms a colourless varnish-like mass; at about 60° it is a clear colourless, odourless, mobile liquid. It does not lose in weight at 100°, its composition agreeing with the formula $C_{17}H_{21}NO_3$. It dissolves very readily in ether, chloroform, alcohol and benzene, sparingly in light petroleum and water; its alcoholic solution has no rotatory action on polarised light, no action on phenolphthalein paper, but turns red litmus blue. Several of its salts are described. Atropamine differs from the other belladonna alkaloids, atropine, hyoscyamine and hyoscine, in that it has no mydriatic action, and it also differs from apoatropine, in producing a burning sensation and inflammation when dropped into the eye, apoatropine being inactive.

Belladonnine has the same empirical formula, $C_{17}H_{21}NO_3$, as atropamine, and is obtained from the latter by exposing to sunlight atropamine hydrochloride moistened with hydrochloric acid; by evaporating a solution of the sulphate; by dissolving the alkaloid in cold concentrated sulphuric acid; by boiling with baryta-water, hydrochloric acid or dilute sulphuric acid. The best method is to heat atropamine hydrochloride with fairly concentrated hydrochloric acid at 80°. Belladonnine forms a colourless varnish-like substance, is readily soluble in ether, alcohol, chloroform, and benzene, sparingly in light petroleum and in water; it forms salts which are however amorphous.

When atropamine is boiled with baryta-water or moderately concentrated hydrochloric acid, it is first converted into belladonnine, this then undergoing a further change, so that the same decomposition products are obtained from both atropamine and belladonnine. The products isolated by the author are a base, $C_{13}H_{15}NO$, and two *amorphous acids*, $C_9H_{10}O_3$ and $C_9H_8O_2$. The base has been identified by means of its platinochloride and aurochloride, and found to be identical with pseudotropine, and not with tropine as stated by Merling (Ber. **17**, 383). The formation of these products is indicated thus:—

I. $C_{17}H_{21}NO_3 + 2H_2O = C_8H_{15}NO + C_9H_{10}O_3$.
II. $C_{17}H_{21}NO_3 + H_2O = C_8H_{15}NO + C_9H_8O_2$.

When atropamine is heated at 100° with fuming hydrochloric acid a crystalline acid is mainly produced in the place of the above mixed amorphous acids, pseudotropine being also obtained as in the first case. The crystalline acid melted at 107°, and proved to be atropic acid; its formation may be expressed thus:—

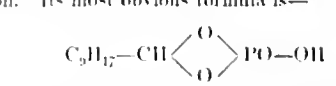
$$C_{17}H_{21}NO_3 + H_2O = C_8H_{15}NO + C_9H_8O_2.$$

Atropamine, like hyoscine, is not a constant constituent of belladonna. It could not be detected in cultivated belladonna, nor in the leaves of the wild plant, whilst the roots of the latter usually contain but traces. In one sample, however, of a root of unknown source a considerable quantity of atropamine was found. Its occurrence appears to be confined to the roots. The cultivated belladonna plant contains solely atropine, which is also obtained in a somewhat less pure condition from the leaves of the wild plant, and in smaller quantity also from the roots. An old belladonna root was found to contain a good deal of hyoscyamine, but no atropine.—A. K. M.

The Indian Grass Oils. F. D. Dodge. Amer. Chem. J. 1890, **12**, 553—564.

Citronellic aldehyde, $C_{10}H_{18}O$, the principal constituent of oil of citronella, is a colourless oil, apparently unaltered by exposure to light or by long standing in a closed vessel, but readily oxidising on exposure to the air (this Journal, **11**, 456). Its specific gravity at 20° C. is 0·8560, and its rotatory power $(\alpha)_D = +4\ 50'$. It has a specific refraction 0·3091, whence the molecular refraction, $Ra = 47·60$, is calculated. The latter agrees with the open chain formula $C_4H_9 - CH = CH - C_5H_6 - COH$, whence the aldehyde appears as a member of the acrolein series—$C_nH_{2n-3}O$. The bromine addition product of the aldehyde decomposes on heating with the formation of cymene; citronellic aldehyde when treated with iodine and the product of the reaction distilled, yields no cymene, but a hydrocarbon boiling at 160° which has not yet been identified.

Phosphoric anhydride acts upon citronellic aldehyde in moist ethereal solution with the formation of a strong acid which contains phosphorus. It is the (COH) group of the aldehyde that appears to take part in this reaction, which only takes place in presence of water. The new acid is a crystalline body, melting near 203°, sparingly soluble in water, readily in alcohol, and with difficulty in ether. It is moderately stable in presence of aqueous acids, but is decomposed by warm alkalis with the formation of an oil which has not been further examined. The sodium, potassium, and ammonium salts of the acid, which is monobasic, are crystalline and readily soluble; the sodium salt is the least soluble of the three. The salts with aniline and with quinoline are also crystalline; the former consists of white needles, melting at 165°. The acid is optically active in solution. Its most obvious formula is—



Attempts to obtain analogous compounds with other aldehydes (cinnamic aldehyde, benzaldehyde, œnanthaldehyde) were unsuccessful.

Lemon Grass Oil, like citronella oil, contains a peculiar aldehyde. The sample examined was a Ceylon oil, which, when redistilled, possessed a light yellow colour and the characteristic odour of the lemon verbena. Its specific gravity at 22° C. was 0·866. The chief fraction of the oil boils at 220°—225° and it reacts with ammoniacal silver nitrate solution, phenylhydrazine, and acetyl chloride just like citronella oil. The action of acid sodium sulphite is peculiar. When an excess of the sulphite is added to the oil, a crystalline molecular compound is first formed, which on standing goes completely into solution. This solution can be concentrated at 100°, when it shows signs of supersaturation, and on being agitated, solidifies to a crystalline mass which contains 52·9 per cent. of water and appears to be a complex acid sulphite. It differs, however, from the generality of these compounds in the fact that the aldehyde is liberated by the addition of alkalis, but not by that of acids. The aldehyde forms a light yellow liquid, boiling with gradual decomposition about 225°; an analysis points to the formula $C_{10}H_{16}O$, hence it is isomeric with camphor. The name *citriodic aldehyde* is proposed for the new body, the physical properties of which the author has not been able to investigate accurately, owing to the product obtained not being sufficiently pure. The bromine addition product of the aldehyde is unstable. Phosphoric anhydride acts upon the aldehyde with the formation of para-methyl propyl-benzene (cymene) in small quantity; concentrated hydrochloric acid acts more readily and yields 50 per cent. of cymene. On reduction with zinc and acetic acid the aldehyde appears to yield an alcohol; on oxidation with dilute potassium permanganate a mixture of acids results in which neither acetic nor valeric acids could be detected.

A portion of the lemon grass oil does not enter into reaction with acid sodium sulphite, and this probably contains a terpene and cymene.

Indian Geranium Oil contains as its chief constituent *geraniol*, $C_{10}H_{18}O$, which on distillation yields a terpene,

geraniene, $C_{10}H_{16}$, an optically inactive body, boiling at 162°—164°, which forms a liquid hydrochloride, but no hydrate. Geraniol readily absorbs hydrochloric acid gas to form geranyl chloride, $C_{10}H_{17}Cl$, a yellow oil of peculiar aromatic odour, which decomposes on heating and does not solidify at − 15°. A sample of Ceylon ginger-grass oil examined gave as the chief fraction a product boiling at 227°—233° which appears to be identical with geraniol.

In view of Semmler's investigations on Indian geranium oil (this Journal, 1890, 889), the author has suspended his experiments on this subject.—C. A. K.

Antipyrine Valerianate. Soehaczewski. L'Union pharmaceutique, 1890, **31**, 516.

Antipyrine valerianate forms white cubical crystals, soluble in water. It has not a specially unpleasant taste; it has a more powerful physiological action than antipyrine. A double valerianate of antipyrine and quinine forms prismatic needles, readily soluble in water and alcohol. It resembles quinine valerianate in taste and smell, and has a very marked action in cases of neuralgia in the head and of intercostal neuralgia. —C. A. K.

Methylal as an Extractive. Chem. Zeit. **14**, 1474.

Methylal possesses the advantages of a low boiling point, and very ready volatility for extracting the odoriferous principles of plants, and has been employed with some success in the case of violets.—C. A. K.

PATENTS.

An Improved Process for Producing Ozonised Oils. F. Pickenbroek, Berlin, Germany. Eng. Pat. 4137, March 17, 1890. 4*d*.

When ozonised oxygen is passed through fat and dry oils, the ozone is absorbed to a large extent, whilst the oxygen escapes. Such ozonised oil possesses greater strength than ozone water, as the oil is a better solvent for ozone, and may be used with greater advantage for cosmetical and technical purposes.—K. E. M.

An Improved Method of and Apparatus for Extracting and Purifying Perfumes, Oils, and other like Substances. H. H. Lake, London. From "La Société Anonyme des Parfumes Naturels de Cannes," Paris, France. Eng. Pat. 5940, April 18, 1890. 1*s*. 3*d*.

This invention relates mainly to mechanical improvements, which are given in detail, and which cannot be adequately described without reference to the drawings.—K. E. M.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

The Sector and Grease Spot Photometers and their Results. F. Hurter and V. C. Driffield.

See pages 98—100.

Relation between Photographic Negatives and their Positives. F. Hurter and V. C. Driffield.

See pages 100—104.

PATENTS.

Improvements in Means or Apparatus for Producing a Flash Light, more especially applicable to Photography. T. H. Redwood, Chingford. Eng. Pat. 401, January 9, 1890. 8*d*.

A flame of alcohol, gas, or other combustible material is allowed to play against a screen of sheet metal or wire gauze, so that it is spread out over a considerable area. A charge of magnesium powder is blown from a tube into the flame, the powder first striking a curved piece of metal, by which it is spread more or less uniformly over the surface of the flame. Under these circumstances combustion is more perfect than in magnesium flash-lamps in which the metal is blown into a flame in a concentrated jet.—C. H. B.

New or Improved Method of and Apparatus for Ascertaining the Requisite Time of Exposure in Photography E. G. Ballard, Chester. Eng. Pat. 669, January 14, 1890. 11*d*.

An instrument for measuring the relative intensity of the photographically active rays reflected from any landscape or other object by observing the time required for the light from a phosphorescent compound to fade from its maximum intensity to the intensity of the light reflected from the object. It consists of an opaque tube with an eye-piece at one end, whilst at the other is a plate of glass, part of which is coated with Balmain's paint, or some similar phosphorescent substance emitting only rays which act upon an ordinary photographic plate. The paint must either be opaque or must be made opaque by means of a backing. Behind this glass is a piece of ground glass, and there may also be a piece of blue glass cutting off from the light reflected from the object all rays except those which act on a photographic plate. The frame carrying these glasses is hinged, so that it can be turned back in order to expose the phosphorescent substance to light. When a measurement is to be made, the frame is turned back, and the phosphorescent surface is exposed to daylight or to the light from burning magnesium, for a time sufficient to excite the maximum luminosity. It is then put back in position, and the apparatus is at once directed towards the object to be photographed. The light reflected from this object passes through the unobstructed portion of the ground glass and blue glass, and at first appears dark as compared with the light from the phosphorescent surface. The brightness of the latter, however, gradually fades, until the two lights are equal in intensity. The time required for this to take place is observed, and with this datum and a series of tables supplied with the instrument, the exposure necessary to obtain a good photograph of the object in question is ascertained.—C. H. B.

A Scarlet Liquid for the Treatment of Negatives in the Art of Photography, by Means of which Liquid Clouds can be made and many other Useful and Artistic Effects produced. H. H. Beale, Reading. Eng. Pat. 16,238, October 13, 1890. 6*d*.

A transparent scarlet solution, which the author calls "non-actinine," and which is used for blocking out skies, strengthening shadows, working in clouds, and otherwise improving photographic negatives. It does not dry very rapidly, and hence lends itself to modification, such as softening off the edges, &c., after it has been applied to the glass. When once dry it withstands the ordinary wear and tear to which a negative is subjected, but can be removed by treatment with water. The preparation is usually applied to the back of the negative, but may also be put on the face of the film, provided that the latter has not been varnished.

375 grains of good gelatin are cut into pieces, and allowed to soak for several hours in 1 pint of pure (not necessarily distilled) water. It is then melted by the application of a gentle heat, and 150 grains of good aniline red, 75 minims of prepared ox-gall, and about 10 drops of creosote are added. When all the materials are thoroughly mixed the liquid is strained and bottled.—C. H. B.

Improvements in Photographic Films. A. J. Boult, London. From G. Eastman, Rochester, U.S.A. Eng. Pat. 19,658, December 2, 1890. 8*d*.

Films composed of nitrocellulose, camphor, and other substances, and coated with gelatinobromide emulsion, bulge and buckle owing to the greater contraction at the edges, a result believed to be due to the evaporation of the solvents. If, however, the film is protected by coating it on both sides with a "sealing coating" of gelatin or similar material, the

contracting and buckling is almost completely prevented. The back sealing coating is preferably of translucent or transparent gelatin made insoluble by the addition of a suitable quantity of chrome alum. The front coating may be of the same kind, but the sensitive gelatinobromide emulsion itself answers the same purpose. One method of preparing the film is to coat a waxed glass plate with gelatin mixed with chrome alum, and when this is dried it is flooded with the solution of nitrocellulose and camphor. As soon as the solvents have evaporated, and the film is dry, it is coated with sensitive gelatinobromide emulsion, dried in the usual way, and stripped from the glass. The film support may be made without camphor, and with substitutes for the nitrocellulose; the gelatin may be replaced by albumen made insoluble in water when dried, and the precise method of coating and stripping the films may be varied.—C. H. B.

XXII.—EXPLOSIVES, MATCHES, Etc.

On the Determination of the Strength of Various High Explosives. W. Walke (Instructor in Charge U.S. Artillery School Laboratory). J. Amer. Chem. Soc. 1890, **12**, 256—274.

The author has compared the action of a number of "high" explosives with that of nitroglycerin on the Quinan pressure-gauge. The apparatus consists of (1) a heavy cast-iron base, into which is let a steel plate flush with its upper surface; (2) a piston of tempered steel, 1 in. in diameter and 5 in. in length (12½ lb. in weight) moving freely up and down between four vertical wrought-iron guides fixed into the iron base at points on a circumference 4 in. in diameter; in the top of the piston is a cavity in which the explosive is placed; (3) a shot of tempered steel 1 in. in diameter, 10 in. in length, weighing 31½ lb., and bored through the axis to receive a capped fuse. In testing an explosive, a cylinder of lead is placed between the piston and the steel plate, the explosive is put into the head of the piston, the shot lowered gently over it, the fuse inserted and fired from the cap. When the charge explodes the shot is thrown out and the lead crushed. Quinan determines the number of foot-pounds necessary to produce different amounts of compression and plots a curve with foot-pounds as abscissæ and compressions as ordinates in order to determine the work done which corresponds to a given compression; he assumes the "strength" of the explosive to be measured by this amount of work. The author was unable to use the instrument in this way, and has only measured the compressions produced. He thinks the results given by the gauge are trustworthy in the case of "high" explosives, *i.e.*, those in which the reaction takes place very rapidly, but it is practically useless for slower explosives.

Lead of a uniform quality was obtained and was made into cylinders 1 in. in diameter, 1 in. in height, and having a mean weight of 115·729 grms., the differences in weight between different cylinders not exceeding 10 to 15 mgrms.

The standard nitroglycerin was made by mixing two parts of HNO_3 (sp. gr. 1·500) with four parts H_2SO_4 (sp. gr. 1·84), cooling and then adding to the mixture with constant agitation 1 part of chemically pure anhydrous glycerin. After total conversion into the nitric ether, the latter was freed from all traces of acid, poured into a glass jar, covered with distilled water and left for six weeks until it became quite transparent and in appearance exactly similar to pure glycerin. The nitroglycerin varies in strength from day to day until this stage is reached, but it then possesses permanent properties.

The weight of explosive taken as the charge was in all cases 24 grains (1·555 grms.). A full record of the mode of preparation of each explosive, and of the separate experiments is given; they are summarised in the following table.

The diminution in the height of the cylinder produced by nitroglycerin being called 100, the ratio of the diminution produced by any other explosive to this diminution is given under the column "Order of Strength."

Name of Explosive.	Diminution in Height of Cylinder, expressed in Inches.	Order of Strength.
1. Explosive gelatin made from nitroglycerin after the Vouges process.	0·585	106·17
2. Hellhoffite	0·585	106·17
3. Nitroglycerin (made Nov. 19, 1889, tested Jan. 6, 1890).	0·551	100·00
4. Nobel's smokeless powder	0·509	92·38
5. Nitroglycerin (made Jan 29, 1890, tested on same day, U.S.N. Torpedo Station process).	0·509	92·38
6. Explosive gelatin (made from nitroglycerin No. 5).	0·490	88·93
7. Gun-cotton (U.S.N. Torpedo Station, 1889).	0·458	83·12
8. Gun-cotton (Stowmarket, 1885)	0·458	83·12
9. Nitroglycerin (made according to the French process and tested on the same day).	0·451	81·85
10. Gun-cotton (made in Artillery School Laboratory).	0·448	81·31
11. Dynamite No. 1	0·448	81·31
12. Dynamite, de Trauzl	0·437	79·37
13. Emmensite	0·429	77·86
14. Amide powder	0·385	69·87
15. Oxonite (picric acid fused before being added).	0·383	69·51
16. Tonite	0·376	68·24
17. Bellite	0·362	65·70
18. Oxonite (picric acid not fused)	0·354	64·24
19. Rack-a-rock	0·340	61·71
20. Atlas powder	0·333	60·43
21. Ammonia dynamite	0·332	60·25
22. Volney's powder, No. 1	0·322	58·44
23. Volney's powder, No. 2	0·294	53·18
24. Melinite	0·280	50·82
25. Silver fulminate	0·277	50·27
26. Mercury fulminate	0·275	49·91
27. Mortar powder, Dupont	0·155	28·13

The author has confirmed his table of orders of strength by actual measurements of the amount of work done by quantities of substance proportional to the number in the third column (details not given). He considers that his experiments dispose of the claims put forward for newly invented explosives, said to be "stronger" than nitroglycerin, though they may be made capable of doing "more mechanical work" by the admixture of some foreign inert ingredient, or change of physical state. He quotes an official report of Professor C. E. Munroe, which points out "that 1 lb. of pure nitroglycerin was found to exert only 81 per cent. of the intensity of action of ¾ lb. absorbed by an inert substance (kieselguhr) which can add nothing to the heat or gases developed."—P. J. H.

New Application for Calcium Plumbate. G. Kassner Chem. Ind. 1890, **13**, 392—393.

Calcium plumbate is recommended as a substitute for lead peroxide in paste for tipping matches, inasmuch as it offers many advantages. Firstly, in it the lead peroxide is more intimately mixed and distributed, and is consequently more active, than in the uncombined state; then the highly basic

character of the lime comes into play, and, promoting combination with the acid products of combustion, reduces objectionable fumes; again, the cementing property of lime is evinced when moistened calcium plumbate is exposed to the air, so that a match paste containing it "sets" to a certain extent of its own accord, and so requires less of, and results in a saving in, the ordinary cementing materials employed. Finally, its cheapness is regarded as the greatest advantage, made as it is with utmost facility by merely heating a mixture of lime and lead oxide in a muffle with free access of air. (See also this Journal, 1890, 187.)

—D. A. L.

The Preparation of Cotton-Waste for the Manufacture of Smokeless Powder. A. Hertzog. Centrbl. f. Textil. Ind. 1890, **21**, 975.

The military authorities require a cotton which, when thrown into water, sinks in two minutes; when nitrated, does not disintegrate; when treated with ether, yields only 0·9 per cent. of fat; and containing only small traces of chlorine, lime, magnesia, iron, sulphuric acid, and phosphoric acid. The waste from the spinning machines and the looms is boiled with soda-lye under pressure, washed, bleached with chlorine, washed, treated with sulphuric or hydrochloric acid, washed, centrifugaled, and then dried. When the cotton is very greasy it is first boiled with lime-water. The loss in these treatments varies largely; for example:—Moisture, 3—15 per cent.; packing and in transit, 2—5 per cent.; boiling and washing, 5—40 per cent.; bleaching, 1·5—20 per cent.—A. L. S.

PATENTS.

Improvements in Percussion Fuses for Explosive Projectiles. A. Martin, Birmingham. Eng. Pat. 18,738, November 22, 1889. 8*d*.

This specification describes a form of fuse in which the striking pin is so held in position in a weighted plunger that it cannot act on the priming. On the gun being fired the plunger slips back over the pin, and then, when the projectile meets an obstacle, the momentum of the plunger carries the striking pin along with it by a special device, and thus the priming is fired. The fuse is fixed to the base of the projectile. Drawings illustrate the arrangements.

—W. M.

Improvements in Treating and Using Explosives whereby the Flame produced is Controlled and Quenched. A. T. Cocking, Rotherham. Eng. Pat. 19,935, December 11, 1889. 6*d*.

Small blocks of a plastic substance formed of 5 parts of water and 1 part of either starch, soap, gelatin, glue, or Irish moss, and a chemical such as oxalic acid or ammonium chloride in sufficient proportion, are placed in the bottom of the bore-hole, and on top of the cartridge; the hole is filled in the usual manner. Or the solution of fire-extinguishing chemicals may be absorbed in an envelope of wool or flannel and the cartridge placed in it, and fired while the composition is in a damp state.—W. M.

Improvements in Percussion Fuses for Explosive Projectiles. A. Martin, Birmingham. Eng. Pat. 19,971, December 11, 1889. 8*d*.

This is an improvement on Eng. Pat. 18,738 of 1889 (see above), the main feature of which is the adaptation of the fuse to the point or head of the projectile instead of the base, a passage being left through the striking pin to afford communication between the priming and the explosive charge.—W. M.

Apparatus for Cutting into Lengths and Delivering Smokeless Explosive or other Plastic Material which has been Moulded through a Die. E. W. Anderson, Erith. Eng. Pat. 20,286, December 17, 1889. 11*d*.

This apparatus, which is preferably fixed to the machine used in pressing out the explosive in the form of rods or cord, consists of an endless belt, suitably supported, on which are attached at proper intervals, according to the length of rods required, narrow knives standing across the width of the belt. The explosive, as it issues from the die, is delivered on to this belt and carried forward. The belt passes between two rollers, or a roller and fixed block so arranged that at this point the rod or cord of explosive is cut, and passing on is removed from the belt.—W. M.

Improvements relating to Machines or Apparatus for the Manufacture of Explosives, and for similar Purposes. H. S. Maxim, Westminster. Eng. Pat. 1951, February 5, 1890. 1*s*. 1*d*.

This invention relates to the manufacture of explosives in grains from, for example, gun-cotton dissolved in acetone, and the object is to carry on manufacture continuously in a machine in which all the operations are effected automatically. The gun-cotton and solvent are introduced into the hopper of the machine, and then pass into a cylinder in which the ingredients are thoroughly mixed by means of knives arranged helically on a shaft; the mass is thus also pressed against the end of the cylinder remote from the hopper and through devices for forming the material into slips and cutting these into grains. Numerous drawings accompany the specification.—W. M.

Improvements in or relating to Lucifer Matches. W. P. Thompson, Liverpool. From J. Hess, Antwerp, Belgium. Eng. Pat. 1995, February 6, 1890. 4*d*.

The invention consists in placing on different parts of the same match the two compositions, which, used in ordinary safety matches, are placed the one on the box, and the other on the match. To strike a light, this improved match is broken in the middle and the two ends rubbed together.

—W. M.

Improvements in the Manufacture of Explosives. J. Y. Johnson, London. From C. Pieper, Berlin, Germany. Eng. Pat. 2547, February 17, 1890. 6*d*.

Nitrocellulose alone or mixed with potassium nitrate camphor, &c., is first gelatinised by kneading with a suitable solvent until the mass has become quite plastic. When this mass is stirred in a warm liquid or vapour which does not act chemically on it, it splits up into grains. The author preferably employs water or steam. The excess of the solvent is removed by boiling the explosive in water or other liquid, and it may be recovered by condensation.

—W. M.

Improvements in Percussion Fuses. H. A. Schlund, Birmingham. Eng. Pat. 2769, February 20, 1890. 6*d*.

"The invention relates to further improvements in percussion fuses of the kind described in the specification of patent No. 112 of 1886 for use with shell torpedoes, and the like, the object of the present invention being to adapt the principle of the fuse described in the said former specification No. 112 of 1886 to fuses that are screwed from the outside into the base of shells, and also to produce more uniform results in the working of the fuse."

For particulars, the original specifications and drawings must be consulted.—W. M.

Improvements in Explosive Shells. H. P. Merriam, New York, U.S.A. Eng. Pat. 10,170, July 1, 1890. 1*s*. 7*d*.

This "invention relates more particularly to mechanical devices whereby the explosive material projected in the shell is detonated instantaneously or at an interval succeeding the initial concussion, according to the nature of the target. In the event of impact upon a solid target the immediate detonation of the explosive charge is provided for; whereas in event of immersion an element of delay in the action of the detonator is allowed, whereby the projectile may become submerged beneath a hostile vessel or other floating object

before exploding." For details the original specification must be consulted. There are twelve sheets of drawings and fifty-five claims.—W. M.

Improvements in Apparatus for Charging Metallic Cartridge Cases with Liquefied Carbonic Acid Gas and in the Construction of such Cartridge Cases. P. Giffard, Paris, France. Eng. Pat. 10,308, July 3, 1890. 8*d*.

This invention has reference to Eng. Pat. 11,050 of 1889, and consists chiefly of apparatus whereby the charging of the cartridge cases with liquid carbonic acid gas can be effected in a very rapid and certain manner. The original specification must be consulted for particulars. It is illustrated by drawings.—W. M.

Improvements relating to Explosive Compounds. J. S. Walter, London. Eng. Pat. 18,519, November 17, 1890. 4*d*.

Picric acid is first melted and then sufficient sawdust or other absorbent added to take up all the melted acid.

This mass is then mixed with more untreated sawdust and a solution of potassium nitrate, and finally flowers of sulphur is added. After thorough mixing and drying the explosive is ready for use. It is stated that 2 oz. of "treated sawdust," prepared as above, contains about 1 oz. 4 drms. of picric acid. The following proportions are recommended:—

	Lb.	Oz.	Drm.
Treated sawdust	0	2	2
Untreated sawdust	0	14	0
Nitrate of Potash	3	12	0
Flowers of sulphur	0	10	0
	5	6	2

—W. M.

XXIII.—ANALYTICAL CHEMISTRY.

APPARATUS.

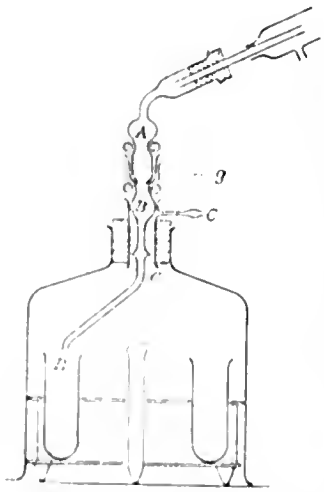
Apparatus for Fractional Distillation under Reduced Pressure. H. Wislicenus. Ber. **23**, 3292—3295.

In connexion with the apparatus it is very convenient to have an arrangement for preventing backflow of water from the pump. Such an arrangement is shown in section in Fig. 1.

Fig. 1.

"Safety Valve for Water-jet Pump."

Fig. 2.



Apparatus for Fractional Distillation under Reduced Pressure.

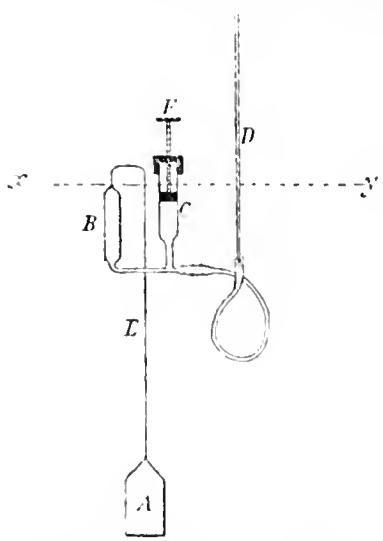
It is of glass and consists of two parts A and B. The lower extended portion *e* of A is pierced in the side with a small hole *o*, covered by means of a piece of rubber tubing cut as shown. A is connected with the vessel to be exhausted, B is fastened by rubber tubing to the pump. When the pump is working A and B are sucked together and the joint is kept air-tight by means of a rubber ring *r*; the air from the vessel undergoing exhaustion escapes easily from *o*, but supposing water to suck back from the pump the connection at *r* immediately gives way, and furthermore the opening *o* is immediately closed by external pressure.

The actual apparatus for the distillation is shown in Fig. 2.

Into the neck of a bell-jar is fitted a rubber stopper, through which passes the suction tube C; fitting into C by means of a rubber ring is the glass tube B, so bent that by merely turning it round its lower end may be brought in turn over the mouths of a number of test tubes arranged in a circle in the bell-jar. Into B fits, by means of another rubber ring, the adapter A, which is attached, as shown, to the condenser of the apparatus. It is advisable to have a rubber tube pushed over the upper wide end of B, and also over A and C.—T. L. B.

A New Form of Air Thermometer for Technical Purposes. A. H. Sabine. J. Amer. Chem. Soc. 1890, **12**, 277—282.

Description.—A Bulb; B Safety chamber for air and mercury; C Cylinder filled with mercury; D Air pressure-gauge; E Capillary tube; F Piston with screw to force mercury from C; *x y* Horizontal line showing constant level of mercury in capillary tube and gauge glass.



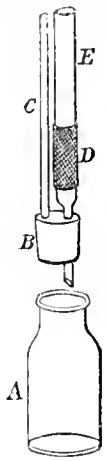
A New Form of Air Thermometer.

The bulb A is a cast-iron vessel of 160 cc. capacity, communicating by the capillary glass tube E with the cylinder B filled with mercury, the piston chamber C, and the compressed air manometer D. The vertical capillary tube is connected to the iron vessel by an asbestos-packed joint. In order to determine the temperature of a chamber, A is introduced into it, the rest of the apparatus, with the exception of the capillary tube, being at the ordinary temperature, and the mercury is brought to a fixed point on the tube E by means of the piston and the moveable air gauge D, which is connected to the rest of the system by a piece of caoutchouc tubing. The mercury in D and in B being at the same height, the pressure in A must be equal to the pressure of the air in the upper part of D, and this pressure is known from the diminution in its volume; its temperature is indicated by means of an internal thermometer. Now, since the pressure of the air is proportional to (273 + T), where T is the temperature in degrees Centigrade, or to (459 + *t*) where *t* is the temperature in degrees Fahrenheit, the volume being constant, we can

calculate the temperature from this pressure approximately, by assuming the volume of A to be constant, and neglecting, in the first instance, the small expansion of the iron. We get a second and nearer approximation by (1) using the first series of numbers obtained to calculate approximately the expansion of the iron vessel, and then (2) allowing for this increase of volume in the calculation of the temperature.
—P. J. H.

Determination of the Solubility of Salts. F. Rüdorff. Zeits. f. angew Chem. 1890, 633—634.

In determinations of the solubility of salts the great difficulty is the filtration of the small sample at the desired temperature. This may be conveniently effected by the apparatus shown in the figure.



The Solubility of Salts.

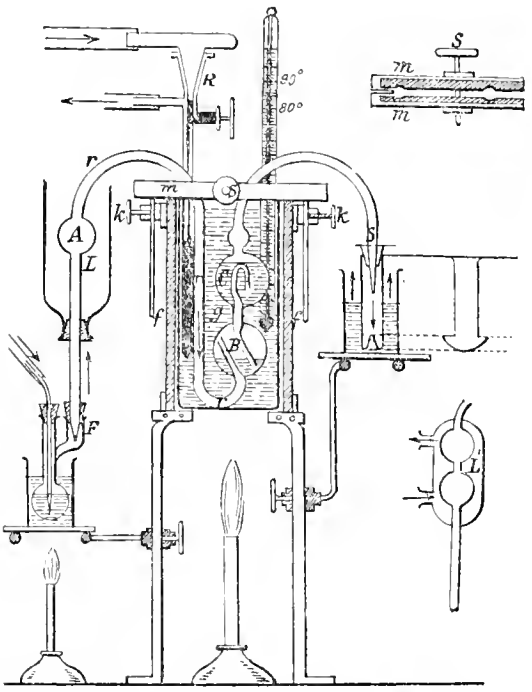
The small bottle A has a height of 4 cm. and is 2 cm. in diameter at the bottom; it is provided with a ground stopper. B is a doubly-bored cork, through one hole of which passes a narrow glass tube C, open at both ends, through the other a small tube, the upper opening of which is covered with a piece of cambric; over this passes a rubber tube D, into which fits the glass rod E.

A standard solution of the salt under examination is made in a wide test tube at a temperature which is higher than the temperature of determination; the test tube, with contents, is then placed in a beaker of warm water, kept warm on a sand-bath. The contents of the test tube cool down to the temperature of the water in the beaker, and then the apparatus above described is used for agitating the solution under examination. A little of the solution is allowed to flow into the rubber tube and so on to the cambric filter by momentarily removing the glass rod. The upper portion of the apparatus is replaced by the ground stopper, and the bottle exterior is freed from adhering solution by means of water. From the weight of the filtered solution in the bottle and the amount of salt in such solution, the solubility is easily ascertained. A series of determinations at different temperatures is very conveniently made with this apparatus.—T. L. B.

New Form of Apparatus for the Determination of Methoxyl (OCH_3). L. Ehmann. Chem. Zeit. **14**, 1767.

This is a modification of the apparatus devised by Benedikt and Grüssner (this Journal, 1890, 735) for the determination of methoxyl, by means of which several determinations can be made at once, and in which the cooling with a current of warm water is dispensed with.

The estimation is carried on in exactly the same way as in the original form of the apparatus. The decomposition takes place in the flask F, to which the absorption bulbs B and C, which are filled with water and red phosphorus, are connected by the bent tube *r*. These bulbs are kept at a constant temperature in the copper water-bath *f*, which can be arranged to accommodate several pairs of bulbs; they are supported by the clamp screw S, and the screws *k*, *k*, which also serve to hold the thermometer and the temperature regulator R. The tube *s* leading from the absorption bulbs is fitted by means of a cork into a second tube widened out at the end, as shown in the Figure, and this latter dips into the silver nitrate solution; the object of this arrangement is to avoid the troublesome cleaning of the tube *s*.



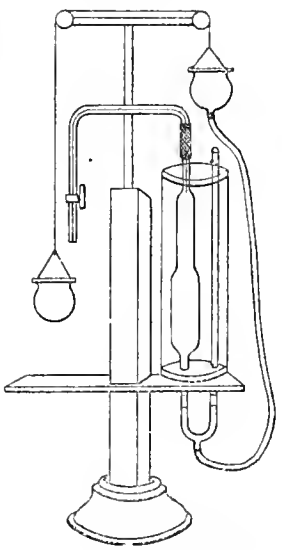
Apparatus for the Determination of Methoxyl.

L′ is a special form of condenser to be placed above the evolution flask F in the case of specially volatile substances.
—C. A. K.

Apparatus for Gas Analysis. J. J. Morgan. English Mechanic and World of Science, October 31, 1890.

J. Parry has arranged an apparatus for analysing producer and other gases. It is a modification of Hempel's apparatus

Fig. 1. Fig. 2.



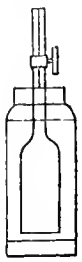
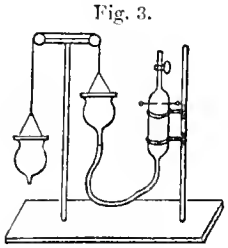


Fig. 3.



Apparatus for Gas Analysis.

(this Journal, 1885, 160), essentially differing from it, as will be readily understood from the accompanying diagram, in that the measuring tube for the gas is surrounded by water. Fig. 1 represents the measuring tube corresponding to Hempel's burette. Fig. 2 represents the absorption apparatus corresponding to Hempel's simple absorption pipette. Fig. 3 represents the apparatus employed in the determination of the hydrogen by explosion similar to Hempel's explosion pipette.—K. E. M.

Wood-Wool Absorption Plates. W. Camerer. Zeits. Anal. Chem. **29**, 576.

Plates for rapidly drying filters or preparations are usually made of earthenware or gypsum. The author has had plates which better serve the purpose intended, made from wood-wool. Sometimes the plates are made with a surface of cellulose which makes a smoother surface. Such plates have been in use for 1½ years, and have remained in good order. They cost from 20—40 pfennige (2½*d.* to 5*d.*) each. —H. S. P.

INORGANIC CHEMISTRY.—QUALITATIVE.

A Simple Test for Tar Products in Ammonia. Bernbeck. Pharm. Zeit. 1890, **35**, 694.

If ammonia containing tarry impurities be carefully poured on the surface of crude nitric acid, an intense eosin colour will be formed at the line of demarcation of the two liquids. —H. T. P.

INORGANIC CHEMISTRY.—QUANTITATIVE.

Estimation of Vanadic Acid in Vanadotungstates. A. Rosenheim. Ber. **23**, 3208—3210.

Rothenbach has stated (Ber. **23**, 3060) that the violet colouration, produced in the reduction of solutions of vanadotungstates containing phosphoric, with sulphurous acid, is not due to the reduction of the tungstic acid existing in solution as phosphotungstic acid; in proof of this statement he quotes the fact that a solution of vanadium tetroxide, from which the sulphurous acid has been completely expelled, gives a violet colouration with phosphotungstates, the cause of which is, he says, according to the author, a partial reduction of the tungstic acid.

The author denies having stated that sulphurous acid reduces tungstic acid, and proceeds to show that the violet colouration produced in the case quoted by Rothenbach is due to the reduction of the tungstic acid by the vanadium tetroxide.

When equal volumes of solutions of phosphotungstic acid of different concentration are treated with equal quantities of a vanadyl solution, a violet colouration is produced in the cold, and the colour, which varies from that of concentrated potassium permanganate to a dull violet grey, is the more intense the larger the quantity of tungstic acid present. When, on the other hand, vanadyl solutions of different concentration are mixed with equal quantities of a solution of phosphotungstic acid, there is no difference in the intensities of the colourations produced.

This reaction between tungstic acid and vanadium tetroxide is without influence on the results when vanadic acid is titrated with potassium permanganate in presence of tungstic acid, because the oxidation of the vanadyl compound is compensated by the reduction of the tungstic acid; the end of the reaction is, however, so difficult to observe owing to the violet colour, that, as Friedheim has shown, the results obtained by different observers may differ by as much as 4 per cent. Friedheim's direct method (Ber. **23**, 353) for the separation of tungstic acid and vanadic acid is, therefore, to be preferred to Gibbs' and the author's indirect process.—F. S. K.

Determination of Nitrogen in Nitrates. A. Süllwald. Chem. Zeit. **14**, 1673.

The author compares Jodlbauer's method with Foerster's method, and concludes that while equally accurate the latter being the simpler of the two is decidedly preferable. Foerster's method consists in dissolving 0·5 grm. of saltpetre in 15 cc. of sulphuric acid containing 6 per cent. of salicylic acid. 5 grms. of sodium thiosulphate are now added, and after the completion of the reaction, mercury and 10 cc. pure sulphuric acid. The following modification of Jodlbauer's method is also described. 0·5 grm. of saltpetre or 1 grm. of the nitrate mixture are moistened with 0·5 cc. of water. 25 cc. of a mixture containing 20 grms. of phenol to 500 grms. of sulphuric acid are now slowly added, and when all is dissolved, 2·5 grms. of zinc powder. After 15 minutes, mercury is added and the mixture heated. To prevent loss of ammonia during distillation the tube of the condenser is allowed to dip under sulphuric acid.—A. R.

Determination of Nitrogen in Nitrates. A. Süllwald. Chem. Zeit. **14**, 1748.

Foerster's method of determining nitrogen in Chili saltpetre has the disadvantage that the latter substance does not readily dissolve in the mixture of salicylic and sulphuric acids. The author prefers to use a modification of Jodlbauer's method (see previous abstract).—A. R.

The Use of the Gooch Crucible as a Silver Voltameter. M. Loeb. J. Amer. Chem. Soc. 1890, **12**, 300—301.

In order to avoid loss of silver by the washing of the deposit in a voltameter, the author uses a modification of the Gooch crucible. A rather tall and narrow platinum crucible perforated at the bottom is fitted into a glass cup terminating in a syphon. The two are united by a piece of rubber tubing which should be freed from sulphur, although there is no real danger of contact with the silver solution. The apparatus is filled with silver nitrate solution, so that the top of the syphon is not quite reached, and is then set upon the stand. The crucible rests in a well-fitting brass block to which the negative wire is attached. The anode consists of a silver cone suspended within the crucible by means of a silver wire attached to a horizontal bar insulated from the cast-iron base.

When the electrolysis is complete, the residual nitrate of silver can be entirely removed, without in any way disturbing the deposit, by filling up the crucible with hot water several times. The crucible is then detached from the syphon, dried and weighed.—P. J. H.

ORGANIC CHEMISTRY.—QUALITATIVE.

Note on Schiff's Reaction. O. F. Müller. Zeits. f. angew. Chem. 1890, 634—636.

Some red lakes made from magenta turn violet; the author has, therefore, been led to study the action of certain resins and their solvents on magenta solution decolourised by sulphur dioxide. Different kinds of shellac, gum damar, gum benzoin, and various kinds of turpentine gave violet to reddish-violet colourations. Methyl alcohol gives a violet colouration, gradually increasing in intensity for some time; on quickly boiling the violet is changed to magenta, which on standing again becomes violet; excess of sulphur dioxide decolourises the solution. Ethyl alcohol gives a reddish violet colouration; on quickly boiling it becomes of a magenta colour, and on cooling only slight change takes place; excess of sulphur dioxide bleaches the solution. Amyl alcohol gives only a faint reddish violet. Glycerin gives no reaction. Aldehyde shows a reddish violet, turning darker violet with a blue shade. Acetone produces slowly a reddish violet. Oleic acid and lanolin give violet colourations; gum arabic no colouration whatever.

Excess of sulphur dioxide has no effect on the resin lakes, neither are these affected by heat. On addition of dilute

acids to a solution or emulsion of the resins in borax solution, first the resin lake is precipitated, then the excess of resin. On addition of hydrochloric acid the violet colouration turns to blue and green, and finally the whole becomes colourless; neutralisation with ammonia brings back the original colouration.

Methyl violet R and B give similar reactions to magenta.

Ethyl violet gives no reaction with methyl and ethyl alcohol, and only a faint reaction with aldehyde and acetone. —T. L. B.

Detection of Vegetable-wax in Beeswax. H. Röttger. Chem. Zeit. **14**, 1473—1474. (See this Journal, 1890, 83 and 771.)

The author considers that Hager's method for the detection of Japan wax in beeswax by means of the specific gravity unreliable. Hager's second method is to dissolve 0·5 grm. of borax in a test tube in 6—8 cc. of water, 0·3—0·4 grm. of the wax are then added, the mixture boiled and allowed to stand, when the wax, if pure, solidifies and floats above the clear liquid. In presence of impurities the whole remains turbid and thick, (Chem. Zeit. **14**, 606). The results of experiments made with this method by the author is that with pure wax an emulsion is always formed between the wax and clear borax solution, and that in the presence of Japan wax, stearic acid and resin the test is not very reliable because the separation of the whole into layers, after heating, lacks sharpness. With 5 per cent. of either stearic acid or resin no solid layer separates and the whole forms a thick emulsion. For the detection of small quantities of Japan wax or of talc, the method is untrustworthy; in presence of 10 per cent. of the former the whole of the liquid below the crust of solid wax appears as a thick emulsion, which only begins to clear after a few days.

The method recommended by a Commission of the German Society of Apothecaries (Arch. Pharm. **24**, 490) is to boil 1 grm. of the wax with 10 cc. of water and 3 grms. of sodium carbonate for a quarter of an hour and allow to cool, when the wax separates as a crust and the underlying solution remains only slightly cloudy in the case of pure wax. But in presence of impurities an emulsion is formed beneath the crust of wax. The results of the author's experiments by this method show that 2 per cent. of Japan wax, stearic acid or resin can be recognised in beeswax by the abnormal character of the emulsion formed, whilst in the case of an admixture of talc the test is less delicate, only 5 per cent. being recognisable.—C. A. K.

Examination of Glycerin according to the New German Pharmacopœia. B. Jaffé. Chem. Zeit. **14**, 1493.

The new Pharmacopœia describes a method of testing glycerin by means of ammoniacal silver solution. This has given rise to considerable discussion, both as to its value and the way in which the test is to be carried out.

Glycerins which have been merely decolourised, and not distilled, stand the test, and such glycerins contain almost all the impurities of crude glycerin. Furthermore, refined glycerin with several per cent. of arsenious acid subsequently added likewise stood the test. Only such products may be detected, therefore, as are produced by the distillation of glycerin, viz., formic acid, acrolein. And yet even several per cent. of formic acid may be present without any reduction of silver solution being shown in presence of excess of ammonia. Small quantities of acrolein may be detected by the smell, and yet it cannot be assumed that odourless glycerins contain merely negligible quantities of acrolein. With regard to the manner of carrying out the test the author asserts his absolute inability to obtain constant results.—T. L. B.

Food Examination. J. Pinette. Chem. Zeit. **14**, 1570—1571.

Detection of Salicylic Acid in Beer.—To 50 cc. of beer in a separating funnel are added 5 cc. of alcohol (to promote separation of the extracting liquid), 5 cc. of sulphuric acid (1 in 10) and 50 cc. of a mixture of equal volumes of ether and petroleum spirit, and the whole is thoroughly shaken. The ethereal extract is distilled to a small bulk, and the residue is shaken up with a few centimetres of water and a few drops of a weak ferric chloride solution. In presence of salicylic acid, the aqueous layer assumes a splendid violet colouration.

Butter may be rapidly analysed as follows:—A small weighing bottle containing a glass rod has about 5 grms. of butter weighed into it. About 2 grms. of it are transferred to a separator of 230 cc. capacity and graduated up to 200 cc. The remainder of the butter in the weighing-bottle is dried at 100° C.; loss of weight represents water. In order to facilitate the expulsion of the moisture, small quantities of alcohol are occasionally added, and the butter is well stirred.

100 cc. of a mixture of equal volumes of ether and petroleum spirit are placed in the separator and shaken about until the butter is dissolved. Then add 20 cc. of alcohol and sufficient water to make the liquid nearly up to the top graduation. The stopper is next inserted and tied down with string, and the separator is thoroughly shaken until on resting for a moment the top layer begins to separate clear. The mixture is then allowed to stand for some time and the volume of the different layers is noted. An aliquot portion of the ethereal layer is evaporated to dryness, and the residue, consisting of butter fat, is weighed. A portion of the aqueous layer is titrated for chlorine with silver nitrate, using potassium chromate as an indicator, the chlorine found being calculated into salt. The ash, other than salt, is always assumed to be 0·2 per cent. Then, 100, less the sum of fat, water, salt, and 0·2 represents organic matter, not fat. If the butter be rancid, the acidity may be estimated by dissolving the residue from the determination of butter fat in a mixture of alcohol and ether (1 : 2), adding some phenolphthalein, and titrating the solution with decinormal sodium hydrate.—H. T. P.

Pyrrol, a Reagent for Aldehydes. Lepidine, $C_{10}H_9N$, a Reagent for Wood, and for a Series of Ethereal Oils. A. Ihl. Chem. Zeit. **14**, 1571.

An alcoholic solution of pyrrol is, in presence of hydrochloric acid, the most delicate of all the known tests for lignin; in fact, it is a test for all aldehydes.

Wood, moistened with an alcoholic solution of lepidine, and then with hydrochloric acid, is stained a bright red. Ethereal oils containing a derivative of allyl benzene give similar reactions. Oil of cinnamon, treated with an alcoholic solution of lepidine and with hydrochloric acid, gives a splendid bright red colour. The oils of pimento and cloves yield a yellow precipitate, which rapidly turns intensely red. Sassafras oil also forms a yellowish precipitate, turning red. Estragon oil yields a white precipitate, which quickly changes to a bright vermilion hue. Fennel and anise seed oils only give a yellowish colouration. Pyrrol gives similar reactions to the above, but is considerably more sensitive than lepidine. (See also this Journal, 1887, 306; 1888, 51; 1889, 421, 640, 914, and 1012; 1890, 418, 555, and 770.)—H. T. P.

A New Reagent for Vanilline. Thiophen, a Reagent for the Substances forming the Incrustation of Wood. A. Ihl. Chem. Zeit. **14**, 1707.

Alcoholic solutions of vanilline mixed with a little thiophen and concentrated sulphuric acid are coloured green to bluish-green.

The author has likewise found that when wood is moistened with a mixture of 1—2 drops of thiophen and about 10 times the quantity of alcohol mixed with an equal volume of sulphuric acid added, the wood is gradually coloured green.—A. R.

A Test for Resorcinol and for Thymol. H. Borntrager. Zeits. Anal. Chem. **23**, 572—573.

Resorcinol and thymol both give a red colour when warmed with nitrous acid, the former giving a blood red colour and the latter a yellow-red. The coloured solution is clear in the case of resorcinol, both in aqueous and alcoholic solutions, but in the case of thymol the alcoholic solution is clear, whilst the aqueous solution yields a flocculent yellow-red precipitate. In the case of thymol also the extremely characteristic fruity odour of thymol nitrite is observed. To further distinguish them, a mixture in about equal proportions of a salt of nitrous acid, gypsum, and sodium bisulphate is put into a test tube, moistened with water, and the liquid to be tested is then added, and the whole warmed. If thymol be present, the mixture becomes chrome-red, if resorcinol be present it turns a dark chrome-green colour, and magenta-red drops collect on the upper part of the test tube.—H. S. P.

ORGANIC CHEMISTRY.—QUANTITATIVE.

On the Indices of Refraction of Fatty, Mineral, and Resin Oils. Holde. Mitt. Konig. tech. Versuchs. 1890, 269—270.

The indices of refraction are stated to be of analytical value for the determination of different oils (see Amagat's and Jean's experiments in Schaedler's Untersuch. d. Fette u. Oele, 1890, 78). The following average results which the author obtained with Abbé's refractometer, seem to confirm this. The temperature of the testing room was always about 20° C.

	Refined Rape Oil.	Crude Rape Oil.	Olive Oil.	Mineral Oil.	Resin Oil.
Limits of indices of refraction.	1·4732 and 1·4756	1·4735 and 1·4760	1·4670 and 1·4705	1·4776 and 1·4980	1·5274 and 1·5415
Mean index of refraction	1·4735	1·4744	1·4698	1·4923	1·5344

It is hoped that this test may be useful, especially for detecting the presence of rape oil in olive oil to which it is frequently added as adulteration.—H. S.

On the Methods in use for the Quantitative Estimation of Acetone. F. Collischoun. Zeits. Anal. Chem. **29**, 562—572.

Practically the only two methods in use are Kramer's gravimetric method (Ber. **13**, 1000) and Messinger's volumetric method (Ber. **21**, 3366; this Journal, 1889, 138). Kramer's method has been repeatedly investigated and the sources of error pointed out by various chemists, among others by Huntz (Zeits. Anal. Chem. **27**, 182; this Journal, 1888, 459), and more recently by Vignon (Compt. Rend. **110**, 534; this Journal, 1890, 659).

The author recommends Messinger's volumetric method in preference to Kramer's, and finds it for all practical purposes quite as reliable and more simple, and an estimation can be made in five minutes by it, whilst Kramer's process requires from one to two hours. In spite of these advantages the author thinks that the volumetric method has not met with general adoption, and probably because the results obtained have not been consistent. The degree of dilution of the acetone solution is generally supposed to have an important bearing upon the result, but he has not found this to be the case. He obtains the same results when the acetone is diluted in the ratio 1:10 up to 1:500. Dilution merely retards the reaction. He recommends, however, that a $\frac{1}{2}$ or 1 per cent. solution be used. With a high percentage acetone it is only necessary to dilute 10 cc. to 1 litre, and take 5—10 cc. of this for analysis. In measuring the solutions the temperature must be observed, owing to the considerable change in the specific gravity of acetone caused by changes of temperature. Messinger's method is applicable to commercial acetones, to methylated spirit, methyl alcohol, crude acetones, and to testing unfinished products during manufacture. It depends (as well as Krämer's method) upon the reactions expressed in the equation—

$$(CH_3)_2CO + 6\,I + 4\,KOH = CHI_3 + 3\,KI + C_2H_3O_2K + 3\,H_2O.$$

When an excess of iodine solution is added to a solution of acetone mixed with a solution of potassium hydrate, 6 atoms of iodine react with 1 molecule of acetone and form 1 molecule of iodoform, and the iodine in excess forms potassium iodide and potassium hypoiodite, which splits up into potassium iodide and potassium iodate. On acidulating the solution the two latter compounds are decomposed, and iodine is liberated, which can then be titrated. The original quantity of iodine added being known the amount that has been combined to form iodoform is easily calculated, and from this the percentage of acetone present in the solution determined. Messinger describes his mode of procedure as follows:—From 20 to 30 cc. of a solution of potassium hydrate (56 grms. KOH in 1 litre H_2O) are introduced into a 250 cc. flask which has a well-fitting ground stopper, 1—2 cc. of methyl alcohol (or a suitable quantity of diluted acetone) added, and the mixture well shaken. A measured volume of one-fifth normal solution of iodine is added and shaken up for $\frac{1}{4}$—$\frac{1}{2}$ minute, until the solution becomes clear. The mixture is then acidulated with hydrochloric acid (1·025 sp. gr.) an excess of decinormal sodium thiosulphate solution added, and the excess determined by titration with iodine solution using starch as indicator. The caustic alkali should be free from nitrite, or the quantity of this determined.

The author finds that sodium hydrate and sulphuric acid may be substituted for potassium hydrate and hydrochloric acid. He also lays stress on the two following points: 1. If, after the addition of the iodine solution the reaction, owing to lowness of temperature, be not completed in the time mentioned by Messinger, viz., $\frac{1}{4}$—$\frac{1}{2}$ minute, the mixture must be energetically shaken for four or five minutes, or, instead of shaking so long, the reaction may be accelerated by shaking the flask for two minutes in water at 60°—70° C., but the temperature must not be raised above 70°. At 80° some iodate begins to be reduced, and in testing methyl alcohol, or when this body is present, the solution, to avoid reduction of iodate, should on no account be warmed. 2. The mixture of acetone and caustic alkali must be continuously shaken during the addition of the iodine solution, and the latter must be added slowly and in sufficient excess. The author finds that an excess of one quarter of the theoretical amount is sufficient. He shows by experiment that the splitting up of the potassium hypo-iodite into iodate and iodide takes place very rapidly, and that in a mixture of 20 cc. of one-fifth normal iodine solution, and 30 cc. sodium hydrate solution, after two minutes, about 75 per cent. of the hypo-iodite will have split up into iodate and iodide:—

$$2\,I + 2\,NaOH = IONa + INa + H_2O$$
$$3\,IONa = IO_3Na + 2\,INa$$

On this account it is necessary, in order to avoid the need of adding a large excess of iodine, to shake the mixture vigorously during the addition of the iodine, so as to bring the acetone at once in contact with the hypo-iodite formed, and so that the reaction may follow the line expressed by the equation—

$$3\,IONa + (CH_3)_2CO + H_2O = CHI_3 + CH_3CO_2Na + 2\,NaOH.$$

It is not possible to do this completely, and for this reason it is necessary to add at least seven atoms of iodine instead of six to each molecule of acetone. If the precaution of thoroughly mixing is not observed, the proportion of iodine must be increased. The author points out that the method cannot give absolutely correct results, because it

does not actually determine acetone alone, but at the same time all other substances present that are capable of forming iodoform. We have as yet no method by which to determine the acetone alone.—H. S. P.

The Examination of Brewers' Pitch. Z. v. Milkowski Zeits. Anal. Chem. **29**, 573—576.

From 0·5 grm. to 1 grm. of the pitch is saponified with alcoholic potash, the solution evaporated to dryness, and the residue taken up with water. The dissolved soap is then treated with ether, either in a separating funnel or in the extracting apparatus shown in Fig. 1. The part soluble in ether is the "neutral resin"; it is dried and weighed on a weighed watch-glass. The soap is then treated with dilute hydrochloric acid either in the separating funnel or in the extracting apparatus. Resin and fatty acids separate out in a flocculent precipitate, and are dissolved out or extracted with ether and well washed with water. The ethereal solution is then evaporated to dryness and the residue dried at 100° and weighed. The residue is then dissolved in from 15 to 20 cc. of alcohol, potassium hydrate solution added until the solution is alkaline, evaporated to a volume of 5 cc., taken up with water and the resin and fatty acids precipitated with a silver salt. The precipitate is filtered off, dried at 100°, and extracted with ether in Soxhlet's apparatus; or the aqueous solution may be precipitated in the flask B of the extracting apparatus, Fig. 1, and extracted directly with ether. The resin and

Fig. 1.

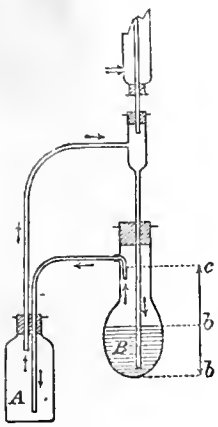
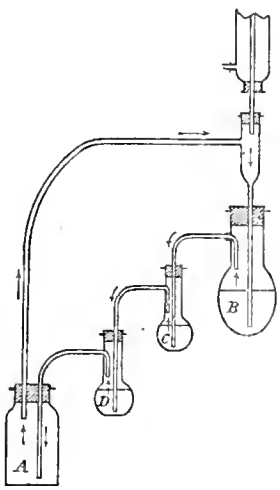


Fig. 2.



The Examination of Brewers' Pitch.

traces of silver go into solution. In the first mode of working, the silver is precipitated by hydrochloric acid and filtered, and the ethereal solution of the resin collected in a dried glass, the ether evaporated, and the residue of resin dried and weighed. When the extracting apparatus is used, a flask containing dilute hydrochloric acid and a flask containing water are inserted. The ethereal solution of resin is thus obtained free from silver and from acid, and is dried at 100° and weighed. The silver salts of the fatty acids are then decomposed with hydrochloric acid, the liberated acids taken up with ether, dried, and weighed. The kind of fat may be determined by aid of the saponification numbers. These methods may be carried out by using separating funnels, but the apparatus shown in Fig. 2 is much more convenient and more exact. The apparatus is a modification of that of Schwarz (Zeits. Anal. Chem. **23**, 368; this Journal, 1884, 648). The flask A holds the extracting liquid; flask B, the solution to be extracted; C and D are washing flasks, C containing diluted hydrochloric acid and D distilled water.

Below are the average results obtained from several analyses of pitch using separating funnels in one set of determinations and the extracting apparatus in another:—

	Separating Funnel.	Extracting Apparatus.
	Per Cent.	Per Cent.
Natural resin	11·23	11·52
Resin	74·28	74·86
Fatty oil	13·05	13·42

—H. S. P.

The Analysis of Crude Tartar and Wine Lees. B. Phillips and Co. Zeits. Anal. Chem. **29**, 577—579.

To estimate the acid potassium tartrate in tartar and wine lees, the authors recommend the following method as being simple and sufficiently accurate. 10 grms. of the tartar or yeast are boiled with 150 cc. of water, and the solution neutralised exactly with sodium or potassium hydrate. All the potassium bitartrate goes into solution, leaving the calcium tartrate undissolved. The whole is then afterwards treated according to the improved process of Goldenberg, Geromont, and Co., that is to say, the whole of the solution together with the insoluble lime salt is put into a 200 cc. flask, the flask filled to the mark (in the case of lees, to 203 cc.), and from 100 cc. of this solution the potassium bitartrate is precipitated. Since the solution contains no potassium carbonate, only 3 cc. of glacial acetic acid are added instead of 5 cc., as in Goldenberg and Co.'s method. The result obtained by this method gives the amount of acid potassium tartrate, whilst the difference between this amount and the total tartaric acid found by Goldenberg, Geromont, and Co.'s method, gives the quantity of calcium tartrate in its equivalent of acid potassium tartrate.

Note by R. Fresenius.

The improved method of Goldenberg, Geromont, and Co. is founded upon the work of F. Gantter (Zeits. Anal. Chem. **26**, 714) and N. v. Lorenz (Zeits. Anal. Chem. **27**, 8; this Journal, 1888, 136), and upon many experiments in Fresenius' laboratory bearing upon the original method of Goldenberg, Geromont, and Co. (Zeits. Anal. Chem. **22**, 270). 10 grms. of tartar or yeast are boiled with 150 cc. water and 7 grms. potassium carbonate for 30 minutes, during which time the solution is repeatedly stirred. The whole is then transferred to a 200 cc. flask and made up to this volume, or to 203 cc. in the case of the yeast, to allow for the volume of water displaced by the undissolved residue. The solution is then filtered on a dry filter and 100 cc. evaporated down to a volume of about 25 cc. in a dish; 5 cc. of glacial acetic acid are then added and the covered dish is warmed on the water-bath for 15 minutes. After cooling, 100 cc. of absolute alcohol are added, the solution well stirred and the precipitate, after the lapse of about 15 minutes, filtered off on a filter of 10 cm. diameter, using the filter pump. The precipitate is then washed with 96 per cent. alcohol until 20 cc. of the washings diluted with an equal volume of water show an alkaline reaction on the addition of three drops of one-fifth normal caustic potash solution. The filter and precipitate are then returned to the dish, about 200 cc. of water added, boiled, and titrated with semi-normal caustic solution, using sensitive neutral litmus paper as indicator. When the solution just shows a feebly acid reaction, it is again boiled a short time and then rapidly titrated to a finish. The caustic solution must be standardised with chemically pure tartaric acid, dried at 100°, using the same kind of litmus paper as indicator.—H. S. P.

Sugar Estimation with Fehling's Solution. Baumann. Zeits. f. Zuckerind. 1890, **40**, 778.

Some of the best filter papers allow considerable quantities of cuprous oxide to run through, even when no pump is used; absorption of copper also takes place. It would seem, therefore, safer to return to the asbestos filter. The recognised tables used with the sugar method have with certain abnormal products given somewhat unexpected results, and the copper obtained by three minutes' boiling was lower by 1—2 mgrms. than that obtained by two minutes' boiling. Repetition proves the results after three minutes to be correct. The recalculated tables are as follows:—

Copper.	Cane Sugar.	Copper.	Cane Sugar.
Mgrms.	Mgrms.	Mgrms.	Mgrms.
80	40·5	180	91·0
90	45·4	190	96·2
100	50·3	200	101·4
110	55·3	210	106·7
120	60·2	220	112·2
130	65·3	230	117·5
140	70·4	240	122·9
150	75·5	250	128·4
160	80·6	260	133·9
170	85·7		

—T. L. B.

A Contribution to the Prevention of Coal-dust Explosions. Meissner. Zeits. f. Berg.-, Hütten-, und Salinenw, 1890, **38**, 358.

The best method for destroying the dangerous qualities of coal-dust in mines is by moistening it and then removing it as soon as possible. In cases where the dust occurs in the strata, having been formed by the pressure of the earth or other causes, one or more bore-holes may be made into the coal and water forced into these under considerable pressure for some hours. The result is said to be satisfactory.

—A. L. S.

New Books.

Chemisch-technisches Repertorium. Uebersichtlich geordnete Mittheilungen der neuesten Erfindungen, Fortschritte und Verbesserungen auf dem Gebiete der technischen und industriellen Chemie mit Hinweis auf Maschinen, Apparate und Literatur. Herausgegeben von Dr. Emil Jacobsen. 1889. Zweites Halbjahr: Zweite Hälfte (Schluss des Jahrganges). Berlin: R. Gaertner's Verlagsbuchhandlung. Hermann Heyfelder. Schoenebergerstrasse, 26, S.W. London: H. Grevel and Co., 33, King Street, Covent Garden.

This part of Jacobsen's Repertorium of Chemical Technology contains all the literature, patented improvements, &c., of note occurring during the second half year of 1889 in connexion with the following branches:—Food-stuffs; Paper; Photography, &c.; Waste Residues, Deposits, Manures; Disinfection and Sanitation. Soap; Explosives, Matches; Preparation and Purification of Chemicals; Chemical Analysis; Apparatus, Machinery, Electro-technology, Technology of Heat; Appendix. Adulteration of Trade Products, &c. The Annual Report concludes with Reviews of New Books, and the Alphabetical Index.

Schbuch der Organischen Chemie, von Victor Meyer und Paul Jacobson. In Zwei Bänden. Erster Band, Erste Halfte. Mit Zahlreichen Holzstichen im Text. Leipzig: Verlag von Veit and Comp. London: H. Grevel and Co., 33, King Street, Covent Garden. 1891.

This, the first half of the first volume, has now appeared. It takes the form of a somewhat large 8vo. volume, price 7*s.* 6*d.* In this part are comprised the following:—The Introduction. Chap. I. Determination of the Empirical Composition of Organic Compounds. Chap. II. Determination of the Rational Composition of Organic Compounds. Chap. III. Principles permitting of a Classification of Organic Compounds. Chap. IV. The Commonest Operations which serve for the Preparation and Investigation of Organic Compounds. (This chapter is profusely illustrated with figures representing all the necessary forms of apparatus.)

Now follows a Special Part: First Book. Compounds of the Fatty Series. Chap. I. The Paraffins. II. The Monovalent Alcohols. III. Alkyl Compounds, of which the Alkyl Group is combined with a Halogen atom or with Oxygen. IV. Alkyl Compounds, the Alkyl Group of which is combined with Sulphur (Selenium or Tellurium). V. Alkyl Compounds, the Alkyl Residue of which is united to Nitrogen. VI. Compounds of Alkyl Groups with the remaining Metalloids. VII. Compounds of Alkyl Groups with the Metals. VIII. Conversion into Carbonic Acids, Aldehydes and Ketones. The Alkyl Cyanides or Nitriles of the Fatty Acids. IX. Saturated Monobasic Carbonic Acids or Fatty Acids.

Trade Report.

TARIFF CHANGES AND CUSTOMS REGULATIONS.

Switzerland.

Customs Decisions.

Note.—Quintal = 220·4 lb. avoirdupois. Franc = $9\frac{6}{10}d$.

Soaps for metal cleaning are removed from Category 9. Mineral soaps (soaps containing mineral substances).—Category 264. Duty, 1 fr. 50 c. per quintal.

United States.

Customs Decisions.

So-called binitro toluole is dutiable at the rate of 25 per cent. *ad valorem* under paragraph 92 of the Tariff Act of March 3rd, 1883.

So-called naphthol sulpho acid is dutiable at the rate of 25 per cent. *ad valorem.*

Marking, Stamping, Branding, &c. of Imported Goods and Packages under Section 6 of the Act of October 1st, 1890.

(See *Board of Trade Journal* for February, p. 150.)

CUSTOMS TARIFF OF NICARAGUA—*concluded.*

Note.—Peso = 2*s.* 10*d.* (about).

Articles,	Rates of Duty per English Pound.
	Pes. Cts.
White wax, pure or mixed, not manufactured	0·15
Do., in candles.....	0·20
Do., manufactured in articles not specially mentioned.	0·25
Beer	0·02
Glues of any kind.....	0·06
Colours of all kinds not specified.....	0·04
Do. do., in tinctures.....	0·15
Glass, common, in sheets, plain and clear.....	0·02
Do., in sheets, ground, white, or coloured.....	0·04
Do., manufactured in articles of any kind	0·05
Paper collars and cuffs.....	0·10
Celluloid collars and cuffs.....	0·60
Emery, solid or in powder.....	0·03
Water filters of any kind.....	0·02
Matches of all kinds	0·04
Fireworks of any kind	0·15
Percussion caps for firearms	0·20
Cochineal.....	0·25
Grease of any kind not specially mentioned.....	0·05
Soap, common	0·02
Do., superior toilet, perfumed.....	0·10
Sealing wax.....	0·15
Ochre and other earths, for paint	0·04
Paper, cardboard, &c. of common quality.....	0·02
Papers of all kinds, not specified, including blotting.	0·04
Wall paper and ornamental paper	0·12
Perfumery, such as oils, soaps, and powders.....	0·10
Parchment and its imitations.....	0·15
Hides, unmanufactured	0·30
Paint, in powder, paste, or oil.....	0·04
Gunpowder for mining (by special permission of Government only).	0·40
Gunpowder of other kinds.....	Prohibited
Tallow, raw	0·02
Do. candles.....	0·05
Oil cloth and floor cloth, and American cloth.....	0·10
Ink of all kinds.....	0·02
Candles, sperm, paraffin or stearine	0·05
Plaster of Paris, solid or in powder.....	0·01

Articles free of duty :—

Manure for agricultural use. Stills for distilling, by special permission of Government. Asphalt, mercury for mines, lime and cement, coal and animal charcoal, crucibles, dynamite for mines by special permission of Government only, and chemical apparatus.

Prohibited articles :—

Stills for distilling alcohol ; dynamite, and gunpowder.

EXTRACTS FROM DIPLOMATIC AND CONSULAR REPORTS.

BRITISH TRADE WITH CHILI.

The following table shows that Germany and Belgium get the bulk of the printing paper trade, yet manufacturers' prices in the different countries are almost identical. The small item from the United States was an experiment which resulted in a dead loss, owing to the difference of freights. The German steamers from Hamburg often carry paper as ballast at nominal rates.

Printing Paper Imported in 1888.

——	Subject to 25 per Cent. Duty.	Free for Newspapers.
	Kilos.	Kilos.
France.....	15,220	60,904
Great Britain.....	55,138	48,539
Germany	82,490	924,048
Belgium.....	3,774	118,865
Italy.....	14,327	13,118
United States.....	3,069	457
	172,018	1,165,931

—*Board of Trade Journal.*

THE MINES OF HUELVA.

The United States Consular Agent at Huelva, in a report upon the mines in that province, says :—

The great copper zone which traverses the province of Huelva extends from Castilla de las Guardas, 40 kilometres west-north-west of Seville, to Ajustel, in Portugal, a distance of more than 200 kilometres, with an average width of 25 kilometres.

In this zone, among others less important, are found the mines of Rio Tinto, Tharsis, La Zarza, Sotiel-Coronada, Lagumza, Peña de Hierro, La Joya, Poderosa, &c., all having great analogy in their ores, which are found in great masses and at little distance from the surface, at which point they generally terminate in immense crests of oxide of iron.

The amount of copper in these ores is very variable, but the great proportion may be taken at 2 to 3 per cent., a poverty of metal which is only compensated by the abundance of ore and the method of extraction and treatment.

This great metalliferous zone, which occupies about 2,000 square kilometres, is tapped to the port of Huelva by three lines of railway—the Rio Tinto railway, the Tharsis, and the Bintron to San Juan del Puerto. The two last are also open to public service. In the more westerly part of the province another railway, elevated for half its length, carries ore to the River Guadiana.

The general characteristics of the ore are :—Sulphur, 50 to 51 per cent. ; iron, 40 to 41 per cent. ; silicate, 4 to 5 per cent. ; copper, 1 to 3 per cent., with variable insignificant quantities of gold, arsenic, silver, antimony, and other metals. The so-called rich ore, with 2 to 3 per cent. of copper, is exported, and the poor, of about 12 per cent., is treated by open air calcination. The amount shipped is about 700,000 tons yearly.

The mines of this province were worked by the Phœnicians and the Romans, neglected by the Moors, and nearly so by the Spaniards until the middle of the last century, when the attention of the Government was seriously directed towards them. But the immense deposits only began to yield a fair part of their treasures when, 25 years ago, foreign companies bought up the great mines and began to develop them. In 1866—67 the number of steamers which loaded ore in this port was 38, with 11,514 tons, while in 1889—90 the number was 727, with 520,494 tons. In 1866 the Custom house collected 315,000 pesetas, and in 1886 about 4,000,000 pesetas.

The capital invested by the different mining companies is 254,560,288 pesetas. They pay in taxes to the public treasury 1,749,624 pesetas annually; in wages, 20,763,125 pesetas; and buy stores in this country for about 8,250,000 pesetas yearly. The number of men employed is from 17,000 to 18,000.

Besides the copper mines, there are a great many small workings of manganese, of which about 8,000 tons were shipped in 1889—90. The principal mines are near Valverde del Camino. Near Aracena ore containing antimony and silver is worked to a small extent and sent down to Seville.

There is gold in the quartz rocks and streams, but it has not been found in any workable quantity.—*Ibid.*

Salt in Germany.

The latest monthly statistical report of the German Empire publishes, under the title "Salt in the German Customs District," information in regard to the production and consumption, the taxation, importation and exportation for the fiscal year 1889—90 and for the ten years from 1880—81 to 1889—90. In the last mentioned year there were in operation 14 salt-producing mines, 64 salt-works producing evaporated salt, and 14 factories producing salt as a secondary product. Of rock-salt of all kinds 500,090 tons were produced, much more than in the preceding years (in 1888—89, only 388,529 tons; in 1887—88, 386,329 tons). On the other hand, the production of evaporated salt (486,281 tons) was materially less than in the preceding year (510,902 tons). With the beginning of the fiscal year 1889—90, in consequence of a trust formed by proprietors of salt-works, the wholesale prices of evaporated salt rose considerably.

The importation of salt (chiefly English evaporated salt) into the German Customs territory amounted to 26,825 tons (28,057 tons in the preceding year and 26,112 tons in 1887—88), and was small as compared with the export from the German Customs territory, which in the past year amounted to 192,258 tons (134,171 tons in 1888—89 and 125,748 tons in 1887—88).

Of domestic and foreign salt together, 364,667 tons (1888—89, 371,869 tons; 1887–88, 360,341 tons) were placed upon the open market after payment of tax for use as table salt, which was 7·5 kilogrammes per head of population; 432,216 tons paid no tax, as being intended for cattle and for industrial purposes (1888—89, 390,812 tons; 1887—88, 388,085 tons), or 8·8 kilogrammes per head of population. The use of salt for industrial purposes increased materially as compared with the preceding year, especially in soda and Glauber's salts factories (251,450 tons, as compared with 207,417 tons in 1888—89 and 220,840 tons in 1887—88), in chemical and colour works (29,796 tons, as compared with 21,294 tons in 1888—89 and 21,100 tons in 1887—88), in the leather industry (16,705 tons, as compared with 14,335 tons in 1888—89 and 12,232 tons in 1887—88), and in the metal ware industry (15,119 tons, as compared with 10,138 tons in 1888—89 and 8,825 tons in 1887—88). On the other hand, the use of salt for feeding cattle decreased (100,727 tons, as compared with 119,440 tons in 1888—89 and 108,498 tons in 1887—88), which was due to the good quality of the cattle food harvested in 1889.—*U.S. Consular Reports, December* 1890.

New Process of Firing Porcelain.

The large porcelain factories at Limoges have been for a long time studying the question of reducing the price of fuel. At a late congress of the manufacturers it was said that some new and cheap way of manufacturing porcelain must be found for France, or the industry which has become so famous and which employs so many of the inhabitants would be driven from French soil because of the cost of firing. It was there ascertained that the cost of firing china in Bohemia was not more than 10 francs per ton; in England it was only 13 francs per ton; for the same thing in France, at Limoges, the cost was 34·50 francs. This is an immense difference, making it impossible for the French manufacturers to make their china as cheaply as their foreign neighbours. Various devices have been tried, but with little success. In order to compete, wages have been reduced to the lowest minimum, and still the manufacturers have in many cases lost money. The coal that is employed is necessarily costly, as a smokeless, long-flame variety is required. Many of the factories burn wood only, as that produces a purer white than the very best kinds of coal; but wood is dearer than coal. It is consequently only used in firing the muffles and in the finest grades of porcelain. A few years ago a new process was tried that baked the porcelain in a short time, but the cost made the process impracticable.

It was under such circumstances as these that one of the most progressive houses in Limoges was induced to employ petroleum or residuum oils as a fuel. To accomplish this an American firm using the Wright burner was requested to come and make a trial with the fuel. There was very much doubt and fear connected with the experiment; but after a while it was attempted, and the results were far better than anticipated. The heat was shown to be absolutely pure. No gases or smoke in any way discoloured the china, which came from the kiln much whiter and in better condition than when it is fired with the best of wood. In the muffles there was a most decided advantage. The delicate colours, which show at once the presence of the slightest quantity of gas, were perfect.

This new discovery promises to revolutionise the whole porcelain industry. It is estimated that by employing these oils there will be a reduction of about 15 or 20 per cent. in the making of china. The only question now is the present classification of residuum oils, as the present duty on petroleum (120 francs per ton) is prohibitive; but strong pressures are being brought to bear on the Government now to have fuel oils classified as fuel, which pays only 1.30 francs per ton. New hope is given to an industry that was greatly threatened, and it is very probable that the French porcelain, which all have admired so much in the past, will be brought to a greater state of perfection by this new and American invention.—*Ibid.*

MISCELLANEOUS TRADE NOTICES.

Consumption of Distilled Spirits in the Arts, Manufactures, and Medicine in the United States.

A report on the quantity of distilled spirits consumed in the arts, manufactures, and medicine in the United States during the year ended December 31st, 1889, prepared by Mr. Henry Bower and Mr. Henry Pemberton, jun., special agents, under the direction of Mr. Frank R. Williams, expert special agent in charge of manufactures under the American census, has just been issued by Mr. Robert P. Porter, Superintendent of Census. The following information is taken from this report:—

A number of estimates have been made by various persons as to the quantity of distilled spirits consumed annually in the arts, manufactures, and medicine. These estimates have been founded upon two bases: First, the quantity of alcohol only consumed in the arts, manufactures, and medicine in the United States; and second, the quantity of distilled spirits of all kinds so consumed.

It is necessary at the outset clearly to understand this distinction in considering the work which has been done in this direction in the past.

Concerning the amount of alcohol alone so consumed, Mr. Windom, Secretary of the Treasury, in his annual report of December 4th, 1889, estimated the amount at about 6,000,000 proof gallons.

Mr. F. Miller, Commissioner of Internal Revenue, estimated, on December 6th, 1887, that 5,900,000 proof gallons of alcohol are consumed in this manner.

Mr. Green B. Raum, Commissioner of Internal Revenue, included in his report for the fiscal year ending June 30th, 1882, a statement of the quantity of alcohol only used in

the arts and manufactures, prepared from statements of collectors of the Internal Revenue Department. According to this investigation 4,269,978 proof gallons of alcohol were so used in the United States during the year ending April 1st, 1882.

From the foregoing it will appear that the estimate respecting the quantity of alcohol so consumed ranges from about 4,000,000 to 6,000,000 proof gallons.

The head of a firm in New York city dealing in alcohol, writing to the chief of the Bureau of Statistics, March 1st, 1887, estimates that less than 6,000,000 proof gallons of distilled spirits are used annually in the arts, manufactures, and medicines.

A manufacturer of chemicals in Brooklyn in 1887 estimated the quantity of spirits so consumed at 14,000,000 proof gallons.

As the total quantity of distilled spirits consumed in the United States in 1888 was 75,845,352 proof gallons, the estimate of 15 to 20 per cent., reduced to ordinary gallons, represents a consumption for the arts and manufactures of from 11,000,000 to 15,000,000 proof gallons.

As a conclusion from the foregoing, it is noted that the estimated quantity of alcohol consumed in the arts varies from 4,000,000 to 6,000,000 proof gallons, and of distilled spirits of all kinds from less than 6,000,000 to 15,000,000 proof gallons.—*Board of Trade Journal.*

Further Tin Discoveries in Texas.

The St. Louis *Age of Steel* says that:—

"Specimens of the new tin discoveries recently made in Texas have been received at San Antonio. The ores were taken there to be sampled. The mineral has been found in workable quantities on the Colorado River, in Llano county, 100 miles north-west of San Antonio, south of the Ballinger iron hill. The specimens are cassiterite, and the deposit covers a large extent. It lays near the iron fields, and was passed by unrecognised by the miners. Professor Comstock, Assistant State Geologist, recently made the discovery of the ores and their value. New discoveries are being made daily, and 60 deposits have already been discovered."

Papers of Interest to Technologists.

The following articles in the *Board of Trade Journal* for February 1891 will repay perusal:—

"Belgian Food Adulteration Law," p. 212, *seq.*

"Minerals used in Iron Smelting in India," p. 218, *seq.*

"The Indian Coal Fields," p. 222, *seq.*

The German Match Manufacture in 1890.

(*A. Kolbe and Co. Chem. Ind.* 1890, **13**, 470.)

No improvement is noticeable in this branch of chemical industry during the past year, partly on account of the high duties levied on the importation of matches made in Germany, into Austria and Italy, and partly because such countries as China, Japan, and South America have commenced to meet their own demand with native manufacture. In spite of this, new factories have been built in Germany, the proprietors being under the wrong impression that large profits could be made. The result is an over-production, which is certainly not a bright prospect for the future of the German match industry.—H. S.

The Production of Sugar during the Season 1889—90 in Austria-Hungary.

(*A. von Asbóth. Chem. Zeit.* **14**, 1674.)

Two years have passed since the new duties on sugar came into force. The effect has been to almost double the production in Hungary. There is no fear of over-production, as the inland consumption has increased as well as the quantity exported. Lower freights in Austria and Hungary will enable the sugar manufacturers of these countries to cope with the competition from Germany. Export of refined sugar to Germany and through Hamburg has decreased, but increased to England, Italy, and through Trieste.

Conventions in Germany.

The *Handelsmuseum* publishes an interesting abstract of a paper by Dr. F. Grossman on the "Cartelle," or syndicates, now in operation in Germany. From 42 at the end of 1887, the number of these organisations increased to 70 in 1888, and 77 in 1889. The year 1891 commenced with the formidable array of 116 existing syndicates, while 23 new ones were in course of formation. The iron, stone and pottery, and chemical industries are the worst afflicted. The last-named of these began the year hampered by 27 syndicates with 2 in course of formation. The leading Cartelle now extant, or which have been in operation, in this industry are:—The Stassfurt potash convention (established in 1879), the conventions in bromine (renewed for three years in 1888), Glauber salts (established 1882), sulphate of alumina and alum (established 1883), potashes (1886 to 1888, renewed in 1889), prussiate of potash (established 1886 with United Kingdom and Austria; from 1889 with Austria alone), and chromate of potash (Anglo-German established 1887); the German Salt Union and its offshoots (established 1886 and renewed in 1889 for ten years), the caustic soda convention (1883–88), the soda-ash union (established 1887), the rings in sulphate of ammonia (with Britain), borax (established 1886), boracic acid (established 1889), tartaric acid (1884 to 1887), sulphuric acid (established 1887), the Anglo-German convention in oxalic acid and oxalate of potash (1887 to 1890), the Anglo-Austro-German convention in Uzan-dyes (established 1889); the corners in quinine (1883 to 1884), sulphonal (1888 to 1889), chloroform (established 1889), salicylic acid (established 1889), and iodine (American-European); the unions of German artificial manure makers (established 1887), phosphate works (established 1888), soapworks (established 1890), and vinegar-works (established 1890); the combinations in mineral oils (established 1885), paraffin candles (established 1887), ultramarine (established 1890), eating-oil (established 1887), gunpowder (established 1881), dynamite (established 1880, renewed 1889), and hunting-ammunition (established 1885); and the German petroleum import trust, dating from the commencement of 1891. It is difficult to see how any legislation could effectually suppress these outgrowths; but perhaps they, too, by teaching the advantages of co-operation to their members on the one hand, and affording to the public object-lessons in the evils of indirect taxation on the other, may actually "labour for some good, by us not understood."—*Chemist and Druggist.*

Alkali Manufacture in Russia.

The Russian Chemical Society has received a communication, with a sample of the first output of Russian bleaching-powder, from P. K. Ushkoff, of Elabouga (province of Viatka), who has just started manufacturing bleaching-powder on a large scale from native products. This is considered a very important step in the growth of Russian chemical industry, as the whole of the bleaching-powder required for home industries—about 10,000 tons per annum—is now imported from England. The same manufacturer has nearly completed his arrangements for manufacturing soda ash and caustic soda by the Leblanc process.—*Ibid.*

A Mountain of Pure Silicates.

A mineral discovery of unusual value is reported from Kamouraska, in Lower Canada. A Quebec correspondent states that an entire mountain has been found composed of silicates, otherwise known as vitrifiable stone, of a purity certified by the Provincial Engineer to average 98 per cent. This material is used for the manufacture of the finest glass, and is believed to exist nowhere else on the American continent in such purity. The Provincial Government has been asked by a deputation to guarantee 4 per cent. interest for 10 years on 20,000*l.* if a local company subscribes that amount to develop the new industry, and has promised to consider the request if the principal municipality concerned is prepared to take a fair share of the risk.—*Ibid.*

Progress of the Basic or Thomas-Gilchrist Process during the Twelve Months ending 31st December 1890.

The total make of steel and ingot iron from phosphoric pig during this period amounts to 2,603,083 tons, being an increase over the make for the previous 12 months of 328,531 tons, and making the total production of basic steel to this date, 13,448,000 tons.

Of the above-mentioned make of 2,603,083 tons, there was made by the basic Bessemer process 2,232,639 tons, and by the basic open-hearth process 370,444 tons. Of the basic Bessemer make 1,593,148 tons contained under ·17 per cent. carbon, and of the basic open-hearth make 298,867 tons contained under ·17 per cent. carbon.

The makes of the various countries for the 12 months ending 31st December 1890 and 31st December 1889 respectively are as follows:—

	1890.		1889.	
	Total.	With under ·17 C.	Total.	With under ·17 C.
England	503,400	351,104	493,019	348,828
Germany and Luxembourg	1,493,157	1,138,241	1,295,887	1,020,416
Austria	202,315	114,857	173,755	124,907
France	240,618	175,550	222,362	159,271
Belgium, Russia, and the United States	163,573	111,263	76,529	71,217
	2,603,083	1,892,015	2,271,552	1,764,639

With this 2,603,083 tons of basic steel there was produced some 623,000 tons of slag (containing about 36 per cent. of phosphate of lime), nearly the whole of which was used as a fertiliser.

Artificial Manures, &c. (Adulteration) Bill.

The objects of this Bill are—

(1) to make it compulsory in all sales of artificial manures or feeding stuffs to deliver to the purchaser a guaranteed analysis, and to place marks of identification on all packages of such manures and on all cakes;

(2) to make misrepresentation of the nature and composition of manures or feeding stuffs punishable by summary process;

(3) to provide for the appointment of public analysts by county councils under the approval of the Board of Agriculture; and

(4) to enable county councils, with the sanction of the Board of Agriculture, for limited periods of time to employ the procedure of the Food and Drugs Acts in the detection and punishment of adulteration of manures and feeding stuffs.

The *Standard* (Agricultural Reports, February 10th, 1891), summarises the Bill as follows:—

"In criticising a rough draft of Mr. Channing's Bill to prevent the adulteration of manures and feeding stuffs six weeks ago, we stated that the terms were not fully settled, and now that the Bill has been issued, we are glad to see that the defects noticed in the draft have been made good. The invoice certificate, which every seller of artificial manures or feeding stuffs in quantities not less than one hundredweight is bound to deliver to the purchaser, under penalty for neglect, and double penalty for misrepresentation, is to be a guarantee of the nature, origin, and composition of each commodity. The percentages of the several constituents of compound artificial manure must be given, and the percentages of the most important elements in other manures, as follows: Phosphate of lime and ammonia in raw or boiled bones or bone dust, soluble and insoluble phosphate of lime and ammonia in dissolved bones, pure nitrate in nitrate of soda, soluble phosphate of lime in mineral superphosphate, ammonia in sulphate of ammonia, phosphates calculated as phosphate of lime in guano, pure muriate in muriate of potash, sulphate of potash in kainit, and phosphoric acid equal to basic phosphate of lime in basic slag. Apparently the percentage of ammonia in the case of guano has been accidentally omitted. In the case of feeding cakes, the nature of the substance or substances from which the oil in the cakes has been derived, and the percentages of oil, albuminous compounds, and other constituents are required in the invoice certificate. Apparently cakes are the only feeding stuffs recognised; but the clause should embrace linseed meal and cotton-seed meal. The Bill proposes to empower county councils to appoint analysts, subject to the approval of the Board of Agriculture, and to pay them such remuneration as may be agreed, in order that they may analyse manures and feeding stuffs for purchasers at low fees. The county councils are also empowered to prosecute offenders under the proposed Act, and to appoint inspectors, subject to the approval of the Board of Agriculture, for the purpose of detecting cases of adulteration."

BOARD OF TRADE RETURNS

Summary of Imports.

	Month ending 31st January	
	1890.	1891.
	£	£
Metals	2,085,063	1,715,867
Chemicals and dyestuffs	810,203	852,787
Oils	601,519	636,434
Raw materials for non-textile industries	2,651,310	2,378,863
Total value of all imports	38,143,850	33,741,082

Summary of Exports.

	Month ending 31st January	
	1890.	1891.
	£	£
Metals (other than machinery)	3,577,155	3,148,001
Chemicals and medicines	689,818	710,457
Miscellaneous articles	2,573,383	2,348,858
Total value of all exports	21,586,752	19,834,315

Imports of Oils for Month ending 31st January.

Articles.	Quantities.		Values.	
	1890.	1891.	1890.	1891.
			£	£
Cocoa-nut ... Cwt.	24,885	6,143	30,693	8,909
Olive ... Tuns	1,415	1,285	53,394	51,740
Palm ... Cwt.	74,266	85,979	79,077	98,659
Petroleum ... Gall.	8,485,795	12,946,134	220,105	282,685
Seed ... Tons	1,338	1,342	38,564	57,345
Train, &c. ... Tuns	1,710	1,142	35,300	22,065
Turpentine ... Cwt.	37,800	39,867	62,660	55,729
Other articles ... Value £	..	..	81,926	59,302
Total value of oils ...	..	..	601,519	636,434

Imports of Metals for Month ending 31st January.

Articles.	Quantities.		Values.	
	1890.	1891.	1890.	1891.
			£	£
Copper :— Ore ..... Tons	5,448	6,139	44,045	39,483
Regulus ..... „	8,141	9,964	219,966	313,040
Unwrought .... „	4,839	3,120	252,210	172,599
Iron :— Ore..... „	355,957	317,331	288,193	245,393
Bolt, bar, &c.... „	5,743	2,976	50,250	30,995
Steel, unwrought.. „	485	294	5,225	2,822
Lead, pig and sheet „	16,461	13,257	223,721	173,747
Pyrites ..... „	61,524	70,685	116,440	126,094
Quicksilver..... Lb.	841,194	82,675	118,618	8,819
Tin ..... Cwt.	54,445	33,353	257,519	153,718
Zinc ..... Tons	4,737	2,369	106,238	53,158
Other articles ...Value £	..	..	102,638	395,999
Total value of metals	..	..	2,085,063	1,715,867

Imports of Raw Materials for Non-Textile Industries for Month ending 31st January.

Articles.	Quantities.		Values.	
	1890.	1891.	1890.	1891.
			£	£
Bark, Peruvian .. Cwt.	11,061	7,786	36,947	22,784
Bristles..... Lb.	195,362	171,686	25,116	25,655
Caoutchouc..... Cwt.	22,104	29,771	274,241	365,203
Gum :— Arabic..... „	3,300	5,036	11,980	14,081
Lac, &c..... „	4,452	8,580	18,672	35,772
Gutta-percha .... „	5,158	6,286	55,038	70,308
Hides, raw :— Dry..... „	46,591	32,987	122,028	89,092
Wet ..... „	47,723	20,873	105,019	42,934
Ivory..... „	870	736	47,100	36,174
Manures :— Guano ..... Tons	5,782	967	40,695	5,870
Bones..... „	5,352	7,048	29,230	36,897
Paraffin..... Cwt.	28,536	37,550	32,954	47,515
Linen rags..... Tons	2,811	1,749	29,388	15,505
Esparto..... „	31,163	24,634	118,676	117,402
Pulp of wood .... „	8,348	8,622	51,866	50,114
Rosin..... Cwt.	200,417	119,356	41,655	26,878
Tallow and stearin „	138,790	111,525	173,056	140,746
Tar .....Barrels	3,867	2,503	2,453	1,101
Wood :— Hewn ..... Loads	103,832	110,153	230,866	227,788
Sawn ..... „	69,775	69,650	185,517	176,175
Staves ..... „	5,699	6,471	38,080	45,870
Mahogany ..... Tons	2,830	4,897	22,441	45,216
Other articles....Value £	..	..	928,292	739,723
Total value	..	..	2,651,310	2,378,863

Besides the above, drugs to the value of 51,829*l.* were imported, as against 83,810*l.* in January 1890.

Imports of Chemicals and Dyestuffs for Month ending 31st January.

Articles.	Quantities.		Values.	
	1890.	1891.	1890.	1891.
			£	£
Alkali..... Cwt.	2,888	1,872	1,955	1,797
Bark (tanners, &c.) „	32,311	12,398	12,878	4,914
Brimstone ..... „	41,330	30,075	8,845	8,615
Chemicals..... Value £	..	..	109,190	90,807
Cochineal ..... Cwt.	1,205	858	7,648	5,342
Cutch and gambier Tons	2,529	2,100	64,442	51,539
Dyes :— Aniline ..... Value £	..	..	19,715	21,517
Alizarine ..... „	..	..	23,777	23,460
Other ..... „	..	..	1,930	1,774
Indigo ..... Cwt.	15,902	13,738	316,676	332,773
Madder ..... „	749	870	1,005	1,591
Nitrate of soda.... „	144,276	263,980	68,385	106,356
Nitrate of potash . „	33,145	26,065	29,729	23,441
Valonia ..... Tons	2,121	1,806	35,851	40,683
Other articles... Value £	..	..	108,237	138,178
Total value of chemicals	..	..	810,293	852,787

Exports of Miscellaneous Articles for Month ending 31st January.

Articles.	Quantities.		Values.	
	1890.	1891.	1890.	1891.
			£	£
Gunpowder..... Lb.	495,100	1,178,500	13,228	29,314
Military stores.. Value £	..	..	76,296	82,591
Candles..... Lb.	1,082,800	1,094,500	20,206	21,840
Caoutchouc ..... Value £	..	..	95,251	88,333
Cement..... Tons	47,038	36,113	94,519	73,878
Products of coal Value £	..	..	135,986	98,707
Earthenware ... „	..	..	154,964	130,031
Stoneware ..... „	..	..	18,816	12,253
Glass :— Plate..... Sq. Ft.	346,466	369,873	19,078	18,247
Flint..... Cwt.	8,516	7,522	21,318	17,115
Bottles..... „	76,207	58,620	34,876	27,150
Other kinds.... „	17,483	15,017	15,410	15,203
Leather :— Unwrought .... „	12,508	9,656	113,810	99,664
Wrought ..... Value £	..	..	27,412	26,701
Seed oil..... Tons	4,814	4,211	107,598	93,013
Floorcloth ..... Sq. Yds.	1,103,400	1,366,200	65,461	58,847
Painters' materials Val. £	..	..	114,180	106,318
Paper ..... Cwt.	80,282	68,446	140,023	117,992
Rags..... Tons	4,281	3,797	31,246	30,438
Soap..... Cwt.	39,519	33,816	41,103	39,583
Total value	..	..	2,573,383	2,348,858

EXPORTS OF METALS (OTHER THAN MACHINERY) FOR MONTH ENDING 31ST JANUARY.

Articles.	Quantities.		Values.	
	1890.	1891.	1890.	1891.
			£	£
Brass..... Cwt.	8,783	8,249	40,256	40,844
Copper:—				
Unwrought ..... „	62,079	18,048	169,663	141,227
Wrought..... „	36,760	20,585	110,462	72,603
Mixed metal .... „	36,781	10,906	99,847	33,551
Hardware ..... Value £	..	..	231,598	214,242
Implements..... „	..	..	115,731	110,787
Iron and steel..... Tons	302,751	219,119	2,531,563	2,112,622
Lead ..... „	3,358	2,545	54,989	38,797
Plated wares... Value £	..	..	29,038	24,746
Telegraph wires, &c. „	..	..	71,686	288,223
Tin ..... Cwt.	5,896	7,178	20,520	34,460
Zinc ..... „	11,305	10,327	11,251	11,196
Other articles .. Value £	..	..	81,625	72,333
Total value	..	..	3,577,155	3,148,601

EXPORTS OF DRUGS AND CHEMICALS FOR MONTH ENDING 31ST JANUARY.

Articles.	Quantities.		Values.	
	1890.	1891.	1890.	1891.
			£	£
Alkali..... Cwt.	522,155	407,392	115,510	109,097
Bleaching materials „	134,536	110,631	39,525	35,379
Chemical manures. Tons	20,427	21,437	167,806	178,004
Medicines..... Value £	..	..	83,852	73,867
Other articles... „	..	..	253,125	254,200
Total value	..	..	689,818	710,457

Monthly Patent List.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

APPLICATIONS.

957. H. Chilcott. Improvements in apparatus for intercepting and separating oleaginous and other matters from the water of condensation from surface condensers. January 19.

1040. A. K. Brown. Improvements in or connected with apparatus for softening and for clarifying liquids. January 20.

1043. C. R. Bonne. Improved machine for drying grains, corn, hops, chemicals, and like substances. January 20.

1071. B. Corcoran. A mixing machine for amalgamating exact proportions of flours, chemicals, and other substances. January 21.

1194. A. Chapman. Improvements in multiple effect evaporating apparatus. January 22.

1385. A. Haigh and J. Thewlis. Improved apparatus to be employed in the drying of animal or vegetable fibres. January 26.

1540. W. H. Webb. Improvements in or connected with compression pumps for gaseous or vaporous fluids. January 28.

1578. L. H. Armour. Improvements in or connected with ovens or furnaces used for the manufacture of hard coke, or for distilling shale, roasting ores, or otherwise subjecting carbonaceous matter to the action of heat. January 28.

1579. L. H. Armour. *See* Class III.

1585. S. Oates. Improvements in smoke-consuming apparatus and fuel economisers. January 28.

1629. W. R. Earp. Improvements in or relating to new or improved boiler anti-incrustation compounds or compositions and in the utilisation of waste substances for their manufacture. January 29.

1697. D. Guelbaum. Improvements in evaporation and distillation of liquids. January 30.

1846. J. King. Improved apparatus or multiple effect drying machine for drying, concentrating, or carbonising fertilisers, ochres, oxides, and other materials, and for concentrating and evaporating liquids, and for other purposes. February 2.

2083. C. H. Fitzmaurice. Improvements in apparatus and appliances for softening, purifying, and filtering liquids. February 4.

2099. E. Blass. Improvements in apparatus for treating materials by a circulating current of heated gases. February 5.

2141. W. T. Cotton and E. L. Garrett. An improved evaporator and surface condenser for producing pure distilled water. February 5.

2142. W. T. Cotton and E. L. Garrett. An improved apparatus for distilling water and other liquids. February 5.

2268. C. E. Miles. Improved means for evaporating liquids containing salts in solution. February 7.

2430. R. Cavanagh. Improvements in apparatus for charging liquids with gases. February 10.

COMPLETE SPECIFICATIONS ACCEPTED.*

1890.

1177. W. Sinclair. Composition for lining casks, &c. January 28.

2632. W. P. Thompson.—From A. Stehlik. Centrifugal apparatus for filtering liquids. February 18.

3907. R. Harvey. Evaporating apparatus. January 28.

3915. J. Schwager. Condensing apparatus. February 11.

4225. J. von Langer and L. Cooper. Valves for hot gases. January 28.

5142. E. Theisen. Apparatus for condensing vapours or gases. February 18.

5598. H. A. Fleuss. Freezing apparatus. February 18.

6951. C. Kellner. Lining boilers or digesters used in manufacture of paper pulp, and for similar purposes. January 28.

16,940. L. C. Riggs. Refrigerating apparatus. January 28.

18,751. O. Schulz. Continuous evaporating apparatus. February 4.

19,835. H. J. Allison.—From The National Salt and Chemical Company. Apparatus for the vaporisation of liquids. February 11.

II.—FUEL, GAS, AND LIGHT.

APPLICATIONS.

971. B. H. Thwaite. Improvements in methods of generating heating and lighting gases from liquids and solid hydrocarbons, and in apparatus therefor. Complete Specification. January 20.

1029. R. W. Papineau. Improvements relating to the manufacture and carburetting of gas, and to apparatus therefor. January 20.

1099. S. Geoghegan and M. F. Purcell. Improved apparatus for the purification and deposition of solid particles from gaseous fumes. January 21.

1237. A. L. Keller. A new fuel. January 23.

1386. J. Hargreaves. Improvements in the generation and combustion of gas for smelting and heating purposes, and in appliances connected therewith. January 26.

1410. J. Woodward. Improvements in machinery or arrangements for charging and drawing gas retorts. January 26.

1563. T. Clapham. Improvements in the construction of condensers applicable for use in the manufacture of illuminating or other gases. January 28.

1577. L. H. Armour. *See* Class III.

1682. J. Bowing. Improvements in coking processes. Complete Specification. January 29.

1866. J. Moeller. Improvement in lighting houses or any establishments through introducing into the pipes a mixture of gas and air to produce a "Bunsen" flame for lighting incandescent lamps. February 2.

1868. J. Moeller. An apparatus producing gas from light oils for lighting the so-called Welsbach incandescent gas lamps, and for general lighting purposes. February 2.

1909. J. W. Ormiston, A. R. Ormiston, and J. Ormiston. Improvements in the manufacture and distribution of gaseous fuel, and in arrangements and apparatus therefor. February 3.

2021. P. F. Macullum.—From J. C. Ressig, Argentine Republic, and J. Landin, Sweden. Improvements in separating carbonic acid from other gases, especially in the production of calefacient gas for lighting and heating purposes, free, or practically free, from carbonic oxide. Complete Specification. February 4.

2098. N. Martin and B. D. Martin. An improved device for increasing the illuminating power of gas flames. February 5.

2145. G. Hargreaves, J. P. Scranton, and E. W. Porter. Improvements in apparatus for carburetting air. Complete Specification. February 5.

2158. A. Woosnam. Improvements in determining the illuminating power of gas and other flames. February 5.

2159. J. A. Soetje and J. C. A. Kahl. New or improved manufacture of briquettes, peat coke, and peat coke briquettes. February 5.

2170. H. Fourness. Improvements in the means and appliances used in the manufacture of illuminating and heating gases. February 6.

2193. D. Rylands. Improvements in fire-lighters and in the process of manufacturing the same. February 6.

2235. T. Williams. Improved combination or employment of ingredients for the manufacture of fire-lighters. February 6.

2452. U. André. Improvements in and connected with hydraulic mains for gas-making apparatus. February 10.

2736. V. Poltavtseff and K. Hodjaian. Improved means for generating heat from liquid and other fuel. February 14.

COMPLETE SPECIFICATIONS ACCEPTED.

1890.

3332. B. C. Sykes and G. Blamires. Separating hydrogen gas and the light carburets of hydrogen from water-gas or producer-gas, or both. January 28.

3684. T. Holgate. Method and apparatus for the manufacture of coal-gas and compounds of ammonia. February 11.

4197. H. L. Müller and W. Adkins. Apparatus for producing lighting gas. February 4.

4223. J. von Langer and L. Cooper. Production of water-gas and generator-gas, and apparatus connected therewith. February 18.

4324. J. A. Kelman. Apparatus for manufacture of gas. February 4.

5078. C. Hunt. Inclined gas retorts, and apparatus for charging same. February 18.

5163. S. J. Woodhouse. Method and means for charging and discharging gas retorts. February 18.

5194. G. Waller. Cooling and conveying coke discharged from retorts. February 18.

5453. W. Aekroyd, T. H. Aekroyd, and J. Willoughby. Method and apparatus for increasing combustion of smoke in furnaces, utilisation and transmission of heat, economising fuel, and improving draught. February 18.

* The dates given are the dates of the Official Journals in which acceptances of the Complete Specifications are advertised. Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the said dates.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

Applications.

1308. C. M. Fielsticker. Improvements in the continuous distillation of hydrocarbon and other oils and liquids. Complete Specification. January 21.

1577. L. H. Armour. Improvements connected with coke ovens or other ovens, furnaces, or retorts wherein ammoniacal products, ligneous acids, and the like are obtained. January 28.

1578. L. H. Armour. Improvements in or connected with ovens or furnaces used for the manufacture of hard coke, or for distilling shale, roasting ores, or otherwise subjecting carbonaceous matter to the action of heat. January 28.

1579. L. H. Armour. Improvements in or connected with ovens, furnaces, or retorts used for the making of coke or charcoal, or for distilling or roasting carbonaceous matter, or otherwise subjecting carbonaceous matter to the action of heat. January 28.

Complete Specifications Accepted.

1890.

2242. F. Hlawaty. Preparing benzol, naphthalene, and anthracene from petroleum, petroleum scales, tar, tar oils, paraffin, &c., and from illuminating gas. February 18.

2955. H. Propfe. Process and apparatus for the continuous distillation of tar. February 11.

4120. J. Laing. Destructive distillation of mineral oils, and apparatus therefor. February 11.

IV.—COLOURING MATTERS and DYES.

Applications.

1001. R. Holliday and Sons, Limited, T. Holliday, and and P. R. E. Seidler. Improvements in the production or preparation of a new colour producing thiobase and of sulpho acids of the same. January 20.

1120. O. Imray.—From The Farbwerke vormals Meister, Lucius, and Brüning, Germany. *See* Class VI.

1223. R. Hunt, E. S. Wilson, and E. Stewart. *See* Class XII.

1224. R. Hunt, E. S. Wilson, and E. Stewart. Improvements in the manufacture of colouring matters. January 23.

1354. O. Imray.—From The Farbwerke vormals Meister, Lucius, and Brüning, Germany. Improvements in the production of a blue green and red violet colouring matter from alizarine blue. January 24.

1355. O. Imray.—From The Farbwerke vormals Meister, Lucius, and Brüning, Germany. Improvements in the production of disazo colouring matters from the rosanilines. January 24.

1681. W. Cole. Improvements in the manufacture of indigo. January 29.

1737. O. Imray.—From The Actien Gesellschaft fur Aniline Fabrikation, Germany. Improvements in the manufacture of colouring matters. January 30.

1742. S. Pitt.—From L. Cassella and Co., Germany. Improvements in the manufacture of a new amidonaphtholsulphonic acid, and colouring matters therefrom. January 30.

1883. B. Willcox.—From The Farbenfabriken vormals F. Bayer and Co., Germany. The manufacture of new dyestuffs of anthracene and anthraquinone. February 2.

2682. I. Levinstein. A new or improved material for use in the production of colouring matters. February 14.

Complete Specifications Accepted.

1890.

3303. B. Willcox.—From The Farbenfabriken vormals F. Bayer and Co. Manufacture of fast dyestuffs. February 4.

3788. M. G. Lindemann. Treating dyewoods and their extracts. February 4.

4382. B. Willcox.—From The Farbenfabriken vormals F. Bayer and Co. Manufacturing new derivatives of phenyl-amido-acetic acid. January 28.

4577. O. Imray.—From The Farbwerke vormals Meister, Lucius, and Brüning. Production of grey colouring matters. January 28.

4904. S. Pitt.—From L. Cassella and Co. Manufacture of dyestuffs. January 28.

5723. B. Willcox.—From The Farbenfabriken vormals F. Bayer and Co. Manufacture of phenacetine derivatives. February 4.

5777. O. Imray.—From The Farbwerke vormals Meister, Lucius, and Brüning. Production of grey basic colouring matters by the action of hydrochlorate of nitroso-dimethylaniline, or hydrochlorate of nitroso-diethylaniline upon 1·5 dioxynaphthalin, and upon 1·2 tetroxy-dinaphthyl. January 28.

5780. O. Imray.—From The Farbenfabriken vormals Meister, Lucius, and Brüning. Production of black colouring matters from amidoflavopurpurine and amido-anthropurpurine. January 28.

6874. J. Y. Johnson.—From The Badische Anilin and Soda Fabrik. Production of substantive colouring matters. February 1.

21,205. T. Peters. Manufacture of colouring matters. February 18.

1891.

583. J. C. L. Durand, D. E. Huguenin, and A. J. J. d'Andiran. Manufacture of new colouring matters. February 18.

V.—TEXTILES, COTTON, WOOL, SILK, Etc.

Applications.

1426. W. P. Thompson. Improvements in or appertaining to the separation or purification of cotton seed from its adherent fibre, and also of other seeds or grains from external adherent matter or coating. January 26.

1616. F. L. Leech and A. Horrobin. An improved waterproofing solution. January 29.

1688. T. Craig, of the Firm of I. Holden and Sons. Improvements in means or apparatus for use in preparing and combing wool or other fibres to prevent waste. January 30.

1982. J. Kershaw, J. Wilcock, and A. Ashworth. Improvements in the treatment of textile fabrics, such as woollen piece goods. February 3.

2227. F. J. H. Sampson. Improvements in the treatment of rhea and other vegetable fibre, and in apparatus to be used for this purpose. February 6.

2348. J. B. Barton. Improved process for the manufacture of granite linoleum. Complete Specification. February 9.

COMPLETE SPECIFICATIONS ACCEPTED.

1890.

3749. H. Blakeley and C. Beving. Ornamenting textile fabrics. February 11.

4452. H. A. Lowe. Treating materials from cotton or other cellulosic fibres. January 28.

21,230. J. W. Barker. Figured pile fabrics. February 11.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

APPLICATIONS.

1120. O. Imray.—From The Farbwerke vormals Meister, Lucius, and Brüning, Germany. Improvements in dyeing and printing on woollens azo-colouring matters derived from dioxynaphthalin sulphonic acids with metallic mordants. January 21.

1702. C. S. Bedford. New and improved methods of dyeing cotton and other fibres. January 30.

2533. H. Thies and F. Cleff. Improved process of dyeing or printing in aniline black. Complete Specification. February 12.

2604. P. G. Wild. A new or improved method of stamping and tinting textile fabrics, and apparatus for effecting same. February 13.

COMPLETE SPECIFICATION ACCEPTED.

1890.

12,379. H. H. Mott and J. Perry. Manufacture of decorative wall-papers. January 28.

VII.—ACIDS, ALKALIS, AND SALTS.

APPLICATIONS.

962. J. W. Kynaston. Improvements in the manufacture of sulphate of alumina. January 20.

1154. F. H. Gossage and J. Williamson. Improvements in or connected with the obtainment or manufacture of sulphur from sulphuretted hydrogen. January 22.

1168. M. N. d'Ardria. Improvements in the manufacture of barium chloride and strontium chloride. January 22.

1203. F. J. Jones. Improvements in the manufacture of sulphate of ammonia. January 22.

1226. R. Williams. Improvements in and connected with the utilisation of the impure sulphate of lead, known as "lead bottoms." January 23.

1261. O. Imray.—From La Société Anonyme des Anciennes Salines Domaniales de l'Est, France. Process for bleaching and purifying aluminium sulphate. January 23.

1453. E. O. Lambert.—From S. Pick, Austria. Improvements in the manufacture or production of salt from brine. Complete Specification. January 27.

1824. I. Lifschutz. An improvement in the process for the simultaneous production of cellulose and oxalic acid from vegetable fibrous substances. January 31.

1825. H. H. Lake.—From G. Letélié, Belgium. Improvements relating to the manufacture of carbonate of soda, carbonate of potash, hydrochloric acid, and chloride of lime, and to apparatus therefor. January 31.

2019. W. Walker. An improved process for obtaining silicates for making glass, and the production of hydrochloric acid. Complete Specification. February 4.

2134. J. Greenwood. Improvements in or relating to the manufacture or production of caustic soda. February 5.

2224. H. H. Lake.—From J. Massignon and E. Watel, France. Improvements in the manufacture of chromates, bichromates, and other chromium compounds. Complete Specification. February 6.

2252. P. G. W. Typke. Improvements relating to the manufacture or production of certain phosphorus compounds. February 7,

2343. T. G. Webb. An improvement in apparatus for concentrating sulphuric acid. February 9.

2499. W. C. Heraeus. Improvements in apparatus for concentrating acids. February 11.

2611. J. Graham, G. E. Davis, and A. R. Davis. Improvements in the concentration of sulphuric acid, and in apparatus therefor. February 13.

COMPLETE SPECIFICATIONS ACCEPTED.

1890.

2296. J. C. Richardson and T. J. Holland. *See* Class XI.

2526. The Borax Co., Lim. Treating borates of lime and boracite for manufacture of borax and other borates. February 4.

2633. J. Leith. Distillation or treatment of ammonium chloride with Leblanc alkali waste, &c. January 28.

4434. J. J. Meldrum and T. F. Meldrum. Apparatus used in the distillation of ammonia. February 11.

4473. H. H. Lake.—From La Société Jph. Jay et Jellaffier. Apparatus for producing carbonic acid and similar gas. February 18.

4519. H. Precht. Production of potash from potassium and magnesium carbonate. February 18.

4759. H. Precht. Production of hydrate of magnesia. February 18.

5072. L. Mond. Treating phosphatic minerals. February 18.

8914. A. Crossley and J. W. Jones. Process and apparatus for producing ferro-ferric and ferric oxides. February 18.

16,049. R. Haddan. — From Viscount de Lambilly. Manufacturing alkaline or alkaline earth cyanides through atmospheric nitrogen, and application of same to the production of ammonia. February 18.

18,187. L. D. Armstrong. Apparatus for recovering soda and other chemicals from spent liquors. January 28.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

APPLICATIONS.

943. H. L. Doulton and S. H. Leech. Improvements in forming undercut projections and recesses in tiles and other articles of pottery, and in apparatus therefor. January 19.

966. E. Arthur. A composition for glazing or enamelling tiles, bricks, and like goods. January 20.

1222. W. W. Pilkington. Improvements in apparatus for forming molten glass into sheets. January 23.

1704. H. Warrington. Improvements in ovens or kilns for burning bricks, tiles, and the like. Complete Specification. January 30.

2019. W. Walker. *See* Class VII.

2668. E. Enderleine. — From Kreysler and Mohr, Germany. Improvements in the decoration or ornamentation of glass, china, and other ware. February 13.

COMPLETE SPECIFICATIONS ACCEPTED.

1890.

3343. T. Fletcher, R. Crag-Brown, and W. Ure. Brick and pottery kilns. January 28.

4501. E. P. Lee. Kilns for burning clay goods. January 28.

4509. D. Rylands and B. S. Shepcote. Machinery for manufacturing hollow glass-ware. January 28.

4792. D. Rylands and A. Husselbee. Manufacture of glass-lined fittings for glass-lined piping. February 11.

6979. J. H. Lewis and J. Skidmore. Asbestos composition shadow for glass and other furnaces. February 18.

13,134. C. D. Abel.—From J. Meurin. Manufacture of bricks, slabs, pipes, pipe stones, &c. February 18.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

APPLICATIONS.

1115. W. R. Taylor. Improvements in and apparatus for the manufacture of cement. January 21.

1119. A. J. B. Ward. Fireproof floors, staircases, and roofs. January 27.

1617. J. G. Garrett. Improvements in kilns for burning Portland cement and other like substances. January 29.

1756. C. von Forell. Improvements in the manufacture of artificial Roman cement. January 30.

1753. G. F. W. Hope. Improvements in or relating to the production or manufacture of sand, chiefly for building and other purposes. January 30.

2017. J. McGlashan and E. H. Braidwood. Fireproof decorative material for ceilings, walls, woodwork, hangings, or upholstery. February 4.

2598. J. Ballantine. An improved medium or composition for decorative purposes. February 13.

2647. A. Lawrence. Improved means and apparatus for moulding artificial stone paving slabs. February 13.

COMPLETE SPECIFICATIONS ACCEPTED.

1890.

1176. W. Sinclair. Compound for cementing iron rails to stone kerbing, joints of stone, drain pipes, &c. January 28.

3133. W. G. Williams and S. Taylor. Ornamenting surfaces. February 11.

16,553. G. F. Redfern.—From W. Heller. Treatment of gypsum for building, statuary, and other purposes. February 18.

1891.

291. T. Potter. Fire-resisting concrete floors and ceilings combined. February 11.

X.—METALLURGY, MINING, ETC.

APPLICATIONS.

914. C. Billington, J. Newton, and C. Billington, jun. Improvements in the production of aluminium. January 19.

946. N. Lébédeff. Improvements in extracting iron or steel or other metals from ores or metalliferous materials. January 19.

950. H. H. Leigh.—From E. B. Heusmann, Germany. Improvements in metallic alloys. January 19.

978. I. Beardmore. Improvements in or relating to regenerative gas furnaces for steel melting, and analogous purposes. January 20.

1047. W. West. Improvement in apparatus for and process of treating zinc ores. January 20.

1161. B. H. Thwaite. An improved form of high temperature furnace especially adapted for the conversion of a high carbide of iron into the low carbide condition known as steel. January 22.

1197. J. Mactear. Improvements in the treatment of auriferous ores for the extraction of precious metal therefrom. January 22.

1208. H. H. Lake.—From J. H. Bevington, United States. An improved method of treating metal in the manufacture of tubes, and for similar purposes. Complete Specification. January 22.

1309. J. H. Pollok. Improved gold extracting reagents. January 24.

1371. A. M. Clark.—From La Société Anonyme de Produits Chimiques Etablissements Malétra, represented by F. E. Costes', France. Treating ores and residues containing zinc by means of bisulphate of soda for the production of commercial products. January 24.

1526. C. P. Aston. An improved method of utilising the calcined hot-blast stove and boiler-flue dust made in connection with iron-making furnaces. January 28.

1785. E. Meyer. Improvements in the production of aluminium. January 31.

1871. W. Ambler and H. Branter. Improvements in moulding hollow ingots and other tubular articles of molten metal. February 2.

1918. A. Birkbeck. Improvements in "tin-pots" or apparatus for coating metal plates or surfaces with tin or the like. February 3.

2000. P. Hart. Improvements in the treatment of composite ores containing zinc. February 4.

2019. E. Edwards.—From E. Honold, Germany. An improved process and apparatus for desilverising lead. February 4.

2089. J. Johnson.—From T. S. Blair, jun., United States. Improvements in the manufacture of steel. February 5.

2234. H. Parkes. Improvements in the manufacture of ferruginous alloys. February 6.

2326. A. P. Smith. Improvements in the separation of iron and nickel from solution of their sulphates. February 9.

2361. J. B. Alzugary. Improvements in metal alloys. February 9.

2508. A. de L. Long and J. Noble. A gas regenerative vertical ingot heating furnace. February 11.

2673. J. H. Darby. Improvements in the manufacture or purification of steel or homogeneous metal. February 13.

2722. J. H. Darby. Improvements in the manufacture of magnets, or of iron or steel, or the treatment of iron or steel for such manufacture. February 14.

Complete Specifications Accepted.

1889.

17,627. H. H. Lake.—From S. H. Emmens. Production of ductile iron from cast iron. February 4.

1890.

2057. A. J. Campion. Processes and apparatus for smelting and treating tin ores, slags, slimes, and furnace débris containing tin, &c. February 18.

2544. J. W. Chenhall. Improvements in blast or smelting furnaces having water jackets. February 18.

3245. W. D. Bohn. Separation of gold and silver from ores. February 11.

3246. W. D. Bohn. Apparatus for separating gold or silver from ores. February 11.

4030. J. H. Darby. Manufacture of steel or iron. February 11.

5199. The Electric Construction Corporation, Limited, T. Parker, and A. E. Robinson. Treatment of copper nickel matte and obtainment of products therefrom. February 18.

5638. T. Teague. Extracting tin from slag or débris of tin smelting. January 28.

5641. H. Howard. Manufacture of iron and steel tubes. February 18.

16,545. H. H. Lake.—From O. B. Peck. Apparatus for decomposing metallic salts and desulphurising ores. February 4.

18,605. L. L. Burdon. Compound hollow metal ingots and wire. January 28.

18,636. R. Haddan.—From G. Conkling. Concentrating iron ore. January 28.

19,572. W. P. Hopkins. Manufacturing bar iron. February 18.

20,533. D. Brennan. Apparatus for crushing or reducing ores. February 11.

XI.—ELECTRO-CHEMISTRY and ELECTRO-METALLURGY.

Applications.

1007. E. Ferraris. Apparatus for separating ores and metals by the aid of electricity. Complete Specification. January 20.

1035. S. W. Marquay. Improvements in primary batteries. January 20.

1049. S. Z. de Ferranti. Improvements in the manufacture of dynamo-electric machines. January 20.

1425. A. J. Boult.—From W. Roberts, Canada. Improvements in storage batteries. Complete Specification. January 26.

1741. H. Howard. Improvements in electric welding, and in apparatus therefor. January 30.

1788. M. Bailey. Improvements in the construction of battery elements. January 31.

1818. J. B. Winder. A new or improved preparation of soluble bichromates and sulphuric acid for use in charging voltaic batteries and for other purposes. January 31.

2418. J. Matthews and G. B. Cruickshank. Improvements in electric accumulators or storage batteries. February 10.

2446. J. Y. Johnson.—From G. D. Davis, United States. Improvements in or connected with means or apparatus employed in electrolysis. February 10.

2471. T. W. Bush and M. Doubleday. The manufacture of hydrolysed lead cells for electrical or storage batteries. February 11.

2518. W. Gibbings. An improved method of depositing copper or other metals by electrolysis, with the object of refining it or them, or of recovering the precious and (or) other metals contained in or alloyed with the metal under treatment. February 12.

2654. Sir C. S. Forbes, Bart. Improvements in primary batteries. February 13.

Complete Specifications Accepted

1890.

1897. E. Fahrig. Composition for electrical insulating purposes, and manufacture thereof. February 4.

2273. G. R. Postlethwaite. Voltaic cells. February 11.

2296. J. C. Richardson and T. J. Holland. Electrolytic production of caustic soda, caustic potash, &c. February 11.

2297. J. C. Richardson and T. J. Holland. Apparatus for electrolytic purposes. February 11.

2945. A. M. F. Laurent-Cély and L. A. Tinmis. Electric secondary cells, and manufacture thereo.. February 4.

3028. A. C. Reigner. Dynamo-electric and electro-dynamic machines. January 28.

3967. J. S. Stevenson. Manufacture of secondary battery elements. February 4.

4384. J. Pitkin and H. C. L. Holden. Plates for secondary batteries. February 11.

5199. The Electric Construction Corporation, Limited, T. Parker, and A. E. Robinson. *See* Class X.

15,455. W. P. Thompson.—From C. L. Coffin. Welding metals electrically. February 4.

20,111. H. H. Lake.—From I. L. Roberts and T. H. McGraw. Apparatus for use in the electrolytic decomposition of metallic salts. February 4.

XII.—FATS, OILS, and SOAP MANUFACTURE.

Applications.

963. P. R. de Faucheux D'Humy. Improvements in the manufacture or treatment of soap for toilet, washing, medical, and other like purposes, and in apparatus for holding or containing soap, and supplying same for personal or other uses. January 20.

1223. R. Hunt, E. S. Wilson, and E. Stewart. Improvements in treating crude cotton-seed oil to obtain oil soap and colouring matter. January 23.

1997. A. Bruce, R. Harrison, J. Harrop, and A. Taylor. An improved washing compound. February 4.

2112. J. A. Clough. Improvements in or appertaining to the manufacture of soap. February 5.

2241. W. S. Somers. Improvements in refining oils and spirits, and apparatus therefor. February 7.

Complete Specifications Accepted.

1890.

1343. T. H. Gray and S. S. Bromhead. Refining linseed oil. February 4.

3601. R. C. Scott. Manufacture or shaping of soap. February 4.

5226. W. P. Thompson.—From R. Krause. Improved lanolin compound, and process for preparing and utilising same, specially applicable to the preparation of lubricants. February 11.

11,629. W. N. Hartley and W. E. B. Blenkinsop. Decolourising vegetable oils in the manufacture of pale drying oils and varnishes, and apparatus therefor. January 28.

19,960. P. Wild. Process and apparatus for smelting margarine, tallow, or other crude fatty substances by means of hot air. February 18.

XIII.—PAINTS, PIGMENTS, VARNISHES, AND RESINS.

Applications.

1127. R. C. Anderson. An improved manufacture of paints or varnish for coating leather, cloth, and other materials. January 21.

1145. J. Campbell. A new composition for coating tin and other like vessels. January 22.

1267. W. N. Hartley and W. E. B. Blenkinsop. The manufacture of an improved preparation of driers or siccative material for mixing with paints. January 23.

2013. C. Schleich and E. Hanetzog. The production of permanent water-colours by means of blood serum. February 4.

2362. H. Wilcox, J. C. Butterfield, and T. C. Batchelor. Improvements in the manufacture of white-lead and other pigments, and in the by-products obtained therefrom. February 9.

2382. G. W. Scollay. Making paint or paint stock. Complete Specification. February 10.

Complete Specifications Accepted.

1890.

1178. W. Sinclair. Waterproofing and preserving composition for stone, bricks, plaster, and cement surfaces. January 28.

3786. G. Larrony. Manufacture of litharge and red lead. February 4.

11,629. W. N. Hartley and W. E. B. Blenkinsop. *See* Class XII.

XIV.—TANNING, LEATHER, GLUE, AND SIZE.

Application.

1631. J. Sadler. Making an improved artificial leather. January 29.

Complete Specification Accepted.

1890.

11,397. J. M. Pujos. Improvements in tanning. February 11.

XV.—AGRICULTURE AND MANURES.

Application.

2168. W. Bowler. Improvements in the collection and utilisation of excreta and in the preparation of manure therewith. February 6.

XVI.—SUGARS, STARCHES, GUMS, Etc.

Complete Specifications Accepted.

1890.

3240. A. A. Brehier and B. G. Talbot. Manufacture of artificial tartaric acids by means of cellulose, saccharine, or amylaceous substances. February 18.

5283. G. F. Redfern.—From M. Wienrich. Manufacture of sugar. February 18.

10,893. R. Pzillas. Apparatus for drying sugar or light substances. February 4.

XVII.—BREWING, WINES, SPIRITS, Etc.

Applications.

1211. A. G. Burkhardt and G. Schule. Apparatus for distilling and rectifying. Complete Specification. January 23.

2188. W. C. Marshall. Ascertaining the average specific gravity of unmixed worts at breweries and distilleries. February 6.

2241. W. S. Somers. *See* Class XII.

2294. H. H. Lake.—From G. Guignard and A. Hedouin, France. Improvements in and relating to the manufacture of alcohol, and in apparatus therefor. Complete Specification. February 7.

Complete Specifications Accepted.

1890.

4746. S. Joseph and H. Citron. Fermenting process in rarefied air-space. February 11.

6220. H. H. Lake.—From A. Joergensen and A. Bergh. Apparatus for the production of yeast and similar substances. February 18.

7195. J. Campbell. Process for the recovery and utilisation of yeast. January 28.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

Applications.

A.—Chemistry of Foods.

2051. J. Y. Johnson. — From La Société Geneste, Herscher and Co., France. Improvements in means or apparatus for sterilising water. February 4.

2055. G. D. Bowie. An improved phosphated salt as a food ingredient and for human and animal use. February 4.

2207. M. P. Hatschek, G. A. Clowes, and L. Briant. Improvements in the preparation of peptone extracts, and in the application of the same to various useful purposes. February 6.

2407. W. T. Thorp. New or improved foods. February 10.

B.—Sanitary Chemistry.

1225. H. Tatham. Improvements in and relating to the treatment of sewage and sewage deposits. January 23.

1998. W. F. Pinfold. An improved automatic mixer for preparing chemicals, to be applied in the purification of sewage or other liquids. February 4.

2117. C. H. Beloe and F. Candy. Improvements in and connected with the purification of sewage and other foul or impure liquids. February 5.

2169. W. Bowler. Improvements in the collection, disposal, and treatment of towns' refuse. February 6.

2729. J. E. Kierby. Improvements in apparatus for automatically regulating the supply of precipitating materials to sewage, and for other analogous purposes. February 14.

C.—Disinfectants.

1349. A. Findlay. An improved liquid or material for destroying insects. January 24.

COMPLETE SPECIFICATIONS ACCEPTED.

A.—Chemistry of Foods.

1890.

2620. F. Grognet. Preserving meat, fish, &c. February 11.

3856. E. Leconte. Treatment or regeneration of yeast to be used in the process of bread-making, and preparation of paste and dough for pastryeooks and biscuit-bakers. January 28.

3995. G. Dosmond and F. Rozes. Process and apparatus for preserving meat and other alimentary substances. February 11.

19,178. O. Imray.—From The Mosquera Julia Food Co. Manufacture of ferments, peptones, and peptonised food products. February 11.

20,946. L. Bregha and F. Breza. Process and apparatus for preserving articles of food. February 18.

B.—Sanitary Chemistry.

1890.

1816. G. W. Ewens. Purifying the sewage of towns, and foul waters discharged from breweries, tanyards, glueworks, &c. February 11.

3312. W. E. Adeney and W. K. Parry. Purification of sewage and other waste liquors containing organic matters. February 18.

C.—Disinfectants.

1890.

3628. F. Bale and C. Sims. Production of hydroxyl or peroxide of hydrogen, and apparatus therefor. February 18.

5113. J. Stilling. Method of destroying microscopic organisms for disinfecting, and substances used therefor. February 11.

XIX.—PAPER, PASTEBOARD, ETC.

APPLICATIONS.

927. R. N. Redmayne. An improvement in the manufacture of pulp for paper-making and other purposes. January 19.

1522. W. E. Benger. An improved substitute for paper upon which to make water-coloured drawings. January 27.

2216. J. L. Lees. Improvement in writing-paper. February 6.

2349. J. C. Juel and E. Ryan. Improvements in purifying wood pulp, and in apparatus therefor. Complete Specification. February 9.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES, AND EXTRACTS.

APPLICATION.

1271. H. W. Hart. Improved method of or process for treating coffee berries and producing an extract therefrom. January 23.

COMPLETE SPECIFICATION ACCEPTED.

1890.

5366. O. Imray.—From The Farbwerke Meister, Lucius, and Brüning. Production of guaiacol ether. January 28.

XXI.—PHOTOGRAPHIC PROCESSES AND MATERIALS.

APPLICATIONS.

1736. O. Imray.—From The Actien Gesellschaft fur Anilin Fabrikation, Germany. New or improved developers for photographic pictures. January 30.

1953. R. J. Winkoop and J. M. Kemp. Improved apparatus for use in photographic contact printing, a method of preserving sensitised paper, and a protective and adhesive solution therefor. Complete Specification. February 3.

2248. F. W. Verel and W. Hampton. Improvements in preparing, developing, and fixing photographic films. February 7.

2491. Marion and Co. (Leon Marion, G. Bishop, F. Bishop, J. P. Kirk, and H. Guibont). The storing and repeating the discharge of magnesium powder through a gas, oil, or spirit lamp, for use in spirit flash light photography. February 11.

COMPLETE SPECIFICATIONS ACCEPTED.

1890.

3393. E. W. Foxlee. Sensitised flexible film for photographic purposes. February 11.

14,189. V. Planchon. Films for use in photography. February 11.

XXII.—EXPLOSIVES, MATCHES, Etc.

Applications.

1054. R. C. Hanrott and S. D. Cox. An improved process for the production and purifying of peat charcoal for the manufacture of dynamite and other explosives. January 20.

1120. L. Errani and M. J. Berg. Improvements in the manufacture of matches. January 26.

2044. N. Erbsloh. A new or improved fuse for igniting the explosive charges of shells and other projectiles. February 4.

2246. H. D. Peckover. Waterproofing matches, explosive substances, fuses, &c. February 7.

2321. G. J. Meyer. Improvements in fireworks. February 9.

2656. O. Bowen. Improvements relating to the production of charcoal for the manufacture of gunpowder. February 13.

Complete Specifications Accepted.

1890.

2883. D. D. Esson. Fuses for projectiles. January 28.

3852. H. H. Lake.—From S. H. Emmens. Explosives. February 18.

5157. A. Noble and G. Stewart. Manufacture of pellets or plungers for percussion fuses. February 4.

20,978. H. H. Lake.—From G. M. Mowbray. Manufacture of nitrocellulose or pyroxylin. January 28.

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Blake, F. C., of Pittsburg, at Helena, Mont., U.S.A., February 21st.

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SESSION 1890—91.

April 6th:—
Election of five members to replace an equal number retiring from Committee. Nominations to be sent to the Hon. Secretary on or before Monday, March 24th.
Professor Vivian B. Lewes:—
1. "The Analysis of Illuminating Gases."
2. "The Products of Checked Combustion."

April 20th.—Mr. W. P. Rix. "Stoneware; and its Application to Chemical Apparatus."

May 4th.—Mr. L. Archbutt and Mr. R. M. Deeley. "An Improved Process for Softening and Clarifying Water."

June 1st.—Dr. W. S. Squire. "The Artificial Production of Cold theoretically and practically explained."

Meeting held Monday, February 2nd, 1891.

MR. THOS. TYRER IN THE CHAIR.

ON STANDARD SPERM CANDLES.

BY W. C. YOUNG, F.I.C., F.C.S.,

Gas Examiner to the Corporations of London, West Ham, Hastings, and Bedford, and to the Carshalton Local Board.

A common expression used in reference to sperm candles as standards of light for coal-gas is, "I get very good results when they are properly used," but it is very difficult to get a clear definition of what constitutes the proper method of using them. During the 30 years sperm candles have held the position of legal standards of light several attempts have been made to abolish them, none of which have yet been successful, and as in all probability they will continue the standard of comparison for some time to come, it is desirable to ascertain if it be possible that they can be so used as to give practically uniform results. Experienced photometrists, even those who have been foremost in condemning sperm candles, agree that by careful use fairly reliable results may be obtained with them, especially when an average of several experiments is taken. This being so one would, of course, expect that the Metropolitan Gas Referees, who were constituted eight years after the sperm candle standard was legalised, would, in their half-yearly notification, give such directions for using candles as would ensure uniformity of method and reliable results. On referring to these official documents I find that for some years all that they contained was the following: "The candles are to be lighted at least 10 minutes before the beginning of each testing so as to have arrived at their normal rate of burning, which is shown when the wick is slightly bent and the tip glowing." In 1877 this direction was altered to the following: "The candles are to be lighted at least 10 minutes before the beginning of each testing, so as to have obtained their normal rate of burning." It would seem that at this date the Gas Referees were of opinion that it was sufficient for the purpose if the candles had been lighted 10 minutes, leaving it to the judgment of the gas examiner to decide whether they were in a fit condition to use or not. In this year the Gas Referees also ordered that all testings were to be rejected where the candles burnt more than 126 or less than 114 grains per hour. In 1889 (13 years after I first called attention to the matter) some notice is taken of the circumstance that the flames of the candles are central only when the wicks are in a certain relative position, and that they are continually shifting their positions, by the insertion in the notification of directions intended to overcome this difficulty, and for the first time the gas examiner is required to use a different candle for each testing in the day's work.

I need scarcely say that even the latest directions of the Gas Referees are insufficient to ensure uniform results, and that a difference of at least a candle is of frequent occurrence in practice.

I have used sperm candles for testing gas daily for 23 years, and have devoted much attention to them for the purpose of ascertaining the causes of their defects and the means of remedying them. From time to time since 1876 I have stated, in the correspondence column of the "Gas Journal," my opinions on the subject, and in Vol. 52, p. 207, will be found a letter in which I detail the mode in which candles should be used so as to give fairly uniform results. The mode there stated is as follows:—

1. They should have been burnt until the tips of the wicks glow, blown out and allowed to cool, at least three times before use.
2. The tips of the wicks should be not more than three-eighths of an inch from the top of the candle.
3. They should never be allowed to burn more than 15 or less than 10 minutes before use.

I had arrived at this method by observations made in the discharge of my official duties as gas examiner, with the addition of special experiments made from time to time as occasion arose, but up to that date I had not made any systematic investigation of the subject. Seeing the great necessity of such an investigation I commenced a long series of experiments, the results of which form the substance of this paper.

At the outset I experienced great difficulty in devising some means by which a uniform volume of light could be conveniently produced at any moment for the purpose of testing the candles with, but ultimately, by means of a simple apparatus applied to the London Argand burner, prescribed by the Gas Referees as the test burner for the Metropolis, I succeeded fairly well. This apparatus consists of a screen of fine wire gauze fitted tightly to the outer rim of the gallery of the burner, and extending three or four inches below, the bottom being closed by resting on the bottom of the photometer case. In this way the currents of air supplying the burner are equalised, with the result that the flame burns, in a good burner, with a perfectly even top, so that it can easily be measured, up to 2·8 in., to within a tenth of an inch. Flames above this length become uneven, rendering exact measurement almost impossible. This little apparatus will be found of great assistance when it is desired to read the length of a flame, and can be obtained of Messrs. Sugg and Co.

After a few preliminary experiments I found a 2½-in. flame the most promising for my purpose, and accordingly I adopted that length of flame in all the experiments to be described; a modified Evan's, in which the disc was stationary, being the photometer employed. The temperature of the room varied, throughout the experiments, between 58° and 68° F., strict cleanliness in regard to the candles being constantly observed.

With a view to ascertaining the value in candles of a 2½-in. gas flame, I tested it against candles selected as fulfilling as near as possible my requirements of what candles should be so as to give an amount of light proportionate to the sperm consumed, but they were not interfered with in any way either before or during the experiments.

Twenty-five different candles (Miller's make, the wicks containing 23 threads in each strand) were tried with the following results:—

Highest = 14·34. Candles burning 120 grs. sperm per hour.
Lowest = 13·90. " " "
Mean = 14·18. " " "

Consumption of sperm varied between 37·8 and 41·8 grs. in 10 minutes.

These results give a mean value of 14·18 candles to the 2½-in. flame, and show conclusively that candles can be obtained that will give uniform results; and further that a 2½-in. flame of common coal-gas in a London Argand burner produces the same amount of light no matter whether the quality of the gas be 15·5 or 17 candles, as the gas used in these experiments varied to that extent.

I may mention here that I have tested 2½-in. flames of Pintsch's oil-gas of 38 and 40 candles power and of carburetted coal-gas of 18 and 20 candles power respectively, and obtained the same results; but with Steinberg's carburetted water-gas, a mixture of carburetted water-gas made by Meeze's process and coal-gas, and coal-gas enriched by petroleum instead of cannel coal, as in Good's patent process, the results have been much higher. I shall have occasion to refer again to these latter cases further on.

Having demonstrated that my 2½-in. flame could be relied upon as sufficiently invariable in illuminating power for my purpose, my next step was to employ candles without regard to the condition or shape of the wicks. Three candles were taken, cut in halves and burnt from the centre in the usual way. They were all allowed to burn until the wicks glowed but not longer, before commencing the test, and were extinguished by blowing out immediately the test was completed. Four tests were taken with each candle, and at least an hour's interval allowed between any two tests with the same candle. The results are recorded consecutively in Table I.

Table I.

Miller's Candles.

Wicks contain 23 threads in each strand.

No. 1 Candle.		No. 2 Candle.		No. 3 Candle.	
Result in Candles burning 120 Grs. per Hour.	Grains Sperm burnt in 10 Minutes.	Result in Candles burning 120 Grs. per Hour.	Grains Sperm burnt in 10 Minutes.	Result in Candles burning 120 Grs. per Hour.	Grains Sperm burnt in 10 Minutes.
15·84	40·1	15·03	41·4	16·32	40·1
14·08	40·8	14·87	42·2	15·76	39·5
14·51	40·8	14·50	40·2	14·80	41·7
14·35	39·8	14·23	39·0	14·56	40·1

An examination of these figures shows a variation, in candle No. 1, of 1·49; in No. 2, of ·78; and in No. 3, of 1·96 candles in the value given to the gas flame, thus confirming in a marked manner the bad results recorded by various operators. It will also be seen that the result diminishes as the candles burn away, until at the fourth test taken with them it approaches near to the mean value given to the gas flame by the experiments recorded in Table I. In order to ascertain whether, after the third test with a candle, the results continue uniform or not, three candles were taken and used in the same way as the others, but continuing the tests until the whole of the candle was consumed. It was found that with care eight tests could be obtained from one candle. The results in consecutive order are stated in the following table:—

Table II.

Miller's Candles.

Wicks contain 23 threads in each strand.

No. 1 Candle.		No. 2 Candle.		No. 3 Candle.	
Result in Candles burning 120 Grs. per Hour.	Grains Sperm burnt in 10 Minutes.	Result in Candles burning 120 Grs. per Hour.	Grains Sperm burnt in 10 Minutes.	Result in Candles burning 120 Grs. per Hour.	Grains Sperm burnt in 10 Minutes.
15·12	39·2	*15·68*	*38·2*	*15·05*	39·0
15·90	40·7	15·19	39·1	14·67	38·7
14·75	41·2	15·18	39·6	14·33	39·7
14·33	40·6	14·97	39·3	14·10	38·8
14·31	41·7	14·61	39·6	14·23	39·8
14·31	40·5	14·22	39·5	*13·95*	41·1
13·97	40·5	13·98	40·7	14·26	41·6
14·30	41·4	*13·95*	40·5	14·16	40·0
14·65 = mean.		14·72 = mean.		14·38 = mean.	

Note.—The figures in italics denote the highest and lowest results in each set of experiments.

The same result is shown here as in Table II., viz., that the first few tests are much higher than the others, and, further, that when the real value of the gas flame is approached, the results do not afterwards vary greatly, this condition of the candle arriving at the fourth test in No. 1, the sixth in No. 2, and the third in No. 3.

A close examination of the wicks of these several candles at once revealed the cause of the excessive results given in the earlier tests, as in every case they were rough, either with deposited carbon or loose fibres, or both, and the worse they were in this respect, the higher the result obtained.

By carefully trimming the wick before use, removing loose fibres and soot with the end of a pair of tweezers, and gently bending the wick down until the tip is within ⅜ in. from the top of the candle, the candles are brought into a condition similar to that in which they are found after being used several times as I have just described. A rather longer time is necessary for bringing them into condition when first used than in subsequent tests, and more attention is then required, but after the first burning they give very little trouble, provided they are used as soon as ready and not allowed to burn a longer time than 15 minutes. If, on lighting, the flame runs down the wick and burns through it a short distance from the tip, leaving a small piece unburnt, this should be removed, as otherwise it either falls into the melted sperm beneath, and ultimately gets drawn on to the wick, making it rough, or burns to ash suddenly, and, fusing, forms a bead on the tip which is difficult to remove, and interferes with the proper burning of the candle. Occasionally in cold weather, but not frequently, the wick will, soon after lighting, curl under, forming what has been called a "pigtail" wick, which causes guttering. This should be cut off with thin clean scissors, after which the candle will usually burn in its normal way.

Having shown the great variation in the results given by candles used indiscriminately and, I venture to think, the cause of some of the discrepancies complained of by official gas examiners and others, I proceeded to use

candles with the wicks carefully trimmed and regulated as I have just described. Six candles were taken, of the same make as those previously used, and eight tests, or as many as possible, taken with each. The following results, stated in the order in which they were taken, were obtained :—

TABLE III.

MILLER'S CANDLES.

Wicks contain 23 threads in each strand.

No. 1 Candle.		No. 2 Candle.		No. 3 Candle.	
Result in Candles burning 120 Grs. per Hour.	Grains Sperm burnt in 10 Minutes.	Result in Candles burning 120 Grs. per Hour.	Grains Sperm burnt in 10 Minutes.	Result in Candles burning 120 Grs. per Hour.	Grains Sperm burnt in 10 Minutes.
14·12	41·0	14·12	40·0	14·04	39·9
14·07	39·7	13·94	40·0	13·99	39·8
13·99	40·6	14·18	39·3	14·10	40·0
14·14	39·4	14·17	39·0	14·31	42·1
14·04	40·3	14·18	38·5	14·64	40·3
13·91	40·6	14·11	39·8	13·99	40·8
13·94	40·4	13·99	41·5	13·88	41·0
14·30	39·7	14·22	41·1	14·40	41·0
14·11 = mean.		14·10 = mean.		14·17 = mean.	

No. 4 Candle.		No. 5 Candle.		No. 6 Candle.	
Result in Candles burning 120 Grs. per Hour.	Grains Sperm burnt in 10 Minutes.	Result in Candles burning 120 Grs. per Hour.	Grains Sperm burnt in 10 Minutes.	Result in Candles burning 120 Grs. per Hour.	Grains Sperm burnt in 10 Minutes.
14·60	40·4	14·35	40·4	14·24	39·9
14·09	40·3	14·08	41·0	13·89	41·4
14·04	42·0	14·32	40·8	14·54	41·5
13·92	40·6	13·90	39·7	14·04	40·6
14·09	41·5	13·92	39·7	13·86	41·8
14·08	40·1	14·15	40·5	14·09	39·2
14·04	40·3	14·35	40·9	13·96	39·1
14·02	39·0	Lost.		13·86	41·0
14·10 = mean.		14·15 = mean.		14·06 = mean.	

It will at once be seen from these results that the figures obtained are much closer than in the former experiments, and that the enormous variations disappear. I think it worthy of especial notice that the mean results obtained with each candle is practically the same, showing that, at any rate with this particular make of candle, really uniform results may be obtained if the mean of eight tests with one candle be taken when the precautions I have indicated have been observed.

In all the foregoing experiments the same make of candle was employed. In order to ascertain whether other varieties would give similar results, I obtained samples of the candles used for the official testings at various provincial gasworks whose gas I have to test periodically for the local authorities, and from other sources, and tested them against the $2\frac{1}{2}$-in. flame, having previously trimmed and regulated the wicks. The results are stated consecutively in Table IV.

TABLE IV.—CANDLES OF VARIOUS MAKES.

SAMPLE A.

Wicks contained two strands of 22 threads, and one of 23.

No. 1 Candle.		No. 2 Candle.		No. 3 Candle.	
Result in Candles burning 120 Grs. per Hour.	Grains Sperm burnt in 10 Minutes.	Result in Candles burning 120 Grs. per Hour.	Grains Sperm burnt in 10 Minutes.	Result in Candles burning 120 Grs. per Hour.	Grains Sperm burnt in 10 Minutes.
14·46	41·2	14·57	43·0	14·09	40·2
14·19	41·5	14·20	42·0	13·83	39·4
14·23	41·9	13·65	42·2	14·06	40·0
14·06	43·8	14·10	41·6	13·99	39·8
14·04	40·8	14·20	43·2	13·95	38·6
14·04	41·6	14·13	41·2	13·94	40·0
13·96	41·6	13·96	40·9	14·13	39·2
Lost.		14·06	40·2	14·85	39·6
14·14 = mean.		14·10 = mean.		14·01 = mean.	

SAMPLE B.

Wicks contained 21 threads in each strand.

No. 1 Candle.		No. 2 Candle.		No. 3 Candle.	
Result in Candles burning 120 Grs. per Hour.	Grains Sperm burnt in 10 Minutes.	Result in Candles burning 120 Grs. per Hour.	Grains Sperm burnt in 10 Minutes.	Result in Candles burning 120 Grs. per Hour.	Grains Sperm burnt in 10 Minutes.
13·93	38·8	14·57	39·5	14·59	38·3
14·05	40·1	14·57	40·6	14·64	39·8
14·24	39·8	14·58	42·1	14·01	40·5
14·59	41·0	14·42	40·1	14·34	39·8
14·28	41·0	14·35	41·9	14·57	40·7
14·27	40·6	14·08	39·5	14·08	40·0
14·45	39·6	14·84	41·0	14·26	38·2
14·21	39·7	14·32	40·0	14·26	38·1
14·25 = mean.		14·31 = mean.		14·34 = mean.	

SAMPLE C.

Wicks contained two strands of 23 threads, and one of 22.

No. 1 Candle.		No. 2 Candle.		No. 3 Candle.	
Result in Candles burning 120 Grs. per Hour.	Grains Sperm burnt in 10 Minutes.	Result in Candles burning 120 Grs. per Hour.	Grains Sperm burnt in 10 Minutes.	Result in Candles burning 120 Grs. per Hour.	Grains Sperm burnt in 10 Minutes.
14·50	39·8	14·48	40·8	14·56	39·7
14·14	39·9	14·04	39·4	14·18	40·5
14·29	38·8	14·32	39·9	14·28	39·8
14·31	39·7	14·10	40·3	14·01	41·2
13·93	40·6	14·18	40·3	13·98	38·6
14·24	39·9	14·11	39·2	13·95	39·8
14·12	39·9	14·27	39·5	14·03	41·4
14·29	40·5	14·24	40·8	14·02	40·0
14·21 = mean.		14·22 = mean.		14·21 mean.	

SAMPLE D.

Wicks contained 18 threads in each strand.

No. 1 Candle.		No. 2 Candle.		No. 3 Candle.	
Result in Candles burning 120 Grs. per Hour.	Grains Sperm burnt in 10 Minutes.	Result in Candles burning 120 Grs. per Hour.	Grains Sperm burnt in 10 Minutes.	Result in Candles burning 120 Grs. per Hour.	Grains Sperm burnt in 10 Minutes.
14·04	42·9	13·10	44·9	14·02	42·8
13·96	43·2	14·35	42·7	14·26	42·8
14·27	42·9	14·12	42·6	13·99	44·5
14·02	42·8	13·97	42·2	13·95	44·5
13·91	43·0	13·98	42·5	13·97	44·0
14·12	44·0	14·02	42·6	13·86	42·3
14·22	42·9	14·05	42·3	13·94	42·7
Lost.		14·24	43·4	14·17	43·6
14·09 = mean.		14·02 = mean.		13·97 = mean.	

SAMPLE E.

Wicks contained 21 threads in each strand.

No. 1 Candle.		No. 2 Candle.		No. 3 Candle.	
Result in Candles burning 120 Grs. per Hour.	Grains Sperm burnt in 10 Minutes.	Result in Candles burning 120 Grs. per Hour.	Grains Sperm burnt in 10 Minutes.	Result in Candles burning 120 Grs. per Hour.	Grains Sperm burnt in 10 Minutes.
14·38	39·2	14·30	39·6	14·27	38·8
14·19	40·9	14·06	39·0	14·12	40·7
14·12	40·1	14·08	40·1	14·22	40·0
14·17	40·6	14·31	40·7	14·04	40·2
14·18	40·2	14·25	39·6	14·28	40·3
14·21	39·3	14·12	38·7	14·35	40·9
14·18	38·6	14·04	39·7	14·29	38·9
14·33 mean.		14·18 mean.		14·24 mean.	

NOTE.—The tests with sample E. candles were commenced with a fresh graduated chimney, the one used in all the previous experiments having unfortunately been broken, when the first tests with the three candles gave as results 15·29, 14·20, and 15·04 respectively. These results being abnormally high, my suspicions were raised as to the correctness of the graduations on the chimney. On testing these I found they were placed nearly a tenth of an inch too high. The chimney was therefore rejected, and another, correctly graduated, taken, which was used in all the succeeding experiments.

SAMPLE F.

Wicks contained 21 threads in each strand.

No. 1 Candle.		No. 2 Candle.		No. 3 Candle.	
Result in Candles burning 120 Grs. per Hour.	Grains Sperm burnt in 10 Minutes.	Result in Candles burning 120 Grs. per Hour.	Grains Sperm burnt in 10 Minutes.	Result in Candles burning 120 Grs. per Hour.	Grains Sperm burnt in 10 Minutes.
14·36	37·4	14·25	36·8	14·26	38·6
14·19	38·6	14·19	38·6	14·10	38·8
13·94	38·0	14·28	39·2	14·04	38·6
14·15	36·7	14·30	38·8	14·22	39·4
14·24	39·4	14·25	37·9	14·04	40·7
14·11	36·8	14·10	39·0	14·20	38·3
14·05	38·6	14·16	39·4	14·02	37·4
14·23	37·8	14·02	36·8	14·10	36·8
14·19 = mean.		14·19 = mean.		14·11 = mean.	

SAMPLE G.

Wicks contained two strands of 21 threads, and one of 22.

No. 1 Candle.		No. 2 Candle.	
Result in Candles burning 120 Grs. per Hour.	Grains Sperm burnt in 10 Minutes.	Result in Candles burning 120 Grs. per Hour.	Grains Sperm burnt in 10 Minutes.
14·27	39·7	14·23	38·0
14·01	38·5	14·01	37·6
14·18	39·2	14·17	39·7
13·94	39·9	13·94	39·2
13·98	39·5	13·90	39·3
14·26	39·1	14·18	39·0
14·10	39·1	14·27	39·1
14·33	37·7	14·34	40·4
14·19 = mean.		14·18 = mean.	

The candles employed in the foregoing experiments comprise, as will be seen, a variety of makes, as indicated by the number of threads in the wicks, yet the results obtained are practically the same with each variety, the mean results being remarkably close to the mean value given to the gas flame. I may point out that the consumption of sperm appears to bear little relation to the number of threads in the wick, and that the candles with the least burnt the largest quantity. It is therefore evident that the consumption of sperm is affected more by the manner in which the wick is plaited than by the number of threads it contains.

On comparing the results obtained with the sperm burnt, these experiments will be found to show very clearly that the quantity of sperm consumed has little or no effect upon the result; or in other words, that the light given by the candle is fairly proportionate to the sperm burnt within the ranges shown. The highest consumption of sperm was 45·4 grains in 10 minutes, and the lowest 36·3, the values given to the gas flame being 14·24 and 14 respectively.

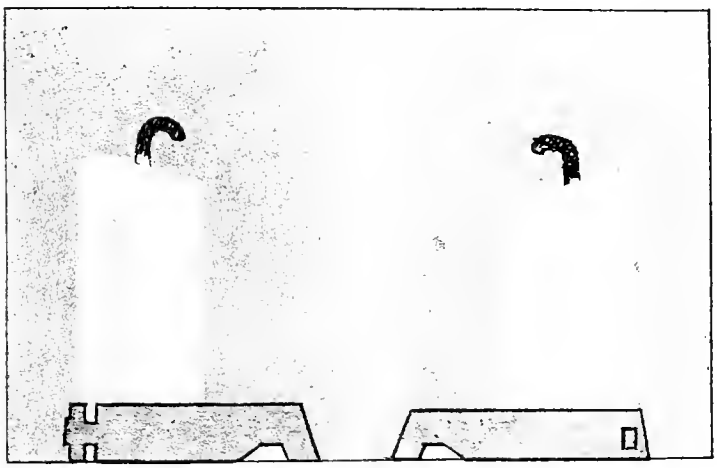
At this stage of my paper it will be instructive to consider the bearing which these results have upon the methods at present in use at the metropolitan testing stations with regard to candles. Up to April 1889 the Gas Referees permitted the gas examiners to use the same candle for the three daily tests, the average of which represents the illuminating power for the day, but since that date they have ordered that different candles shall be used for each test. The effect of this is that two gas examiners testing the same gas may obtain totally different results, for if one works with three fresh candles he may report the gas as a candle and a half higher than another who employs candles that have already been used several times. Under the old regulations a better average of the candle was possible, and as a consequence disputes were less frequent. I have also shown that the restrictions imposed of late years by the Gas Referees as to the sperm burnt by the candles are quite unnecessary.

On comparing the method adopted with the candles in the experiments recorded in Tables III. and IV. with that suggested in my letter to the "Gas Journal" (vol. 52, p. 207), it will be noticed that I omitted in the former to burn the candles three times to a glowing wick before using them, but commenced testing with them as soon as the wicks were smooth and burnt with a bright glowing tip. I did this in order that as many tests should be obtained with each candle as in the previous experiments, where no precautions were taken beyond waiting until the tips of the wicks glowed before commencing.

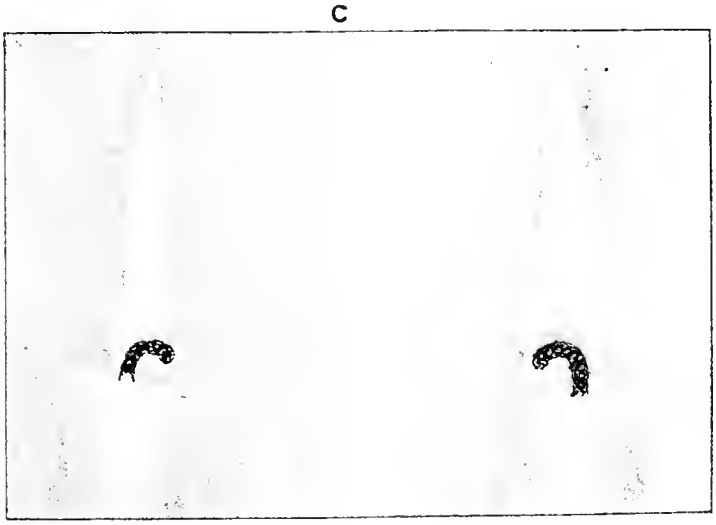
My next experiments were made in accordance with the suggestions in the letter referred to, and the wicks were further assisted to burn into proper condition by gently

A

B



C



bending them downwards when necessary and removing all loose fibres. The candles were all of the same make as those used in the experiments recorded in Tables I. to III. Six tests were made with each candle, that being as many as could conveniently be obtained, and at least an hour's interval elapsed between any two tests with the same candle. The results, stated in consecutive order, were as follows :—

TABLE V.

No. 1 Candle.		No. 2 Candle.		No. 3 Candle.	
Result in Candles burning 120 Grs. per Hour.	Grains Sperm burnt in 10 Minutes.	Result in Candles burning 120 Grs. per Hour.	Grains Sperm burnt in 10 Minutes.	Result in Candles burning 120 Grs. per Hour.	Grains Sperm burnt in 10 Minutes.
13·94	40·3	14·38	39·9	14·36	39·8
14·03	42·5	14·12	40·0	14·42	39·2
14·34	42·0	14·08	39·1	14·02	38·3
14·32	41·4	14·24	41·7	14·47	39·7
14·35	43·7	13·94	41·0	14·02	41·0
14·24	41·6	14·11	40·5	14·25	40·2
14·20 = mean.		14·14 = mean.		14·25 = mean.	

No. 4 Candle.		No. 5 Candle.		No. 6 Candle.	
Result in Candles burning 120 Grs. per Hour.	Grains Sperm burnt in 10 Minutes.	Result in Candles burning 120 Grs. per Hour.	Grains Sperm burnt in 10 Minutes.	Result in Candles burning 120 Grs. per Hour.	Grains Sperm burnt in 10 Minutes.
13·98	39·2	14·03	41·7	14·37	41·6
14·00	39·5	14·08	41·8	14·28	41·1
14·01	40·8	13·98	41·4	14·22	40·8
14·26	41·0	13·99	41·9	14·48	41·8
14·18	41·0	13·94	40·3	13·91	43·6
14·18	40·7	Lost.		14·20	42·6
14·10 = mean.		14·00 = mean.		14·24 = mean.	

These results are even less variable than those recorded in Table IV., and the several means equally uniform, showing that in this way the number of tests necessary to ensure a reliable result may be reduced to six.

If this method were adopted (with an average of six tests) at the public gas-testing offices it would, of course, double the work required of the gas examiners, but a further examination of the results will show that an average of three tests by this method gives equally satisfactory results. The tests, as regards the position of the wicks in relation to each other, and the interval elapsing between each test, were all taken in accordance with the Gas Referees' recent notifications, and assuming that they were the official tests for the several days, the results would be recorded as follows :—

1st day	14·23
2nd „	14·19
3rd „	14·15
4th „	14·34
5th „	14·10
6th „	14·20
7th „	14·13
8th „	14·12
9th „	14·07
10th „	14·24
11th „	14·01
12th „	14·19 (mean of two tests)

showing a maximum variation of only a third of a candle in the illuminating power of the gas flame in 12 days' work. It may reasonably be supposed that the 2½-in. gas flame employed varied slightly in illuminating power from time to time, but even if it is assumed to have been absolutely invariable, and the whole of the differences in the results attributed to the candles, these experiments prove that sperm candles can be so used as to give very satisfactory results.

Candles as a standard of light have got into bad repute through being looked upon as a rough and ready measure, instead of being treated as a scientific instrument. My suggestion (the outcome of these experiments) is that they should always, before use, be brought into a uniform condition as regards shape and state of the wicks. Opinions may differ as to what that shape should be, but all will agree that the wicks should be clean and free from loose fibres. The shape I have adopted is that which they naturally assume, in the majority of cases, after the candles have been burnt and extinguished three or four times, and which enables them to be properly consumed, as the ash flies off in sparks and does not accumulate on the tips, and prevents the deposition of soot. This shape is also generally retained as long as the candles last, if they are burnt only long enough for the tips of the wicks to glow before commencing a test, which is from 10 to 15 minutes, and are extinguished by blowing out immediately the test is completed.

The accompanying photographs illustrate, more clearly than I can describe, the shape of wick I advocate.

A shows the shape of the wick for the first two or three times of using a candle, if allowed to burn without interference, and is the condition which gives variable and unsatisfactory results.

B and C show the shape of wick I advocate.

In the discharge of my duties as gas examiner I have noticed that, although I could get very uniform results in tests taken immediately following each other (when the chimney on the burner was not changed) with candles used as in the experiments last described, yet tests taken with intervals between each of at least an hour gave results not always as uniform as I expected from the length of the flames. I was not surprised at this when the flames approached or exceeded 3 inches in length, as I have already stated that above 2·8 in. it is difficult to read the length exactly, but with 2·7-in. flames one would expect uniformity in results, and I have occasionally failed to get it. In all my experiments with 2½-in. flames only two different chimneys were used, these were of the same colour, thickness and dimensions, and invariably placed in the same position on the burner so as to present the same face to the photometer disc in each experiment. In my daily official tests a different chimney was always used for each. It occurred to me that the discrepancies might be due to the chimneys. On examining my stock I found they were all of a smoky brown colour, and varied very much in thickness. They varied also in internal diameter, and not one was perfectly cylindrical, all being wider at one end than at the other.

I made a number of tests immediately following each other with thick and thin chimneys, varying in thickness from $\frac{1}{8}$ to $\frac{1}{16}$ of an inch, taking especial care with the candles. The results are below :—

No.	Thick.	Thin.	No.	Thick.	Thin.
1	15·53	15·93	8	15·43	16·36
2	15·94	16·68	9	15·98	16·36
3	15·48	16·28	10	16·06	16·63
4	15·85	16·53	11	16·34	16·83
5	16·09	16·65	12	16·17	16·68
6	16·08	16·50	13	16·10	16·55
7	16·77	17·48			

These results show very conclusively that the thickness of the glass had a considerable effect on the illuminating power, and in order to see if the colour of the glass had anything to do with it, I made comparative tests with thick and thin brown glass, and thick very pale amethyst glass chimneys. The amethyst chimney was thicker than the thickest brown one, but was more cylindrical. The results were as follows:—

No.	Thick Amethyst.	Thick Brown.	Thin Brown.
1	16·24	..	16·18
2	16·00	15·25	..
3	16·12	15·85	..
4	16·29	16·02	..
5	15·90	15·68	16·12
6	16·24	15·65	16·17

These results show that the colour of the glass had a most important effect on the light of the flame, and should not be disregarded when accurate work is to be done. The thickness of the glass also, apart from the colour, appears to be of importance. It seems probable that the light of the gas may be further influenced by the diameter and shape of the chimney, but I have not had time to put the matter to the test. Where the dimensions of the test burner are stated in an Act of Parliament the height and diameter of the chimney are given, but none of those Acts with which I am acquainted states whether the internal or external dimensions are to be taken, or if it should be perfectly cylindrical. It seems to me that the internal measurement is the only proper one to take, and the Gas Referees also take this view, but recently, in a dispute on this point in the provinces, the makers of the burner, Messrs. Sugg and Co., contended that it should be the external. The subject is most important and calls for more attention than it has hitherto received.

On completing these experiments I proceeded to make my daily official tests, using the same chimney for each and marking it so that I could always ensure placing it on the burner in the same position. The candles were treated as in the experiments recorded in Table VI., and the length of the gas flame taken immediately before the commencement of each test.

I may mention that an official of the gas company was present at each test. I give below the results of each test for 18 days:—

TABLE VII.

Official Tests taken at the City of London Testing Station, 3, Jewry Street, Aldgate.

No. of Candle.	Result in Candles burning 120 Grs. per Hour.	Grains Sperm burnt in 10 Minutes.	Approximate Height of Flame.	Date.
			Inches.	
1	16·04	39·4	3·0	18 March.
2	16·07	41·0	3·0	,,
3	16·14	40·2	3·0	,,
1	16·20	39·0	3·0	19 March.
2	16·29	42·2	3·1	,,
3	15·84	40·4	3·0	,,
1	15·78	39·4	3·0	20 March.
2	15·84	39·7	3·0	,,
3	16·02	40·5	3·0	,,
1	15·94	40·2	3·0	21 March.
2	15·78	38·3	3·0	,,
3	15·98	39·5	3·0	,,

TABLE VII.—*cont.*

No. of Candle.	Result in Candles burning 120 Grs. per Hour.	Grains Sperm burnt in 10 Minutes.	Approximate Height of Flame.	Date.
			Inches.	
1	15·78	42·2	3·0	22 March.
2	15·70	39·8	3·0	,,
3	16·24	41·7	3·0	,,
1	15·77	40·9	2·9	24 March.
2	16·24	40·7	3·0	,,
3	16·03	41·9	3·0	,,
1	16·04	45·9	3·0	25 March.
2	15·87	39·0	3·0	,,
3	15·80	39·0	3·0	,,
1	16·08	40·3	3·1	26 March.
2	16·17	39·4	3·1	,,
3	16·00	42·6	3·0	,,
1	16·84	40·6	2·9	27 March.
2	16·16	39·6	3·0	,,
3	16·10	40·2	3·0	,,
1	15·30	41·7	2·8	28 March.
2	15·76	38·2	2·9	,,
3	15·66	39·6	2·9	,,
1	16·22	41·8	3·0	29 March.
2	15·96	40·0	3·0	,,
3	16·30	40·0	3·0	,,
1	16·08	39·5	3·1	31 March.
2	16·84	41·8	3·2	,,
3	16·74	41·6	3·2	,,
7	16·54	40·4	3·1	1 April.
8	16·15	41·4	3·0	,,
9	16·72	41·6	3·1	,,
7	15·94	41·4	3·0	2 April.
8	15·93	40·6	3·0	,,
9	16·24	39·1	3·0	,,
7	16·14	40·1	2·9	3 April.
8	16·70	42·9	3·1	,,
9	16·63	40·5	3·1	,,
7	16·09	41·8	3·0	8 April.
8	16·30	40·3	3·1	,,
9	16·59	40·7	3·1	,,
7	16·38	40·8	3·1	9 April.
8	16·81	42·4	3·2	,,
9	16·42	41·6	3·1	,,
7	15·98	42·0	3·0	10 April.
8	16·03	41·9	3·0	,,
9	16·34	41·5	3·0	,,

Taking into consideration the fact that the heights of flames recorded are only approximate, and that a difference of a tenth of an inch in the flame more or less must greatly alter the light, I think, with only three or four exceptions, these results give favourable evidence for candles as a

practical standard of light. Taking the results in the order of the heights of the flames they appear as follows :—

2·9-in.	3-in.	3-in.	3·1-in.
16·06	16·20	16·16	16·39
16·07	15·94	16·10	16·08
16·04	15·78	16·22	16·17
15·84	15·98	15·96	16·08
15·78	15·78	16·30	16·54
15·84	15·70	16·15	16·72
16·02	16·24	15·94	16·50
15·77	16·24	15·63	16·63
15·81	16·03	16·24	16·30
15·76	16·04	16·09	16·59
15·66	15·87	15·98	16·38
16·14	15·80	16·03	16·12
..	16·00	16·54	..

	2·9-in.	3-in.	3·1-in.
Percentage of results close to 1 per cent. of mean.	83·3	76·9	50

There were in addition one instance of a 2·8-in. flame, and three of 3·2-in. flames, the results being 15·3 and 16·84, 16·74 and 16·81 respectively.

Viewed in this way, the results seem to indicate that the variations are not due to the candles, but attributable to the difficulty of exactly measuring the flame. I have already stated that the longer the flame the more uncertain the measurement becomes, and this table shows that with the shortest flame (2·9 in.) the results are most uniform and with the longest (3·1 in.) least uniform.

Two days after the date of the last tests mentioned above, my station was closed for alterations, and on those days I varied the proceedings by using the same candle for each test, the results being as follows :—

Result in Candles burning 120 Grs. Sperm per Hour.	Grains Sperm burnt in 10 Minutes.	Approximate Height of Flame.	Date.
		Inches.	
16·60	40·3	3·2	11 April.
16·80	40·0	3·2	,,
16·59	40·6	3·2	,,
16·62	39·9	3·2	12 April.
16·90	39·3	3·2	,,
16·70	39·1	3·2	,,

I think I have shown conclusively: 1st, that standard sperm candles may be relied upon to give fairly uniform results if due regard is paid to the condition and shape of the wicks before commencing an experiment; 2nd, that the light they give is practically proportional to the sperm burnt far outside the limits fixed by the Gas Referees; 3rd, that the number of threads forming the wicks within certain limits is immaterial; and 4th, that the glass chimneys used with the test burner should be uniform in colour and thickness in order to obtain accurate results.

In conclusion I may mention some experiments I have made with one of the latest proposed standards of light, viz., Harcourt's 16-candle standard. In the early part of this paper I stated that I had found that, 2½-in. flames in the 16-candle test burner of coal-gas, carburetted coal-gas (*i.e.*, coal-gas passed over cold petroleum spirit as in Lowe's carburetter, or hot as in Maxim's) and of Pintsch's oil-gas, all possessed the same lighting power, but that a similar length of flame of Steinbergh's carburetted water-gas, of a mixture of coal-gas and carburetted water-gas made by Meeze's process and of coal-gas enriched with petroleum oil instead of cannel coal, as in Good's patent (in which the petroleum is injected into the gas retorts when the charge is nearly exhausted), gave much higher results. My experiments show that with Steinbergh's gas the 2½-in. flame equals 18 candles, with coal-gas and Meeze's carburetted water-gas 16·4 to 17·4 according to the proportion of the latter present, and with gas obtained by Good's method, 15 candles.

In view of the fact that carburetted water-gas is now being made and supplied in England either alone or mixed with coal-gas, it is important to know whether standards of light such as the one under notice are affected by the substitution of such gas for common coal-gas.

Harcourt's 16-candle standard consists of a London Argand burner over which a screen is fixed at a definite height above the top. The gas is turned on at the rate of 4·5 cb. ft. per hour, and sufficient of the gas is then passed through a carburetter containing pentane to produce a flame about 3 in. in length which is shown by the tips of the flame appearing at a peep-hole provided in the screen for the purpose.

By the kindness of Mr. Heisch, who lent me the Harcourt's standard, and of Professor Lewes, who placed at my disposal the gas and photometer at Steinbergh's carburetted water-gas works at Knightsbridge, I was enabled to test the standard when burning carburetted water-gas. The apparatus was set up in the photometer in place of the test burner, and tested against candles. The gas used was of a value of 18·2 candles. Two tests were taken with the following results :—1st = 17·58, 2nd = 17·8 candles instead of 16 candles. Therefore gas of this character possessing an actual illuminating power of about 17·7 candles, when tested by this standard, would be returned as only of 16-candle power.

It is evident, from the result of these experiments, that this proposed standard would be quite unsuitable for testing carburetted water-gas or coal-gas mixed with it in any proportion.

Lowe's jet photometer also gives equally erroneous indications with carburetted water-gas. With a mixture of coal-gas and Meeze's carburetted water-gas I have on several occasions found the jet photometer indicate 16 candles when the quality has really been over 18.

I have no doubt that all other standards of light in which the gas under examination is employed, such as Methven's and Sugg's 10-candle standard, would be found to be affected in the same way, and I hope shortly to have an opportunity of making an exhaustive series of experiments in this direction.

Discussion.

The Chairman having invited discussion—

Mr. W. J. Dibdin said that the facts so ably brought before the Society by the author would have an important bearing upon the future settlement, if ever it came about, of the vexed question of standards of light. Mr. Young had shown that it was quite possible, by means of sperm candles, to obtain definite and constant results. He himself had been able to obtain similar results. The difficulty in his case was not what candles could be made to do if he was allowed to use his own discretion in employing them, but what they would do in his hands when he was tied down by the red tape of Acts of Parliament and the instructions of authorities—instructions no doubt given in good faith, but limited by the terms of an Act of Parliament. The lawyers with whom he was sometimes associated in this matter frequently met his statements with the remark, "Yes, your science is no doubt good, but it is the law that we have to deal with." He had found that, as a rule, science had to take a very minor place in a police court, and in his experience of those unwholesome places he had frequently been made to feel very small when questions

arose involving matters of scientific accuracy. That difficulty was well illustrated in a case relating to the testing of petroleum which had come under his notice. The gentleman who had made the test had omitted to swing the string with a bob at the end, which oscillated while the test was made, and he was honest enough to admit that he had not set it swinging, but said that he did not think it would make any difference to the result. Counsel, however, contended that he had not complied with the Act, and the case was dismissed. And it was the same with them in the matter of candle tests. Therefore it was that they complained of candles as a standard of light, *i.e.*, of candles in their legal aspect. In the laboratory, where the chemist was allowed to use his common sense, much better results were obtained. But then arose the question from the point of view taken by Mr. Young. He would say that process A was a proper one to use. On the other hand, the gas companies would probably object that the results were abnormal, that he had not burnt the candles in the right way; and they would ask that they should be burnt in some other way, so as to give results, say, of 17 candles. He did not blame them. It was a question of two parties having hold of the two ends of a piece of elastic and fighting the question of which was the fixed end and which the moving. That, he thought, summed up the candle controversy. They could work the candles better than they were obliged to do by the Act, and they must endeavour to get an alteration of the Act and more definite instructions. That, however, raised the question whether it would not be better at once to get a new Act of Parliament, which should prescribe a definite and invariable standard that could be worked in only one way. If they used a standard gas, they would have checks on the operations of the examiner, inasmuch as they would know the rate of flow of the gas and the height of the flame. Taking the broad facts of the paper, Mr. Young had told them that a 2½-in. flame from a standard argand burner was equal to about 14·2 candles. In listening to the statements about the 2½-in. flame, the question had occurred to him whether Mr. Young's or the other figure of 16 to 17 candles were the correct one. He was therefore rather sorry not to hear from the author a few comparisons between candles used in the way he proposed and one of the recognised substitutes for candles as a standard of light. Mr. Young had not given any evidence that his method of using the candles was correct, nor any reference to the Parliamentary standard candles. That was an omission which he hoped that the author would take the first opportunity of supplying, for everything depended on whether Mr. Young's figure or the higher figure were correct. Most of the gas people, he thought, would maintain that 14·2 could not possibly be correct. Mention had been made of the German method of using a standard candle. He would, however, remind the author that the Germans did not use a sperm candle, but a paraffin one. They had experienced precisely the same troubles in Germany, and were not out of them yet; in fact in some respects they were waiting to see what course would be taken in England. Germany had appointed a Royal Commission to inquire into all the vexed questions that we were now troubled with in connexion with standards of light. They had decided that it would be best to have a standard paraffin candle manufactured under the immediate supervision of the authorities and sent out in sealed packets, the candles being so marked by a red thread as to be easily identified as genuine standard candles. But the Germans went further; they measured the height of the flame, and if they were not satisfied with its character, they snuffed the wick. That was a practice that in England would be regarded as most objectionable, it being held that the examiners should do nothing which might bias the results. He was reminded of the German practice when listening to the author's statement of how he thought it right to virtually snuff his wicks by burning, blowing out, relighting, and repeating the operation several times, taking care meanwhile that the wick was not bent down too much. They used to know the normal curve of the wick, and the conditions under which they could get satisfactory results. Still, there always remained the initial difficulty—where to fasten the piece of elastic—which position of the wick should be taken. They had, it was now contended by the gas companies, to use the wick, not vertical, but approaching the vertical. That was, in the companies' opinion, the normal candle, and one with a gentle curve was abnormal, because it gave results which were too low. They were, therefore, as far off as ever from a settlement of the question from the candle point of view, and must approach it by some other means. Mr. Young was, he thought, entitled to great credit from a scientific point of view for the information which he had put before them. It was to be regretted that he had not given some definite comparisons of his results with those of known standards; and if he now supplied that omission the value of his contribution would be greatly increased. With regard to the 16-candle argand introduced by Mr. Harcourt, Mr. Young had shown that in using some of the gases which were proposed to be introduced into London, the standard would be no longer reliable. That was an interesting point, but in connexion with it he would like Mr. Young to try the pentane argand which he (Mr. Dibdin) had had the honour of bringing before the Society, in which the standard combustible was absolutely separate from the gas to be tested. This proposed standard, which he had called the pentane argand, was simply a small argand specially constructed to burn a combustible consisting of common atmospheric air charged with vapour of pentane. The use of atmospheric air did away with all the uncertainties of coal-gas. It was perfectly reliable and easily obtainable, and it was equally useful for testing electric lights or oil burners. He had never put it forward in preference to the one-candle pentane flame, but he was sure that if Mr. Young tried it, using atmospheric air and pentane, and keeping his carburettor properly charged with pentane, he would not fail to obtain results of a very satisfactory nature.

Mr. W. Foster said that if, as he understood, Mr. Young proposed to use an argand burner with a metallic gauze round the base for testing various carburetted gases, it would be interesting to have before them a sketch—even of the roughest nature—of the apparatus to be employed.

Mr. Young, interposing, said that he thought Mr. Foster had missed the point with regard to that matter. The burner used was the ordinary test burner in the photometer, and the gauze curtain was simply to steady the flame,—to enable him to produce a 2½-in. flame—which he had found to possess a practically uniform lighting power, to test his candles against, and not for the purpose of testing any particular gas.

Mr. Foster replied that he merely wished to know whether the air passed through the gauze, and what was the position of the gauze in relation to the burner.

Mr. Young said that it was a cylindrical curtain fitting tightly round the outer gallery of the burner.

Mr. Foster: Then the air passes through the gauze?

Mr. Young: Yes, all the air passes through.

Mr. Foster, continuing, said that it seemed to him that Mr. Young was acting on the lines of the Siemens argand burner, for by introducing a heated and heating medium the argand was practically turned into a small recuperative burner; and to warm the air supply by any means would modify to a very considerable extent the amount of light that any particular gas flame would give. He was glad that Mr. Young had brought forward the question of the character of gas flames when nitrogen was present. It was a matter which would have to be dealt with sooner or later. He felt strongly that the only way to test gas with satisfaction to both producer and consumer was to have a standard which should be independent of the material to be tested. He was glad, therefore, that Mr. Dibdin had referred to the test by atmospheric air carburetted by petroleum vapours, for such a material as that was independent of the body to be tested. Whether it could be made by special devices to yield results of a reliable and uniform character was another question. But at any rate they got rid of the initial difficulty of connecting the thing to be tested with the means of testing

it. He quite agreed with the author that certain points in connexion with the use of chimneys were worthy of more consideration than they had yet received. They were trifles, he admitted; but such trifles might make a difference of large sums of money to the gas companies. Another point which had occurred to him in listening to the paper referred to the mode of burning the candles. For instance, if they had a wick which was not perfectly straight, it seemed to him that they must have a character of flame which could not possibly be the same physically as one which was a perfect cylinder. That was not the kind of thing they got when the flame was merely a conically shaped mass. The external area of such a flame must be greater, and there must be a different character of combustion for each unit of weight of sperm burnt. He had often wondered that nobody had attempted to construct a candle with an indestructible wick. There would, of course, be nothing in it, except a flood of criticism; but it did seem to him that it should be worth somebody's while to construct something of the kind, which would be really a lamp. The material of the candle might be either sperm or paraffin, and the wick might consist of asbestos threads, glass, or any other non-combustible material, the candle being pushed up by a spring, as in carriage lamps. He had too many such foibles on hand to attempt it himself; and what was everbody's business became nobody's business. No one was interested in doing more than substitute a new standard in place of the candle. Still, with all its defects, the candle lived on; and seeing that it could be easily procured and used without much preparation, its term of life seemed likely to be still further prolonged by the experiments that Mr. Young had given them.

Mr. D. A. Sutherland could confirm the results obtained by the author from trimming the wicks of his candles. With reference to the use of a paraffin candle as a standard of light, it was impossible to obtain a candle of such constant composition as to give a uniformly constant light. The German plan, therefore, must fall through, and the pentane flame become the only reliable standard. Further, in making a large number of tests per day with different lights the use of candles was very tedious. In testing oil gases of varying compositions by means of the measured flame, he had found considerable variation. He would expect that the nature of the hydrocarbons would materially affect the character of the flame obtained, and he was glad to be corroborated by Mr. Young. The class of oil usually employed in the Pintsch apparatus was of sp. gr. 0·840 to 0·850, but he would like to ask Mr. Young whether he had ever experimented with oils of a higher specific gravity than that, as the oils most suitable for enriching water-gas appeared to be of sp. gr. 0·900, or higher. He thought it would be worth his while to do so, as in the course of a few months' time London would be supplied daily with some millions of cubic feet of carburetted water-gas.

Mr. G. R. Morrison had some experience in gas testing in Glasgow, and could say from his own knowledge that the form assumed by the wick in burning was of very great importance. He would show on the blackboard what that effect was. [Mr. Morrison here drew diagrams on the board indicating the various forms assumed by the wick of a candle in burning.] Mr. Dibdin had referred to the normal and abnormal conditions of burning, and his illustrations would indicate to those who were intimate with the subject what were the conditions desired by the managers of the gas companies. If the wick bent towards the argand, the illuminating power of the gas went down 1 to 1·5 candles; if it bent the other way, the illuminating power went up from 1·5 to 1·7 candles. He thought the position should be at right angles to the pencil of light. Another point which he considered of great importance was the number of apertures in the argand burner, and the diameter of those apertures. In Glasgow they used a No. 8 batwing burner as the standard, burning five cubic feet at five-tenths pressure. The result was that it was not a fair standard of comparison if the candles were used with the wicks pointing indiscriminately in any direction. They had the apertures at a particular angle for certain gases. If they changed the angle of the apertures, an entirely different result was recorded—he would not say whether it was higher or lower—this depending upon the quality of the gas. He would like to know whether the author had taken that matter into account, and whether any particular size of burner and number and size of apertures was stipulated for in England.

Dr. S. Rideal had been under the impression before Mr. Young's paper was read that the subject of standard candles had been thrashed out. At any rate the paper, and the graphic remarks upon it had, he thought, conclusively proved that there was no such thing as a normal standard candle. A normal standard candle was now shown to be the name given to a genus of candles, including a great variety of species, and it had been further shown that the different species gave rise to many varieties, depending chiefly on their environment at the time of burning. That particular aspect of the question had not been raised on the present occasion, but those who were acquainted with the subject knew that the photometer itself had a considerable influence on the results obtained, depending upon whether it was in an enclosed or an open box. The results were affected not only by the position or bending of the wick, but by the rate of flow of the air, and by the air being heated or not heated, as Mr. Foster had pointed out with respect to the standard burner. All these things pointed clearly to the fact that a reliable standard candle did not exist, and that steps should be taken to abolish the candle as a standard of light. Mr. Dibdin's work on this subject had been well known for many years past, especially his work in connexion with the British Association Committee, which had reported some years ago in favour of altering the standard of light. His idea of doing away with coal-gas and candles as standards and substituting air carburetted with pentane had the additional advantage that they not only had a record of the results given by the test, but a means of checking whether the operator had carried out the test according to the instructions given to him. In fact, the subject had already passed the stage of discussion before scientific societies, and all that was required was to dispel the lethargy of public bodies such as the London County Council, and arouse them to take steps towards altering the present unsatisfactory state of things. The Board of Trade were already discussing the matter, and the sooner an Act of Parliament was passed or a commission of experts appointed to devise a new standard the better.

Dr. C. R. Alder Wright said that there was one point not touched upon by previous speakers, and upon which he would like to elicit a little information. What was meant by a sperm candle from the chemical point of view, or, in other words, what was sperm as employed as a standard? Was it defined as being made of material having a particular melting point? The commercial article did not seem to have a perfectly definite chemical composition. It was possible to obtain half a dozen samples of spermaceti, each one of them good in colour, specific gravity, and all the other physical conditions, but which would be found to differ considerably when tested chemically for the amount of free palmitic acid present. One might contain as much as 10 per cent. and another only one-tenth per cent. or none at all. He had a strong impression that differences of that sort might have a considerable effect on the results, by influencing the rate at which the material burned, or, if that were the same, the amount of light given out by it. He would like to ask, therefore, whether the candles had been examined from the chemical point of view as well as from the physical light-giving point of view, so as to see if it were pure cetyl palmitate present. With regard to sperm, it might not be generally known that varieties of spermaceti were sometimes sold which contained from 25 to 30 per cent., and even more, of free fatty acid. One method of purifying crude sperms consisted in treating them by a small amount of caustic alkali, one result of which was that the purified spermaceti obtained often contained a little cetylic alcohol, separated by the treatment from its compound ether, and which probably burned differently from the true compound ethers which were the normal constituents. But besides this, the residues which contained the palmitates produced as the complementary

products of the cetylic alcohol were often worked up and the free acid isolated from them, and mixed with fresh quantities of sperm. He had met with samples containing as much as 35 per cent. of free acid derived from such source. It was, however, difficult to convince people that spermaceti of that description was just as bad as that intentionally adulterated with candle stearine, *i.e.*, mixed stearic and palmitic acids derived from tallow and palm oil, &c.

A Member inquired what was the range of melting point of ordinary spermaceti as used for candle-making?

Dr. Wright replied that he could not say precisely from memory without referring to his notes. But he had examined side by side different samples of spermaceti, some of which contained practically no free acid, and some as much as 4 or 5 per cent., and had found little or no difference in their respective melting points, a result quite different from what one would have expected *à priori*, but probably due to the material having been pressed in each case until the required melting point was attained.

Mr. T. S. Lacey regretted that no authorities connected with the gas companies had thought it worth while to criticise a paper on so important a subject. He feared that anybody in his own position speaking on such a subject—which, however, was one that interested him greatly—ran the risk of appearing to hold a brief for the companies. He wished to state therefore that he spoke quite independently of them. Mr. Dibdin had raised the point of what was a normal candle. He thought it was only fair to regard that question from the point of view of the ordinary consumer. Such a person would take a number of candles and burn them from beginning to end, neither blowing them out nor snuffing them. They were not meant to be snuffed, and they were not snuffed by the ordinary consumer. Such were, in his opinion, normal candles, namely, candles burning from beginning to end without disturbance, and an average of the candle, or a number of them, being taken. An average of 100 or 1,000 would give them something very near the truth; but that being impossible, they took a small number of candles and got a large number of variations, some of them rather astounding. So far as Mr. Young's researches had gone, they were very interesting to him, and he must also say very surprising. It was astonishing that so much concordance could be obtained with a standard which was known to be variable in the ordinary way. But the figures showed conclusively that a candle treated by Mr. Young's method was capable of being used as a standard; whether it was a standard candle, he would not discuss then. If they looked at the table of results given, they saw that at first the results were higher, then lower results were given, and by-and-by they became normal, showing that the rate of burning was approaching the average. But those first high results should, he thought, be taken into the general average. It was unfair to reject them, since they all belonged to the general results of the candle. That the candles burnt by Mr. Young's method did give a more regular light appeared to be proved by his tests. But whether they were right in adjusting the wick or not, it was quite clear that the wick should not be snuffed. If the candles were burnt in a certain way, the more those conditions could be maintained the more likely one was to get regular results. The candle during burning changed its conditions, and if one could overcome that difficulty the results obtained might be constant; but whether they would be the same as if the candle had been left alone was another question. With regard to other standards, he did not think that anything they might say that night would be likely to settle that question. Much argument would occur in the future, as much had in the past, before they would be any nearer to getting a substitute for the candle at present used. The difficulty did not consist in getting a tolerably regular standard, but that if they adopted a standard that made his company's gas, for instance, 15 candles instead of 16½ candles, his company would certainly say that it was not a fair test, though they (the inventors) might say that it was. The problem was to determine whether the standard really represented a certain factor of the candle or not; and until that was settled it would be impossible to substitute any other standard for the candle. The tests showing the effects of using different chimneys were very important, and the author deserved much credit for the work done in that connexion, as well as for the paper as a whole. With regard to the 2½-in. flame, there could be no doubt that such a flame under the conditions of Mr. Young's experiments gave a 14-candle light with his candles. But whether a 2½-in. flame without the gauze curtain round the bottom of the burner would represent the same amount of light was quite another question. He felt certain that by placing anything round the burner, or making any alteration in the air supply, one would make a great difference in the flame. One effect of altering the air supply would be to increase the length of the flame, and therefore less gas would be passing through the burner to produce the 2½-in. flame, and consequently less light would be obtained with the gauze than without it. But of course gas was not tested so: and he did not suppose that Mr. Young had any idea of doing so. By simply measuring the length of the flame he found a coincidence that a constant light was given: and he thought that Mr. Young was quite right, when he found that in a number of tests under certain conditions the light was constant, in regarding it not as a coincidence, but as something good enough, for his purpose, to be taken as a standard. It was convenient and workable; but to say that such a flame would give a certain illuminating power under other conditions would be more than they had a right to assume.

Mr. S. H. Johnson said that, with reference to the proposed pentane standard, it appeared to be very important, bearing in mind Dr. Wright's remarks, that a body of absolutely fixed chemical constitution should be used as a standard of light. In that respect the pentane standard had a great advantage over the candle. But it must be looked at from another standpoint. The pentane standard depended for its accuracy not only on the purity or fixed composition of the pentane, but also on the fixed composition of the gas produced by the mixture of air with the pentane vapour. That would, however, vary with several conditions. The first and most important of these was that the tension of the vapour of pentane would vary with the temperature. He would, therefore, like to ask Mr. Dibdin whether that factor had been taken into account. Other causes of variation would be alterations of atmospheric pressure and degree of moisture. It was necessary that these variations should be taken into account or eliminated.

Mr. Dibdin said that he would reply to Mr. Johnson at once. There was a certain amount of confusion in the minds of both Dr. Rideal and the last speaker, which had led them to mix up the pentane one-candle standard of Mr. Harcourt with the pentane argand introduced by himself. The two things were different. Mr. Harcourt's method was to take a measured volume of atmospheric air, corrected for temperature and pressure, and a measured volume of liquid pentane, also corrected, and he incorporated them so as to get a perfect mixture of the two, every possible precaution being taken in the operation. That mixture was burnt in a specified burner at a certain rate, and that constituted Harcourt's one-candle pentane standard, which was proposed as the standard of light. Many people, however, objected to it, as being too delicate for the ordinary examiner. Something more handy was wanted, and it occurred to him that it would be desirable to try the effect of passing atmospheric air over a body of the pentane, paying no regard to the volume of the air, the quantity of pentane, or to any external circumstances other than the height of the flame when burnt in a special argand burner with the top of the flame cut off by a screen, the whole of the blue portion being included in the standard. He had found that the results were very constant. He had filled his carburetter first with ice and cold water, and got the same result. There was a reduction of the flow, and he had to increase the pressure; but the standard of light was exactly the same. He had then taken away the ice and cold water, and replaced them by water at 100°, with the result that the pentane almost boiled, and an enormous rush of gas occurred. He had to

check the flow by turning down the flame to 3 in. in height, when the volume of light was exactly the same as with the ice and cold water. That disposed of the question of temperature. With regard to pressure, there must, of course, be sufficient to give a 3-in. flame. It seemed almost incredible that so constant a light should be got under such extreme conditions as those he had mentioned, and at first it puzzled him. But he also found that whether the carburetted air was cold or warm, he could alter the height of the flame from $2\frac{1}{2}$ in. to 4 in., and yet the amount of light passing under the screen would remain constant. If the flame was over 4 in. the colour was altered. They therefore had a test which was as elastic as one could wish, and yet by using the amount of light which passed under the screen they had a constant standard. Then he had noticed that as the quality of the gas or the degree of temperature of the carburetter altered, a change occurred in the relative volumes of the white and blue flames, and as it was evident that these variations exactly compensated one another, the result being that he always got the same amount of light (10 candles) passing under the screen. The arrangement might, however, be modified to give the light of 16 candles, or any other desired quantity.

Mr. Foster remarked that the screen was, in fact, an opaque body cutting off the top of the flame, and that Mr. Dibdin used a flame of any height, but took only a definite portion of it which was always constant in height.

Mr. Johnson said that that was what he was about to ask: how Mr. Dibdin selected the portion he used as a standard? He supposed that he used the same fixed screen equally for all his experiments.

Mr. Dibdin said that was so, the position of the screen being determined by experiment, using the pentane one-candle flame as a standard of reference.

Mr. W. C. Young, in reply, said that he did not agree with Mr. Dibdin in his view that it would be necessary to alter the law if his suggestions were to be carried out. The present law provided for the issue of instructions by the Gas Referees to the examiners as to the mode of testing gas, and they had already ordered that the candles should be used in a particular manner. He did not see why they should not go further and order that what he had suggested should be done. That would be quite sufficient, and it would be unnecessary to go to Parliament for an alteration of the law. Mr. Dibdin had also said that the gas companies expected the examiners to use the candles so as to get high results, while the examiners preferred to use them so as to get low results. His experience, however, was that if one did his work carefully and impartially the companies made no objection to what one did. Nearly the whole of the experiments in Table VII. had been made in the presence of the officials of one of the companies, and they had taken no exception to the results, though they were perfectly well aware that all his testing had been made in that manner for years. And the same remark applied to gas managers all over the country. He said that because he thought it was only fair to the gas companies to do so. With regard to the value of the $2\frac{1}{2}$-in. flame, that length was the whole flame, and not $2\frac{1}{2}$ in. screened off from a longer flame. He was rather surprised to hear Mr. Dibdin say that the portion which he screened off from his flame was invariable in lighting power, no matter what the total length of the flame was.

Mr. Dibdin, interposing, said that he used a special burner, not the standard argand.

Mr. Young said that it might be different in that case. With an ordinary burner, $2\frac{1}{2}$ in. screened off from a 3-in. flame would give a light of 15 candles power. It was not possible without some such apparatus as the gauze curtain referred to in his paper to say whether the length of a flame was $2\frac{1}{2}$ or $2\frac{5}{8}$ in., and the effect of the difference would be very important. Mr. Dibdin had also raised the question of the value of the Parliamentary candle. Table III. showed the value of that candle, made with sperm containing 5 per cent. of wax, as supplied to the testing stations: and the average showed that in the case of No. 1 the flame equalled 14·65, &c. That was taking the whole candle and using it as many times as possible under the prescribed conditions of working. A comparison of Tables III. and VI. showed the difference between using the whole candle and working as he proposed, roughly, about half a candle. The companies were liable under the existing law to have all the tests taken with candles that had been used several times, in which case they had the conditions which he said should always obtain. It was only because they had to break the wick in order to halve the candle, and thus made it rough, that the flame did not give its full power at first. But as soon as the wick became properly bent, then there was a definite amount of light for the sperm burnt. That was shown by the experiments, and was a condition which ought to be imposed on the companies, and one to which he did not think they would object. Mr. Dibdin had objected that lighting and blowing out the candles three times was tampering with them. But that was done with every candle used, for one never burnt it right out, using it for one test only. The Gas Referees required that a different candle should be used for each test, and as the examiner employed the candles till they were used up, the result was that even in the ordinary way of working a candle was lit and blown out seven or eight times. But what he objected to was taking the tests obtained during the first two or three times the candle was lighted; they were not correct, and ought to be rejected. He had no doubt that Mr. Dibdin's standard burner, if used by a careful workman, would give constant results. His own experiments, with a $2\frac{1}{4}$-in. flame of coal-gas had proved that, given the possibility of accurately measuring the flame, and a properly constructed apparatus to start with, the light coming under the screen would be of constant value. But there was the difficulty that they must have a standard that could be taken all over the country, and not confined to the elaborately fitted stations of the Metropolis. They wanted such a standard that a man who had to use it officially in the provinces only six or seven times a year, could be sure of finding it fit to use at any time. Supposing a pentane standard were adopted: A gas examiner visiting a country gas works would want to use his own carefully verified pentane, but the manager would want him to use his (the manager's) pentane, to which he would object; and there would be a difficulty at once. That was the objection to all such standards. But candles could be carried in the pocket, and were so obviously standard candles, that no manager ever thought of objecting to them. Moreover, they could be left at the works for testing by the officials if they were so disposed. Mr. Foster had objected to his curtain being used for testing purposes. But he had not suggested in the paper that it should be. It was employed only for the purposes of the paper; and he found that with it a $2\frac{1}{2}$-in. flame was equal to 14·18 candles. He had made many experiments with flames of various length, and found that the curtain made no difference whatever to the light. A test taken with the gauze curtain on, which enabled him to read off the exact $2\frac{1}{2}$ in., did not differ from another taken after the curtain was removed, more than two-tenths of a candle in the result. Another point that had been raised had not, he thought, been made enough of. That was the question of the dimensions of the standard test burner. The Referees went into minute particulars with reference to the dimensions of the holes; but the examiners were not provided with the means of ascertaining whether the dimensions were correct or not. They were provided with standard test burners, but they never tested them, in fact one part could not be tested without cutting the thing to pieces. He very much doubted whether any two were alike, for he knew that the burners in two different stations differed in the pressure required to pass 5 ft. from 2·5 tenths to 4·2 tenths. Those two could not be of the same dimensions. If they were to be so particular about their standard of light, they should first see that the instruments in which the gas was burnt were of exactly the same dimensions in every case.

Mr. Dibdin remarked that to his own knowledge the standard burners used in London were all most carefully measured by the Board of Trade, and were not sent out unless they passed their measures.

Mr. Young replied that he did not know whether that was the case with all the burners. One of those he had referred to was in a provincial testing station, and the other in London. Of course they might agree while the burners were new. But they remained in the stations without change for years, and it was not reasonable to suppose that after, say, eight years, they were of the same dimensions as when newly made.

Mr. Dibdin said that so far as the district of the London County Council was concerned, it was his duty to compare the burners from time to time with the standard. He did so, and he had never found any alteration of the lighting power due to the burner being used even for eight years.

Mr. Young, continuing, said that Mr. Foster had referred to the shape of the candle flame. If he would look at the photographs which were to be exhibited after the meeting he would see that the shape of the luminous part of the flame was essentially different in one case from what it was in the other. In the case of the candle burnt as he recommended, the base of the luminous flame was almost level, while in the other instance it extended lower down on one side of the cone, and the flame was less conical in the latter case than when his method was followed. The idea of an incombustible wick and a spring under the candle had been suggested many years ago, and was tried by Dr. Lethelby, who rejected it because he found that he could not keep his candles from guttering.

Mr. Foster said that he had intended to convey the idea of a candle made without a wick, and an incombustible wick pushed up through it.

Mr. Young, continuing, said that in reply to Mr. Sutherland's question he could only say that Pintsch's oil-gas was the only one he had tested. But he had tested coal-gas that had been enriched by light oils, and also water-gas carburetted by both light and heavy oils, and the difference in the luminosity of the respective flames was distinct, and was referred to in the paper. The Pintsch's oil gas and coal gas enriched by light hydrocarbons gave the same illuminating power, using a 2½-in. flame, as did coal-gas alone, but the rate of consumption was very much less in the case of water-gas enriched by hydrocarbons, the illuminating power of a 2½-in. flame went up to 18 candles; and the flame enriched by petroleum instead of cannel was increased from 14 to 15 candles. Mr. Morrison had referred to the shape of the wick. That matter had been dealt with in 1876, when its effects were clearly pointed out in the "Gas Journal." The Gas Referees at length saw that there was something in it, and in their instructions to the examiners they made such arrangements as to practically prevent any interference with the relative position of the wicks one to the other. Dr. Rideal seemed to be of opinion that all the work of gas examining was scientific, or should be so. His experience, however, was that it was really a matter of commercial valuing rather than of scientific experimenting. What they really wanted was a reliable means of testing the gas, which should not be too scientific for an average gas manager to comprehend and use himself; and that they had, he thought, in the candle. He feared that the average manager of a small gas works would not be able to work with such a standard as Mr. Harcourt had proposed. In answer to Dr. Wright, he had not made analyses of the sperm in the candles, and had no idea of its composition. He had taken them indiscriminately from different sources, had tried them as shown, and had found them to agree fairly well one with another. They were all supposed to be standard sperm candles of six to the pound, as required by the Act. Mr. Lacey (who, he regretted to say, was the only speaker on behalf of the gas companies) seemed to think that a candle could only give normal results when burnt, and kept burning, from beginning to end; and, further, that a candle should never be snuffed. His memory, however, took him back to a time when gas was not so general as now, and in those times a pair of snuffers was an essential part of the furniture of a sitting-room, though they were now only seen as curiosities.

Mr. Lacey: They were not used with sperm candles.

Mr. Young: Mr. Lacey had also raised the question as to whether, in fixing a new standard, an average should be taken right through the life of the candle, or whether it should be taken as he (Mr. Young) had suggested. That question could only be settled by discussion between the authorities and the companies; and as the authorities had practically given the companies the benefit of half a candle in the last Act, the latter might now be gracious and give up a half in the case of any new standard, and he thought it very likely that they would.

Meeting held on Monday, 16th February 1891.

MR. WM. CROWDER IN THE CHAIR.

INCANDESCENT GAS LIGHTING,

BY W. MACKEAN, F.C.S.

There is no doubt that the question of gas lighting is at present attracting a good deal of attention on account of the progress that is being made with the electric light, and as I find but little record in the Society's Journal regarding gas lighting by incandescence, I think the subject one of sufficient interest to bring before the members of this Society.

The pure atmosphere, the steady brilliant light maintained where electric light is employed are so much in advance of the unpleasant atmosphere and unsteady flame resulting from the use of coal-gas, that it is not surprising electric light is so much more appreciated, but when we come, however, to consider the cost of electric light compared with that of coal-gas, the high price of the former at once gives coal-gas such an advantage as to almost defy competition for ordinary household illumination.

Nevertheless a demand has sprung up to obtain a higher standard of illumination from coal-gas which shall as far as possible possess the many advantages of electric light in point of brilliancy and steadiness, and maintain a comparatively cool atmosphere.

The production of light for illuminating purposes by the incandescence of refractory materials, such as platinum and iridium, or the oxides of zirconium, magnesium, &c., is not entirely new, but their adoption for ordinary household illuminating purposes has only recently been attempted with any degree of success. Several forms of lighting by incandescence have already been brought before the public, among the more important being the Welsbach, Clamond, Lewis, and Sellon.

I desire, however, to refer more particularly to the Welsbach system, as during the past three years I have had special experience in the working of this system in my capacity as chemist to the company.

In this, the Welsbach system of incandescent gas lighting, a hood or "mantle" composed of the oxides of the rare earths, such as zirconia, thorina, yttria, &c. is employed which is prepared as follows:—

A cotton thread is knitted into a cylindrical shape in network form, washed first in dilute ammonia, then in water containing a little hydrochloric acid, finally in distilled water, and dried. The knitting is then cut up into suitable lengths, saturated in a solution of the lighting fluid, composed of the nitrates of zirconium, lanthanum, thorinum and cerium, and dried on glass rods at a temperature of 90° F.

A fine platinum wire is then passed through a double thickness of the net, forming the top, by which means the mantle is attached to a stout steel wire or support. The mantle is then drawn into shape by being pulled over a model of the desired form, and the flame of a Bunsen burner afterwards applied to the upper portion of the mant'e, which

burns slowly downwards, and shrinking considerably in length, the cotton being entirely consumed, leaves only a fine network of the oxides, zirconia, thorina, &c., which on being placed over the flame of a Bunsen burner at once becomes incandescent, emitting a bright steady light.

By altering the nature and composition of the fluid employed the light obtained can be varied from an intense white light to a golden yellow or greenish colour, which differ to a certain extent in their diffusive power.

The following compositions will give a fair idea of the changes of light as regards colour :—

White Light.

I.

	Per Cent.
Zirconium oxide	40
Lanthanum oxide	40
Thorinum oxide	20

II.

Zirconium oxide	40
Lanthanum oxide	60

III.

Yttrium oxide	20
Thorinum oxide	80

The above compositions may be considerably altered without affecting the colour of the light.

Yellow Light.

I.

	Per Cent.
Lanthanum oxide	40
Thorinum oxide	28
Zirconium oxide	30
Cerium oxide	2

II.

Zirconium oxide	47
Lanthanum oxide	50
Cerium oxide	3

Orange Light.

I.

	Per Cent.
Lanthanum oxide	40
Thorinum oxide	30
Zirconium oxide	27
Didymium oxide	3

II.

Lanthanum oxide	50
Thorinum oxide	40
Niobrim oxide	10

Green Light.

	Per Cent.
Thorinum oxide	50
Lanthanum oxide	20
Erbium oxide	30

Many other oxides may be employed in the compositions, but the presence of some, such as alumina and magnesia, are very detrimental to the duration of the illuminating power.

Of the many substances which may be employed, cerium oxide is the most satisfactory for the yellow lights, when added in small quantities. Didymium oxide has the effect of causing a rapid diminution in the light, unless a high temperature can be maintained.

I find the most effective as to duration of light being composed of—

Zirconium oxide,
Lanthanum oxide,
Thorinum oxide,
Cerium oxide.

to which a small quantity of yttrium oxide may also be added; mantles made from the above composition lasting from 800 to 1,000 hours.

The duration of the illuminating power varies considerably according to the nature of the fluid employed, a curious fact being that the diminution is very gradual as a rule after 500 hours burning, and the light is then much whiter in colour than when first used.

Table I. on p. 198 shows the loss in the illuminating power of mantles during 1,000 hours.

The presence of an excess of cerium is shown in Table II., p. 198.

Table II. also shows the illuminating power remains more constant when 1 per cent. cerium oxide is added to the fluid, but the colour of the light is nearly red and unsuitable for ordinary lighting purposes. The temperature of the Bunsen flame being insufficient to heat the cerium oxide to incandescence.

Mantles which give a light of a slightly yellow tint give a much higher illuminating power than those of a pure white light and last much longer, as the following table will show :—

Gas.	Original. Pressure.	Original. Candle-power.	500 Hours.	1,000 Hours.	Colour.
	Inch.				
2·5	1·0	17·6	5·1	1·3	White.
2·5	1·0	16·8	5·6	4·5	White.
2·5	1·0	25·6	18·0	13·7	Yellow.
2·5	1·0	27·2	17·6	13·0	Yellow.

The illuminating power of the different oxides vary considerably both in colour and intensity, and differ to a large degree in the properties during the manufacture of the mantle.

The oxides of thorinum, zirconium, yttrium, and aluminum when cold are rather brittle, but when brought to incandescence they become very flexible and easy to work.

Lanthanum, cerium, didymium, and magnesium oxides on the other hand are very brittle, even when incandescent, and are more difficult to work, but a mixture of the oxides, provided the lanthanum does not exceed 50 per cent., are very flexible when brought to incandescence.

The following table (which I hope to be able to make more complete) shows the illuminating power obtained from the pure oxides and the colour of the light :—

	Candle-power.	Gas.	Pressure.	Colour of Light.
			Inch.	
Lanthanum oxide	22·5	3·0	1·0	White.
Zirconium oxide	12·2	3·0	1·0	White.
Thorinum oxide	25·0	3·0	1·0	Bluish white.
Yttrium oxide	19·8	3·0	1·0	Yellowish white.
Cerium oxide	4·0	3·0	1·0	Nearly red.

The highest illuminating power I have been able to obtain from a mantle of the ordinary size, is made from a mixture of yttrium and thorinum oxides.

	Per Cent.
Thorinum oxide	60
Yttrium oxide	30

A mantle of the above composition giving an illuminating power of 40 candles with 3 cubic feet of gas at 1·0-in. pressure. The duration of the light I have not yet fully determined.

TABLE I.

DURATION TESTS OF WELSBACH MANTLES.

Showing decrease in light in 1,000 hours burning.

Gas, Cubic Feet per Hour.	Pressure.	Original Candle-power.	After 100 Hours.	200.	300.	400.	500.	600.	700.	800.	900.	1,000.	Difference in Candle-power.	Percentage Loss in Light.	Remarks.
2·5	1"0	23·2	22·0	21·4	20·8	17·4	17·0	17·0	16·0	16·0	16·0	16·0	7·2	31·0	Mantles containing lanthanum, zirconium, thorimum, and cerium oxides.
2·5	1"0	21·0	19·4	21·0	19·2	16·5	16·8	16·8	16·5	15·0	14·0	14·0	7·0	30·0	
2·5	1"0	26·0	24·2	22·5	21·0	19·5	17·2	15·5	14·0	13·8	13·8	13·8	12·2	47·0	
2·5	1"0	22·4	20·6	19·0	18·0	18·0	18·0	18·0	18·0	18·0	18·0	18·0	1·4	19·6	
2·5	1"0	21·4	13·0	13·0	11·4	11·4	10·4	10·0	9·4	8·8	7·4	6·2	15·2	71·0	Mantles containing lanthanum, zirconium, and cerium oxides.
2·5	1"0	22·0	13·0	13·2	11·8	11·6	11·4	11·2	10·6	10·0	7·6	6·5	15·7	70·7	
2·5	1"0	21·8	12·5	12·4	11·2	8·8	9·0	8·5	8·0	7·2	6·4	4·2	17·6	80·7	

TABLE II.

TABLE SHOWING PRESENCE OF EXCESS OF CERIUM OXIDE IN LIGHTING FLUID.

Gas, Cubic Feet per Hour.	Pressure.	Original Candle-power.	After 100 Hours.	200.	300.	400.	500.	600.	700.	800.	900.	1,000.	Difference in Candle-power.	Percentage Loss in Light.	Remarks.
2·5	1"0	25·0	22·2	21·0	20·4	19·0	19·0	19·0	18·7	16·5	15·0	14·2	10·8	43·2	Ordinary lighting fluid containing ·25 per cent. cerium oxide.
2·5	1"0	18·0	18·0	17·2	16·5	15·0	14·5	13·6	13·0	12·4	12·0	11·4	6·6	36·6	Above fluid containing ·5 per cent. cerium oxide.
2·5	1"0	17·8	17·7	15·8	15·2	14·0	14·0	13·0	13·0	13·0	13·0	12·2	5·6	31·4	
2·5	1"0	13·5	13·5	13·5	13·0	13·0	13·0	13·0	13·0	13·0	13·0	11·8	1·7	12·6	Above (ordinary) fluid containing 1·0 per cent. cerium oxide.
2·5	1"0	13·2	13·2	13·2	12·8	12·0	12·0	12·0	12·0	12·0	10·8	9·5	3·7	28·0	

To obtain a good illuminating power it is absolutely necessary to have the salts as free from impurities as possible, and special care has to be taken to get rid of the last trace of iron which affects the illuminating power to a very large extent, the amount of iron usually present in the fluid being from 0·001 to 0·0003 per cent.

IRON PRESENT IN OXIDES.

	Fe.	Fe_2O_3
Lanthanum oxide	·001	·0014
Lanthanum ammonium nitrate crystals	None.	None.
Thorium oxide	·005	·0071
Zirconium oxide	·007	·010
Cerium oxide	·003	·0043
Didymium oxide	·003	·0043

The above estimations were made in the salts (nitrate) and calculated to the oxides.

Perfect combustion of the gas should also be carefully obtained as, if too much gas is used causing the flame to smoke, the illuminating power is considerably reduced, and a deposit of carbon takes place inside the mantle which often increases to such an extent that the mantle is broken and thereby destroyed.

It is necessary that the flame of the Bunsen burner should be inside the mantle, as the presence of air or oxygen is necessary to obtain a good result, as the oxide only gives illuminating power in the oxidising flame of the Bunsen. This is accomplished by means of the chimney, the best form of which is contracted about two inches from the base, which forces the air on to the mantle and keeps the flame in the desired form.

The chimney usually employed is 9 in. in length, 2 in. diameter at the base, and $1\frac{5}{8}$ in. diameter at the top. The illuminating power differs according to the height of the chimney employed.

Gas.	Pressure.	Chimney.	Illuminating Power.
		Inch.	Candles.
3"0	1"0	12	28·2
3"0	1"0	9	25·0
3"0	1"0	8	24·4
3"0	1"0	7	22·0
3"0	1"0	6	16·4
3"0	1"0	5	16·0

It was my intention this evening to have gone into the question of incandescent lighting by means of water-gas, but as the experiments have not yet been completed, I have decided to withhold them till completed, and hope to be able to lay them before the Society at a future date.

In the Clamond system of incandescent gas lighting a basket or hood of magnesia and zirconia is employed,

which is heated to incandescence by an atmospheric burner of peculiar construction, whereby the air and gas are heated before combustion takes place. The hood is prepared by mixing pure magnesia with the solution of magnesium acetate and forcing the mixture through a suitable dise, from which it issues in a continuous thread, and is wound into shape on a mandrel. The illuminating power obtained with this system is when at its best, 5 candles per cubic feet, the chief drawback being the short life of the hood, which burns out in about 100 hours.

A number of systems have been shown whereby illuminating power is obtained from the metals platinum and iridium, among them being the Lewis and Sellon.

In the Lewis system a small hood of platinum or alloy of platinum and iridium is used, which is brought to incandescence by the Bunsen burner, perfected by Lewis, in which the air is admitted under pressure, this being a great drawback to its application for domestic purposes. The hood is brought to a high state of incandescence and emits an illuminating power of 200 candles, when consuming about 40 cubic feet of gas per hour, being equal to 5 candles per cubic foot. It is a curious fact that when the hood is incandescent the temperature is so great that it may be exposed to rain without being in any way affected. It is well suited for outside purposes or large buildings.

In the Sellon system a cone of metal gauze is employed heated with a Bunsen burner of the same form as that employed with the Lewis. Another modification is that of a downward light, obtained by suspending a small piece of the refractory material (platinum gauze) between two diaphragms of asbestos, the gas and air are allowed to mix in a small glass bowl, afterwards burning at the top of the gauze which is immediately brought to a high state of incandescence, no flame being perceptible, showing perfect combustion is obtained. In another modification the air and gas are carried in a small metal cylinder to the top of the outlet of the gases, and are heated in their passage downward before combustion takes place, the illuminating power being about 5 candles per cubic foot.

The attempts hitherto made with carburetted water-gas have not been so successful as to meet with their general adoption. The system of Fahnehjelm, a Swedish chemist, is being extensively employed. This consists in attaching small pencils of magnesia or a mixture of magnesia and zirconia to a small frame in the form of a comb which is suspended over the flame of a water-gas burner and is immediately brought to a high state of incandescence. The pencils are prepared much in the same way as the Clamond hood or mantle. This system gives a very beautiful intense white light and is not at all expensive, one drawback being the duration of the magnesia cone, which lasts only from about 50 to 100 hours, but this is considerably increased when magnesia and zirconia are employed. The magnesia cone costs only about 3*d.*, is easily replaced, and the cost of lighting by this system is much less than that of ordinary gas, and the illuminating power considerably greater.

Before any system of incandescent gas lighting can be considered a success, so far as the adoption for ordinary use is concerned, there are many difficulties to be overcome, among them being as follows :—

1. Existing fittings should not be interfered with, except so far as the burner is concerned.

2. The system ought to give a better and steadier light than the ordinary gas flame.

3. No separate service of service pipes must be required, and the arrangement of the system must be as simple as that required for ordinary gas. There should be little or no liability of breakage or derangement.

4. The duration of the lighting medium must be so great that the cost of renewals should be inappreciable.

5. The consumption of gas must not be increased, but on the contrary a very marked saving in the consumption, or its equivalent in increased light, must be secured.

6. The combustion of gas burnt must be more perfect than the ordinary gas burner, in order to reduce the objectionable and destructive effects of gas consumed in dwellings.

7. The atmosphere must be comparatively cool, and the light must not greatly deteriorate by the use of the illuminating medium.

As regards the above-named systems shown, notably Clamond, Welsbach, and Sellon, the existing fittings are not interfered with, but at the same time a good pressure of gas (not under 1 in. pressure) is essential to obtain satisfactory results. The systems mentioned give a better and steadier light than the ordinary gas flame, being an inducement towards their employment. So far, none of the systems fulfil the conditions of ordinary gas as regards the simple arrangement required, all of them requiring more care and attention than the ordinary gas burner. A higher candle power per cubic foot is obtained, but at the same time with all the systems there is a gradual decrease in the illuminating power, and renewals of the illuminating medium are necessary to obtain the maximum amount of light. In incandescent gas lighting, the combustion of gas being perfect, the destructive effect on ceilings and paintings is much less than with the ordinary gas burners. That the illuminating medium will remain constant seems impossible so far, as with gas we have a continually renewed service for illumination, while the resistance offered by the illuminating medium employed in incandescent gas lighting to the ignited gas, and air drawn into the chimney, very soon causes an alteration in the lighting power, but which after a time remains fairly constant.

I have no doubt that considerable progress will be made with regard to the systems at present employed, and in the future, incandescent gas lighting, provided the present difficulties are overcome, will be a serious competitor to electric light for ordinary domestic use or general illumination.

Discussion.

Mr. F. Scudder said that he had hoped to have been able to bring before the meeting some improvements in the application of water-gas to illuminating purposes, but unfortunately the experiments were not in a sufficiently advanced state to enable him to do so. In 1888, Mr. Wilson had read a paper before the Society on the subject of the production and application of water-gas, and the Fahnehjelm comb was introduced and explained on that occasion. His only excuse therefore for bringing it forward again now was that it had been improved in the meantime. He had had occasion to visit America last autumn in connexion with his investigation of the production of water-gas, and while there he found that better results were being got with the comb than in England. The comb hitherto used here came from Essen. It gave a pure white light, and was stated by Mr. Wilson to have an illuminating power of 3·5 candles per cubic foot of gas. The American comb, however, gave a five candle power for the same amount of gas. On investigating the matter, he found that the American comb underwent a course of treatment after manufacture. The ordinary comb consisted of a number of needles of pure magnesia, which gave an intense white light. The American combs were dipped into a solution of chromate of potash, allowed to dry, and then ignited. This treatment gave them a yellow light, which was found to have a higher illuminating power and a greater degree of diffusion. Mr. Mackean had obtained a similar result with the Welsbach burner by the addition of cerium. In the paper to which he had referred, Mr. Wilson had made the following statement: "Looking at the efficiency of these various systems relatively with ordinary gas lights, and taking them all simply as machines for converting heat into light, which appears to be a useful test, the following table has been prepared to show approximately the number of heat units required per hour to produce one-candle power by various ordinary and incandescent arrangements. From this it at once becomes clear that the incandescent system is essentially the one for producing the most light with the least heat." (See Table, Vol. VII. p. 23.) The German comb deteriorated to such an extent that if burnt with water-gas at the rate of five cubic feet per hour it would only last 100 hours, losing 25 per cent. of its illuminating power during that period, whereas the American comb, in which the needles were shorter, would last 150 hours under the same conditions. In testing the illuminating

power of the new Fahnehjelm comb, he had also tried a Welsbach mantle with water-gas. It was necessary to alter the usual arrangements of the Welsbach burner, on account of the air required for water-gas being about only one-half of that required for ordinary coal-gas; but he had found that for each cubic foot of water-gas consumed he obtained an illuminating power equal to 7 candles. He had seen a specially designed Welsbach burner for natural gas in use on a large scale in Pittsburgh and Philadelphia which gave an illuminating power for each cubic foot of gas consumed equal to 3·5 candles. There was no doubt a large field open for incandescent lighting in this country, and the use of water-gas in conjunction with such a system would be of immense value.

Mr. Bernard Dyer felt that he must plead guilty to very great ignorance of what were generally known as the "rare" metals; indeed, until the Welsbach Company had introduced their lights a few years ago, he had been under the impression that many of the metals whose oxides were now employed in the manufacture of their mantles were not only not much known, but naturally rare in occurrence. He did not know whether his ignorance was shared by many other chemists present, but if so it would be of interest if Mr. Mackean would give some further information as to the sources of some of those oxides and the methods of obtaining them in commercial quantities. He would also be glad of further information respecting the chemical changes in the mantles to which the deterioration of the light might be due. He was interested in that aspect of the question, because he had tried the light some years ago in his laboratory, and found that, although it was satisfactory at first, in about a fortnight the power rapidly diminished, and in three weeks the mantle was useless. He thought that that must be due to the effect of the chemical vapours produced in his laboratory, for lights which had been started at the same time in his private house showed no such deterioration. He had had Welsbach lights burning in his drawing-room constantly for three years without renewal, and one of them which he returned intact to the company at the end of that time still possessed a high illuminating power. He had found the light a very comfortable one to read by; and after constant use for three years in his rooms there was a remarkable absence of that dirt on the ceilings which was the usual result of employing the ordinary gas burners.

Mr. W. F. Anderson said that, it having been stated that it was essential that the mantle should be kept in the oxidising flame, and that chemical changes took place in the mantle which caused a deterioration of the lighting power, he would like to ask whether the oxides might not in time be reduced to the metallic condition, in consequence of the mantle being subjected to the action of the reducing flame instead of the oxidising flame. He would also be glad to know whether any experiments had been made in connexion with the photometric power of the incandescent light.

Mr. A. H. Allen said that the same idea had occurred to him as to Mr. Dyer, namely that it would be useful to have a short account of how these rare earths, which used to be regarded as nuisances to the ordinary chemist and of interest only to the very patient scientific investigator, were now obtained. Mr. Dyer having spoken of the return of a mantle to the manufacturers after three years' use, he supposed that even after that time it had some value as "old rare metal." He would like to know whether the rare oxides employed for the Welsbach mantles, after being subjected to a white heat for so long a time, acquired an insoluble condition, similar to that of highly ignited alumina. If not, it would be easy to redissolve them by means of nitric acid, and hence recover them in a condition ready for use. He should also like the author to give them an idea of the method employed in separating these rare earths in actual practice. Such points were of considerable scientific interest, and if it were not inconvenient to the manufacturers, he hoped that some further information would be given respecting them.

Mr. Brinkley inquired whether the oxide of vanadium had been used.

Mr. Mackean replied that he had tried it, and had found it to give a yellow light, and to be too fragile.

Mr. Brinkley: And uranium?

Mr. Mackean said that he had tried that also, and rejected it because of its low diffusive power and yellow light.

Mr. D. A. Sutherland thought that the Society was indebted to Mr. Mackean for a very valuable paper on a subject which was but imperfectly understood, though it had been before the public for some years. Mr. Mackean had been altogether too modest in speaking of the difficulties he had had to contend with in separating the earths referred to, difficulties out of which he had some most satisfactorily. With regard to Mr. Allen's remark as to the value of old returned mantles, from his (Mr. Sutherland's) experience during a joint use of the same laboratory for the past six months, he would ask to be allowed to forestall Mr. Mackean, and state that by treatment the oxides could be recovered, and further, that Mr. Mackean had been able to deal successfully with old mantles sent as unutilisable from Germany, and had thus saved money to his company. There had been difficulties, due to the impurities which the mantles contained, but those difficulties had been overcome. With reference to the illuminating power obtained, there was one point which seemed to him to be worthy of more attention than it received, namely, the usefulness of the incandescent gas light for titration purposes. He had been very successful with it in that way, and had no doubt that by means of a Welsbach burner attached to a flexible tube, one would be able to work as well in the heavy fogs of London as one could in summer daylight. They could not all afford electric light, and therefore it was as well that the members generally should know that. Care was to be taken, however, to get a white light mantle, such as that with zirconium oxide and yttrium oxide. He was much interested in the relative diffusive power of the light from the various oxides under varying conditions, and regretted, therefore, that Mr. Mackean had not been able to give the results of his water-gas experiments. He might allude, however, to one point of great interest. It might naturally be expected that, incandescent lighting being due to certain bodies being raised to a high heat, the higher the heat the better the incandescence would be. And it had proved so generally in actual practice. But some of the oxides gave a better light when water-gas was used instead of coal-gas; and it was quite possible that still better results would be got by using pure oxygen instead of air in the burner. Mr. Mackean had brought the method to a high pitch of perfection, many of the processes being his own patents, and their thanks were due to him not only for that, but for the frank manner in which he had treated the subject.

Mr. G. R. Morrison could confirm the results given by Mr. Mackean with regard to the illuminating power of the Welsbach mantles. He had had considerable experience of them, and had obtained a power of 28 to 29 candles per 2½ feet of gas consumed. That was with ordinary Scotch gas; but in some of the outlying districts of Scotland he had obtained similar results with a consumption of only 1½ cubic feet. There was some difficulty in using a gas of such high power, for he had found by experience that the viscosity of the gas being so heavy, the air and gas did not mix properly in the Bunsen burner, the result being that the combustion was imperfect, and the mantle was carbonised, just as Mr. Mackean had described. He could also confirm Mr. Sutherland's remarks as to the usefulness of the burner for titration purposes. He had found great advantage from it in that respect, and also in sugar analyses. The illuminating power of the mantles did, in some instances, depreciate to an enormous extent, and in an unaccountable manner. His own opinion had been that the high illuminating power was due to cerium; but he now found himself mistaken, as the author had stated that cerium itself gave only a four-candle power, and that it could only be used in limited proportions. His experience was that the red lights gave the highest power and lasted the longest, and that the white lights gave a low power, and depreciated rapidly. In some instances he had used yellow mantles for 2,000 hours,

and at the termination of that time they gave an illuminating power of 18 candles. On the other hand, he had had white mantles in Scotland, which gave an illuminating power of 21 to 22 candles, and after about 2 weeks burning, the power had gone down to 12 or 14 candles. He had not been able to quite make out from the paper what Mr. Mackean regarded as the standard oxide, that which gave not only illuminating power but stability to the mantles.

Mr. W. Mackean, in reply, said that one of the sources from which the oxides employed were obtained, was monazite. From it was got thorinum, lanthanum, cerium, and didynium, but it was a complicated ore and difficult to deal with. Orthite was another source, from which cerium and didymium was obtained, this mineral costing about 1*s.* per kilo. Zircon, from which zirconia is obtained, was quoted some time ago at 7*s.* 6*d.* per oz., but could now be bought in quantity at about 2*s.* per lb. Thorite, the source from which thorium oxide was extracted, was most difficult to obtain, and the most expensive. The first supplies cost about a guinea an ounce for 60 per cent. ore, but the price was now considerably reduced, the quality averaging about 50 per cent. thorinum oxide. Thorite also contained about 10 per cent. uranium oxide and 15 per cent. silica (a specimen of which was shown, as well as the mineral gadolinite from which yttrium oxide is extracted). Most of the minerals were said to come from Norway, but they had, with the exception of thorite, been found in large quantities in America. He hoped to give full analyses of the various minerals from which the oxides were derived in a future paper, and at the same time to bring before the Society some very remarkable properties possessed by the salts of the metals in question. In the extraction of the oxides, thorite for instance, was finely powdered and dissolved in hydrochloric acid with which it forms a stiff gelatinous mass, the silica passing into solution which is evaporated to dryness to render the silica insoluble. Hydrochloric acid was then added, and the chloride solution separated from silica, &c. Sulphide of sodium was added to separate lead, &c., after which hyposulphite of soda was added to the dilute solution to precipitate all the thorium as the hyposulphite; most of the impurities passing into solution. Afterwards, if necessary, the cerium, &c., were separated by bringing down first of all with ammonium oxalate from the solution of the chloride. The hyposulphite was dissolved in hydrochloric acid and then further precipitated as a hyposulphite for the second or third time. Finally, the thorium was brought down from the solution of the pure chloride with ammonia, thus getting a hydrate from which any of the other salts could be obtained. Zircon could be treated in the same way if first fused with bisulphate of soda or caustic soda, and afterwards evaporated to dryness, the chemical reactions being much the same as in the case of thorium. Cerium was prepared from cerite, but, with the exception of zirconia and thorina, all the minerals he had mentioned contained it as well as dydmium. With the exception of zirconia, most of the minerals being hydrated silicates, were very soluble in hydrochloric acid unless they were first heated, in which case they became quite insoluble, excepting in boiling sulphuric acid. He had a process for separating the salts from old and broken mantles, which he would describe later on. The prices of the oxides varied very much, the lanthanum oxide being very expensive, as the ore contained only about 20 per cent. of the oxide, and it was difficult to get rid of the cerium and didymium. The oxide of zirconium only became insoluble in the ordinary acids after being heated to a very high temperature; the others were all soluble in sulphuric acid, even after burning in a Bunsen flame for 3,000 hours. He had burned some of them (the mantles) continuously for over 12 months.

The diminution in the illuminating power was partly owing to a change in the composition of the mantle. He had started with a mantle containing 40 per cent. of lanthanum, 30 per cent. of zirconium, and smaller proportions of yttrium and cerium oxides, and after burning 1,000 hours the lanthanum oxide had gone down to 30 per cent. As lanthanum was one of the salts which give diffusion, the diminution of the illuminating power appeared to be due to the loss of that salt, caused by friction at the point where the air was drawn on to the flame at its hottest part. A further proof was that as the light diminished in power it also became white, showing that the cerium oxide to a certain extent volatilised and, a white light having less diffusive power than a yellow one, its illuminating power, after being converted into a white light, was proportionately diminished, though the white light itself seemed more intense. In reply to Mr. Anderson's suggestion that the oxides might become reduced to the metallic state in the reducing flame, he considered that that would be impossible. But, even if such a thing did happen, they would be immediately oxidised again to the oxide, just as magnesium ribbon would be, as nearly all the rare metals possessed the property of being readily converted into the oxide when held in a Bunsen flame. As to the photometric power of the mantles and the oxides, that had been dealt with in the paper. It was generally, with the mantle, from 8 to 10 candles per cubic foot, decreasing in time to the extent of from 19 to 30 per cent. With respect to the variability of the diminution of light in certain mantles, that could not be satisfactorily accounted for in some cases. Two mantles might be made from the same fluid, one of which would burn and remain intact for about 3,000 hours, while the other would go to pieces in a few weeks. That was possibly due to the condition of the burner; if too much gas or not enough air was present, the illuminating power would rapidly go down. As he had already pointed out, perfect combustion of the gas was necessary to obtain a good result.

In reply to the question as to the extraction of the broken mantles, he would say that the mantles were first treated with sulphuric acid, evaporated to dryness, and dissolved in water. The solution of the sulphates was then treated with caustic soda and the precipitated hydrates washed to get rid of the soluble sulphates. The hydrate was then dissolved in hydrochloric acid and treated with hyposulphite of soda to precipitate the thorium and zirconium. The filtrate was retained and treated with ammonium oxalate to precipitate the lanthanum, yttrium, and cerium oxides. Those oxalates were then ignited and dissolved in dilute nitric acid, by which means the cerium oxide was left undissolved, the lanthanum and yttrium oxides passing into solution. Another method, and one which would be found more useful in analysis, would be to treat the oxides of lanthanum, yttrium and cerium with ammonium chloride, thus converting the lanthanum and yttrium into the soluble chlorides and leaving the cerium insoluble. In reply to Mr. Morrison, zirconium gave only 15 candle power, it was thorium which gave 25 candles, and yttrium and thorium combined were the best for producing high illuminating power and stability, provided they were present in the proportions he had mentioned, but the mantles were so soft that they were difficult to keep up. The Welsbach lights were especially useful for spectroscopic and laboratory work, as they gave a very steady illumination. He quite omitted to mention that when reading the paper, and was much obliged to Mr. Sutherland for reminding him of it. They were also useful for distinguishing colours. If the spectroscope was turned towards the mantles, which did not contain didymium or erbium the pure solar spectrum would be obtained; but, if those metals were present, of course one got the didymium or erbium lines.

In conclusion, his thanks were due to his directors for allowing him the necessary time for working out the experiments, and to Mr. Sutherland for assistance given him in the completion of the paper.

THE VOLUMETRIC ESTIMATION OF ALUMINA.

BY C. F. CROSS AND E. J. BEVAN.

In the course of a paper on "The Economy of Pure Caustic Soda," which we had the honour of reading before the Society on April 30th, 1889, we had occasion to draw attention to the fact that the alumina present in caustic soda could be estimated by titration with standard acid, taking the difference between a titration in presence of litmus, or, better still, phenolphthalein, and one with methyl orange as indicator, as a measure of the alumina present. The actual method consisted in boiling with a slight excess of acid, allowing to cool and titrating back with soda in presence of phenolphthalein. The acid so consumed represents the total amount of alkali present. To a similar portion a slight excess of acid is added and the solution titrated back in presence of methyl orange. In this way a perfectly sharp and well-defined point is reached when the colour changes from pink to yellow.

We found that although there was a perfectly definite ratio between the excess of acid consumed in presence of methyl orange and the alumina actually present, the ratio was not normal, *i.e.*, 2 Al_2O_3 to 6 SO_3, but was as 2 Al_2O_3 is to 5 SO_3. Thus 1 cc. of normal acid was found to be equal to ·0205* grm. Al_2O_3 instead of ·172 according to the normal ratio.

The following table contains the results of the titration of solutions of caustic soda containing known weights of alumina. Column I. represents the amounts of alumina added; column II. the amounts calculated from the difference between the two titrations, using the factor corresponding to the ratio 2 Al_2O_3 : 5 SO_3; and column III. the amounts calculated from the normal ratio:—

I.	II.	III.
·084	·083	·069
·168	·158	·132
·421	·413	·342

When we wrote our paper we were under the impression that we were the first to observe this abnormal behaviour of alumina. An abstract of our paper appeared in the Bulletin de la Société Industrielle de Rouen, 5, 1889, 402, and in a footnote our attention was drawn to the statement that a M. Blondel had already observed the same fact. His communication was, however, only an abstract of a paper by K. J. Bayer, which appeared in the Monit. Scient. 1886, S. 1133.

Between Bayer's original method and that credited to him by Blondel there is, however, a very remarkable and instructive point of difference. Bayer used litmus and tropæolin, and obtained normal results, whereas Blondel, who must have repeated the experiments, used litmus and methyl orange, and obtained results identical with our own. The importance of this difference will appear subsequently.

Professor Lunge, having overlooked all previous observers' work, published as original, in the Zeits. f. angew. Chem., 8, (S. 227), the same process as our own. He used phenolphthalein and methyl orange, but obtained normal results.

In the same Journal, 10, 1890, he acknowledges his want of originality, and publishes a number of observations, the object of which was to prove that we were in error. His paper has been abstracted in a number of English journals, including that of the Society.

Upon seeing Professor Lunge's results, and knowing him to be a very careful observer, we repeated our former experiments with precisely the same results. We then corresponded with him with a view, if possible, of settling the point at issue between us.

After many letters had passed, it occurred to us that possibly the cause of the discrepancy lay in the samples of methyl orange employed. We purchased several specimens from various dealers, and found that they were of widely different composition, giving very different titration results. One specimen we obtained gave too high a percentage of alumina, using the factor calculated from the 2 to 5 ratio, but correct results using that calculated from the normal ratio. We subsequently found that this specimen was not methyl orange at all, but was tropæolin OO. This then seemed a probable explanation of the discrepancy, and we therefore exchanged samples of methyl orange with Dr. Lunge.

Strange to say, this brought us no nearer the solution, as we still differed although using each other's methyl orange, and the point at issue resolved itself into one of simple observation.

We probably should not have troubled the Society with a further discussion of the question had not Professor Lunge seen fit, in a paper read before the Newcastle Section and published in this Journal (Nov. 29, 1890), to refer again to the subject and to reiterate the statement that we were in error. We therefore, not unnaturally, claim the right to be heard in defence of our position.

In order to remove any possibility of doubt we prepared a solution of alumina in soda by dissolving an unknown quantity of sodium aluminate in water. A portion of this we retained, and a portion we sent to our friends Drs. Evans and Wirtz, of Great Ormond Street, who were good enough to estimate the alumina in it, both volumetrically and gravimetrically. Their results, and also those done in our laboratory, we give in the following table. In the case of our own results the letters indicate different observers. It may be worth while remarking that the only instructions given were to add excess of acid and titrate back, the exact point being left entirely to the discretion of the observers.

Drs. Evans and Wirtz.	Cross and Bevan.				
	A.	B.	C.	D.	Mean.
25 cc. consumed, using methyl orange, 82·3 cc. N. acid.	82·3	82·6	82·37	82·3	82·4
25 cc. consumed, phenolphthalein, 35·5 cc. N. acid.	36·0	35·7	36·1	35·5	35·8

We now give the amounts of alumina as determined gravimetrically, and those calculated from the difference between the two titrations.

Al_2O_3 in 25 cc methyl orange—phenolphthalein × ·265 = ·9546
" — " × ·1716 = ·7988
Determined gravimetrically, Evans and Wirtz ·9460
" " Cross and Bevan ·9560

These numbers speak for themselves. We will merely remark that if Dr. Lunge's contention be correct the number of cc. consumed in presence of methyl orange should have been 91·4 instead of 82·4. It is hardly conceivable that two chemists could differ to such an enormous extent in such a simple operation as a titration with normal acid.

In conclusion we would call attention to a statement by Dr. Lunge in the paper already referred to (November, 1890, 1018) that "the soda in these compounds (silicate and aluminate) in well-nigh all practical cases acts like the hydrate." This statement, which practically amounts to saying that soda which is already combined with an acid is as powerfully alkaline as the pure hydrate, will indeed be news to the soap-maker and paper-maker.

Discussion.

The Chairman said that the question of the determination of alumina had led to considerable controversy in various trades. He would instance the manure trade, in which a heated discussion as to the proper methods to follow was at present proceeding. As most of the members were interested in the question before the meeting, he hoped that they would contribute to the discussion.

* This number is calculated from an atomic weight of 27·3 for aluminium, oxygen being 16 and sulphur 32. It is somewhat more correct than the number previously given, viz., ·0212.

Mr. Bertram Blount thought that the evidence brought before the meeting was so conclusive that it admitted of no discussion. Messrs. Cross and Bevan had shown that the reaction was reached at a certain point laid down in their formula, and in the absence of any evidence similarly adduced by Dr. Lunge, the matter must be regarded as settled.

Mr. D. Howard said that there appeared to him to be a sort of half change of colour in the liquid treated by Dr. Lunge's method. It seemed to be one of those cases which were as interesting as they were deceptive, in which a partial effect occurred; the change of colour being so slight as to make it a very undesirable one to work to. But that there was a certain change or neutral tint produced was, he thought, evident.

Mr. Bertram Blount observed that there were a certain number of people who were unable to distinguish the colour change in methyl orange. He himself knew more than one chemist who suffered from that particular disability, although perfectly competent in every other respect. The difference of opinion which existed in the present instance might therefore possibly be due to defective vision on the part of the observer.

Mr. A. H. Allen said that he used methyl orange constantly in his laboratory, and never experienced any difficulty in seeing the end reaction. But he had known complaints to be made by other chemists that they could not obtain good results with methyl orange, and in one or two instances he had received samples of the colouring matter from other chemists, which samples were certainly unfit for use, the end reaction being very indefinite. It was therefore quite possible that the fault in the present case might lie quite as much with the so-called methyl orange as with the eyesight of the individual observers.

Mr. Bernard Dyer said that the great point in using methyl orange was that it should be sufficiently dilute. It was a very common error to use too much of it, and in that case it became difficult to distinguish between the vanishing of the pink and the coming of the yellow tint. With the proper degree of dilution, however, the change was very striking.

Mr. A. P. Hoskins, referring to Mr. Allen's remarks, said that he had recently received a sample of methyl orange from a London firm with which he had failed to get any definite reaction. Thinking it possible that the difficulty might be due to there being more than one substance present, he made a rough separation with alcohol, with the result that he got two bodies which gave exactly opposite reactions—one, the ordinary methyl orange reaction, and the other the inverse of that. It was just possible, therefore, that the differences mentioned by Messrs. Cross and Bevan were due to a similar cause.

Mr. Allen inquired whether the true methyl orange was soluble in alcohol.

Mr. Hoskins replied that he would not like to say positively at the moment.

Mr. C. F. Cross said it seemed odd that a change so definite and sharp should not be got by so practised an observer as Dr. Lunge. The controversy being on a simple matter of fact, the testimony of one or two independent observers would decide it. He would be glad therefore if some of the members present would be so good as to make a few observations with a view to setting the matter at rest.

Mr. Bernard Dyer observed that there were two directions in which abnormal eyesight might affect an observation of this sort. Some people suffered from lack of sensitiveness to colour changes, but others might be ultra-sensitive to them, and thus be able to read very distinctly that partial or "half-way" change of colour which Mr. Bevan had produced in his second experiment.

Mr. E. J. Bevan, in reply, referring to Mr. Howard's remark as to the partial colour change produced, asked whether he would consider that an end reaction.

Mr. Howard: No, I should not.

Mr. Bevan, continuing, said that Mr. Blount's suggestion that Dr. Lunge was not sensitive to colour change could hardly be correct, for the numbers which he had given them, but not allowed them to publish, were wonderfully concordant. With regard to differences in the constitution of the methyl orange employed by different observers, that was undoubtedly a source of error; and he would advise all chemists to test their methyl orange before using it. In one case they had obtained a sample which turned out to be tropæolin. With that sample they found that if they used the method he had described, though the reaction was not a sharp one, yet the results were normal, viz., 6 : 2, not 5 : 2. On discovering that, they thought they had arrived at a possible solution of the difficulty, so they sent Dr. Lunge a sample of their reagent in exchange for a sample of his. But no change in the respective results followed. Dr. Lunge got precisely similar results with their methyl orange as with his own; and by using Dr. Lunge's reagent they had been able to confirm their own original numbers. The matter therefore resolved itself into one of individual observation.

ESTIMATION OF GLYCERIN BY ALKALINE PERMANGANATE.

BY WILLIAM JOHNSTONE, PH.D., D.SC., F.I.C.

My object in appearing before you this evening is to publicly withdraw a statement I made a short time ago in this room when taking part in the discussion on Mr. Wanklyn's paper on the "Constitution of Butter."

I stated that evening that I had no difficulty in obtaining the theoretical quantity of glycerin from butter fat by using the well known process of Benedikt and Zsigmondy (Chem. Zeit. **9**, 975; this Journal, **4**, 610). That statement, gentlemen, with your permission, I wholly withdraw, as the process, although an accurate one for the estimation of glycerin in certain circumstances, is totally inapplicable for the estimation of glycerin in a butter fat or in oils containing soluble fatty acids. The process originated, I believe, with Mr. Wanklyn, and was experimented on by Mr. W. Fox (Chem. News, 53 15), who obtained discouraging results, and abandoned the process, which was then taken up by Benedikt and Zsigmondy, who worked it into shape, and finally it was taken up by Mr. Allen, leaving his hands as a full-blown accurate process for the estimation of glycerin in oils and fats.

The process is a simple one, depending upon the saponification of the fat with an alkali and the subsequent oxidation of the resulting glycerin into oxalic acid by boiling with alkaline permanganate thus:— $C_3H_8O_3 + 2\ K_2Mn_2O_8 = K_2C_2O_4 + K_2CO_3 + 4\ MnO_2 + 4\ H_2O$. The excess of permanganate is destroyed by sulphurous acid or a sulphite, and the manganese oxide filtered off, the filtrate acidified with acetic acid, and the oxalic acid precipitated by calcium, the resulting oxalate filtered off, dissolved in dilute sulphuric acid, and the oxalic acid titrated with standard permanganate.

Mr. Allen states: "When, however, the method is employed for determining the glycerin produced by the saponification of oils a serious practical difficulty arises. Ordinary (ethylic) alcohol yields a considerable, though variable, proportion of oxalic acid by oxidation, and if, as recommended by Wanklyn and Fox, alcoholic potash be employed for effecting saponification, it becomes practically impossible to eliminate all traces of alcohol by evaporation, without incurring or risking the loss of an appreciable quantity of glycerin; to avoid this difficulty Benedikt and Zsigmondy employ pure methyl alcohol.

As is well known, the estimation of glycerin produced by the saponification of oils and fats was a very unsatisfactory operation, chiefly owing to the loss of glycerin by volatilisation: however, the problem was supposed to be satisfactorily solved by employing Mr. Allen's *improved process*, but as far as I can see at present we are still in the same predicament, as the process is totally inapplicable for the estimation of glycerin in oils and fats containing soluble fatty acids, particularly in the presence of butyric acid, as it is readily converted into oxalic acid by boiling with alkaline permanganate, 1 molecule of butyric acid being converted into 2 molecules of oxalic acid with liberation of four atoms of hydrogen thus—

$$C_4H_8O_2 + O_6 = 2\,C_2H_2O_4 + H_4$$

Two experiments gave the following results:—

Butyric acid, taken	·1858	·3916
„ found.....	·1710	·3684
Per cent.....	93·64	94·07

So much therefore for Mr. Allen's improvement upon Messrs. Benedikt and Zsigmondy's process for the estimation of glycerin in oils and fats. From these results I am therefore now more inclined to support Mr. Wanklyn's statement, that the theoretical quantity of glycerin cannot be obtained from a butter fat, and that the large amount of soluble fatty acids calculated as butyric acid lately found by myself goes a long way to support his *iso-glycerid* theory.

I am at present experimenting with alkaline manganate of potash in the *cold*, and have got fairly concordant results, butyric acid apparently not being converted into oxalic acid by treatment with alkaline manganate; the results however are much below the supposed theoretical quantity, and when the experiments are completed I shall have much pleasure in laying the results before the Society at some future date.

Discussion.

Mr. A. H. Allen said that as his name had been mentioned in the communication, he would like to make one or two observations. In the first place, he would point out that Dr. Johnstone was not accurate in his account of the part he (Mr. Allen) had had in perfecting the method of estimating the glycerin, produced by the saponification of oils, by oxidising it to oxalic acid by permanganate in alkaline solution. This was the more remarkable, as the correct account was given by him (Mr. Allen) on the very page of the Journal (Vol. V. page 70) from which Dr. Johnstone had quoted a passage in his paper. He (Mr. Allen) there stated that "the problem (of the estimation of glycerin) had, however, been recently solved in a fairly satisfactory manner by Mr. J. A. Wanklyn, further worked out by Mr. W. Fox, and *perfected* by Benedikt and Zsigmondy." He failed to see, therefore, the basis of Dr. Johnstone's remarks, as the only modification—whether "improvement" or otherwise—to which he (Mr. Allen) laid claim was saponification by aqueous potash, to avoid the interfering action of alcohol. He had however, very carefully investigated the process of Benedikt and Zsigmondy, and found that he got accurate results by their method. Working in the way prescribed by them, he had obtained from pure glycerin the theoretical quantity of oxalic acid, and had shown that the product did not undergo any further change by treating it with alkaline permanganate. With respect to the erroneous results which were obtained, according to Dr. Johnstone, in the case of butter fat, owing to the formation by the saponification of butter of a soluble fatty acid which yielded oxalic acid on oxidation, he would point out that it was not so much a question of "Mr. Allen's improvement on Benedikt and Zsigmondy's process," as of the accuracy of Benedikt and Zsigmondy's statement that butyric acid was not acted on by alkaline permanganate. He (Mr. Allen) had simply quoted Benedikt and Zsigmondy, who had made a positive statement based on experiment that butyric acid, acetic acid, and caproic acid underwent no oxidation and formed no oxalic acid or other acid precipitated by lime from acetic acid solution when treated with permanganate in alkaline solution under the conditions of their process. If, therefore, Dr. Johnstone had found that oxalic acid was undoubtedly formed under such circumstances, the result was that he was in a position to controvert the statement made by them, and their process would be proved unsuitable for estimating the glycerin produced by the saponification of butter, though applicable to other fats. But it was very difficult to understand how that could be the case, especially if Dr. Johnstone had used normal butyric acid. Dr. Johnstone had not mentioned the source of his acid, and it was therefore just possible that it was isobutyric acid, in which case it was just conceivable, though very improbable, that it might yield oxalic acid as the product of its oxidation. But isobutyric acid was stated, on good authority, to form an hydroxy-iso-acid by oxidation with permanganate in an alkaline solution, and as the calcium salt of the acid thus produced was readily soluble, it could hardly have been mistaken by the author for calcium oxalate. It was quite clear therefore that Dr. Johnstone was quite as much at variance with Messrs. Benedikt and Zsigmondy and the text-books as Dr. Lunge had just been shown to be with Messrs. Cross and Bevan respecting the volumetric estimation of alumina. He himself had taken some interest in the matter, and might say that Mr. Hehner had recently made some experiments, the results of which absolutely contradicted those now brought forward by Dr. Johnstone. In consequence of the statement made by Dr. Johnstone, Mr. Hehner had tried to oxidise butyric acid by means of alkaline permanganate in the manner pointed out, and had failed to obtain the least trace of oxalic acid. It was clear therefore that there was a direct conflict as to the facts, and he for his part should await with interest the development of the question, which admitted of being definitely settled one way or the other without difficulty.

Dr. W. Johnstone, in reply, said that he had not tested the butyric acid used in the experiments to ascertain whether it was normal or iso. He could only say that he had bought it for normal, and it had been in his possession for a long time.

Note by Dr. Johnstone.

Since the reading of my paper I have subjected the butyric acid used to the action of dilute sulphuric acid, and a known quantity of bichromate of potash, and boiled for six hours. The amount of bichromate remaining in the flask was then estimated, and found to be practically the same, proving beyond the shadow of a doubt that it was the normal acid which I had employed in my experiments. The iso acid also requires 3 parts of water to dissolve one of the acid; on the other hand the normal acid is readily soluble.

Meeting held on Monday, 2nd March, 1891.

MR. TYRER IN THE CHAIR.

THE CHEMICAL CHANGES BETWEEN NITRIC ACID AND METALS.

BY V. H. VELEY, M.A., THE UNIVERSITY MUSEUM, OXFORD.

I have a three-fold object in bringing before you to-night a subject so trite, so common-place, so appertaining to the very nursery of chemistry as the action of nitric acid on metals. My first object will be, so far as circumstances permit, to give you an experimental demonstration of certain statements of mine upon this subject. My second object is to offer an opportunity to those who may differ from my views for passing criticism upon them; and my third object will be to trace in outline the investigations upon which I am now more particularly engaged, and to indicate their practical utility.

I suppose that it has fallen to the lot of most of us at some time of our past to have learned that when moderately concentrated nitric acid is poured on copper there is an evolution of nitric oxide gas, and I suppose also that it has fallen to the lot of some of us either to have taught or to have been taught that the formation of nitric oxide under these conditions is due primarily to the replacement of the hydrogen of the nitric acid by the copper, the liberated hydrogen reducing the nitric acid to nitric oxide. It will be my endeavour to-night to disprove as far as possible the statement, and then to controvert the explanation.

Nearly 20 years ago, Dr. Russell (Jour. Chem. Soc. 1874, 3) showed that if a current of hydrogen gas be passed through a dilute solution of silver, nitrate metallic silver is precipitated. The logical consequence of such a result would be that silver does not dissolve in moderately dilute nitric acid. Further, Dr. Russell found that the amount of hydrogen thus absorbed was not commensurate with the amount of silver precipitated—in fact that some of the hydrogen reduces the nitric to nitrous acid, which in its turn is blown off by the current of hydrogen gas. If it is not thus carried away by the stream of hydrogen gas, the silver re-dissolves in the nitrous acid formed.

About two years ago (Proc. Roy. Soc. **46**, 218), in the course of some experiments made for an entirely different purpose, upon the solution of copper in nitric acid, I observed that when pure metallic copper was placed in moderately concentrated nitric acid, at first no gas was evolved, and, further, that the amount of copper dissolved in those initial stages of the operation was less than the amount of copper which was dissolved when the copper was placed in a solution in which some of the metal had previously been dissolved.

The method adopted for purifying the nitric acid was comparatively simple; it consisted in warming up the acid to 35° and blowing a current of air through it. The concentrated nitric acid was then added to a quantity of water to produce the degree of concentration which was thought desirable.

I have here some nitric acid which has been purified in this way, and I will endeavour to show that it contains no appreciable quantity of nitrous acid. In these cylinders I have some water, and into each of them I will put a comparatively large dose of nitric acid. In the one case, I will add solutions of starch and iodide of potassium usually employed for testing for the presence of nitrous acid, and it will be seen that the amount of nitrous acid present in this case at least, is comparatively small. Another delicate test is the carbon compound known as meta-phenylenediamine hydrochloride ($C_6H_4N_2H_2$ 2 HCl), and I therefore introduce some of it into the other sample of nitric acid. It should produce a yellow-red colouration if nitrous acid be present, but the amount of colouration produced is inappreciable.

It was found that if the metals copper, mercury, and bismuth were placed in such purified nitric acid under such conditions that the metal and the nitric acid were both kept in agitation, no chemical change took place. In the case of copper, the criteria of there being no chemical change were, firstly, that there was no gas evolved; secondly, that no blue colour was imparted to the solution; and thirdly, that the weight of one of these copper spheres, when thus treated, was exactly the same at the end as at the beginning of the experiment, provided that no nitrous acid was present initially, and that no nitrous acid was formed during the experiment. To prevent such formation of nitrous acid, I found it necessary, in the cases of copper and bismuth, to add a small proportion of some substance which would react with the nitrous acid and destroy it as fast as it was formed. Such substances are urea, potassium chlorate, hydrogen peroxide, &c.

[A photograph of the apparatus used, which is figured in the Journal of the Chemical Society, 1889, 365, was here thrown upon the screen.]

The principal parts of the apparatus consist of the wooden cone, upon which works, by friction only, a brass disc, through which passes a brass rod. This cone is driven by a tangent screw, connected with a water motor. When the cone is rotated it causes the disc to rotate. At the lower end of the brass rod there is a glass rod, bearing at its lower end a small glass dish, upon which is placed the sphere of copper or other metal; the whole is immersed in a beaker. The glass rod is set slightly skew-wise, in order that the metal sphere should not always rotate on the same axis. A current of carbonic acid is delivered through a funnel, in order to keep the nitric acid in perpetual agitation. Under these circumstances, provided that the nitric acid is kept well stirred, and the metal is in continual agitation, I found that using nitric acid of 30 per cent. concentration there is no reaction between the metal and the acid, if a small quantity of urea, potassium chlorate, hydrogen peroxide, or other substance capable of removing any nitrous acid be added.

Here is a small trough divided into three divisions, and into each division I introduce a small quantity of nitric acid. Then into one of these divisions I place a small quantity of sodium nitrite, in order to give the required quantity of nitrous acid; into another division I introduce a small quantity of potassium chlorate, which will destroy any nitrous acid which may be formed; and in the third division I leave the acid as it is. Then in each division I place a small strip of copper, and throw the image of the whole upon the screen. The experiment is, however, shown at a disadvantage in that I am not able to keep either the metal or the acid in motion, and the purified acid cannot bear a railway journey without formation of some nitrous acid.

It is evident that in the case of the division containing the nitrite, there is a rapid stream of bubbles, whereas from the copper in the pure nitric acid but few bubbles arise, and in the third tube the reaction has not as yet started. This shows the effect produced upon copper and nitric acid by the presence of a small quantity of sodium nitrite.

I propose next to show a precisely similar experiment with metallic mercury. Into each division I will put some nitric acid, as before, and to one I will add a little sodium nitrite, and to the other a small quantity of potassium chlorate. Then into each I introduce a small quantity of carefully purified mercury. In the division containing the nitrite the whole field is studded with bubbles, whereas in the other case, in which a little potassium chlorate was introduced, no bubbles are formed. This shows the effect of a small trace of chlorate of potash, which prevents nitrous acid from being formed, and thus the mercury from being dissolved.

But it may be argued, and with reason, that the non-evolution of gas is not necessarily a criterion that no metal has been dissolved. I propose, therefore, to illustrate this point by an experiment in a somewhat different form. Into these three cylinders I place a small quantity of purified nitric acid, and into one I put as before a small quantity of my nitrite solution, into the other some urea, and the third is left as it is. Into each cylinder a copper sphere is introduced. It will be seen that there is a great evolution of gas in the case of the cylinder containing the nitrite, while in the other two cylinders there is little or no gas formed. The nitric acid in each of the cylinders is neutralised with ammonia, and it is manifest that there has been a far greater amount of copper dissolved in the one case than in the others.

A similar experiment can be shown with mercury. I take three cylinders as before, and place in each some nitric acid. Into one I put a small quantity of nitrite, and to the other I add some hydrogen peroxide, and in each a little mercury is placed. Bubbles come freely from the cylinder containing the nitrite, while the surface of the solution in the cylinder containing the peroxide and that containing the nitric acid only are nearly or quite free from bubbles.

The case of bismuth is precisely similar. Some nitric acid is placed in each of these three cylinders, and into one I will put some sodium nitrite, into the second some urea, and the third I will leave as it is. I introduce spheres of bismuth; and it is evident that the evolution of gas commences at once in the cylinder with the nitrite, while in the other two cylinders it is hardly perceptible.

The acid solution from the three cylinders containing the mercury is poured off and tested with dilute hydrochloric acid, since mercury dissolves initially as mercurous nitrate. From the first cylinder an abundant precipitate of mercurous chloride is obtained, from the next cylinder hardly any, and from the third no precipitate, a result which illustrates the effect produced on the solution of the mercury by the presence of a small quantity of nitrous acid. I will likewise test the three cylinders containing the bismuth spheres with a solution of hydrogen sulphide. There is an abundant precipitate of bismuth sulphide in the first cylinder, far less in the second, and only a colouration in the third case. [Experiments shown.] Thus, in the case of bismuth also the presence of small quantities of nitrous acid, on the one hand, or of a substance that will destroy it as it is formed, on the other hand, produces a considerable difference in the amount of metal dissolved.

If, then, these metals will not dissolve in nitric acid, but will dissolve in nitrous acid, and if one starts with pure acid, how does the change commence? First, it may be that the metal can seize a quantity of nitrous acid which cannot be detected by even the meta-phenylenediamine reaction; or it may be that the metals contain a small quantity of impurity, which produces a couple, thus electrolysing the nitric acid to produce nitrous acid, and starting the reaction. I am inclined to favour this latter hypothesis, as I have been more successful with mercury than with copper, and with copper than with bismuth; and that is the probable order of purity of the metals.

My experiments also showed that the amount of mercury, copper, or bismuth dissolved, and the amount of nitrous acid formed, were concomitant variables.

The net result of the investigations appears to be that the nitrous acid is decomposed as fast as it is formed. In fact the whole explanation of the solution of these metals, copper, mercury, bismuth, and silver, depends upon the presence of this small quantity, 1 or 2 parts per 10,000, of the effective reagent nitrous acid.

The equations representing the changes are probably reversible thus:—

$$(1.)\ 2NO + HNO_2 + H_2O = 3HNO_2$$

$$(2.)\ 3HNO_2 = 2NO + HNO_2 + H_2O.$$

It will be remembered that Dr. Divers (Jour. Chem. Soc. 1883, 165) distinguishes metals as regards their reaction with nitric acid into two classes. The first class, with which I have dealt this evening, consists of copper, mercury, bismuth, and silver, which convert the nitric acid to nitrous acid; the other class includes the metals zinc, lead, cadmium, magnesium, iron, &c., which do not, according to Dr. Divers' experiments, yield an appreciable quantity of nitrous acid when they dissolve in nitric acid. On the other hand, Dr. Armstrong has stated, in a foot-note to the same paper by Dr. Divers, that he finds that the primary product of the reduction of nitric acid is nitrous acid, and that this body is invariably formed when any metal is dissolved in nitric acid. My results showed that all metals dissolve in nitric acid to form nitrous acid as the primary product of the reaction; and I will illustrate this by selecting those metals belonging to the second class of Dr. Divers' acid.

To this end, I place in one tube some metallic cadmium five times purified by distillation in vacuo, in a second tube some zinc, distilled four or five times in vacuo, into the third tube some steel wire, and in the fourth nitric acid.

[The contents of the tube were warmed up and then tested with meta-phenylenediamine to show that in all these cases nitrous acid was formed, except in the tube containing the nitric acid only.]

I propose, now, to show that the nitric acid, so far from dissolving the metals, actually prevents their being dissolved. I will place in one tube a small quantity of nitrous acid, in another some nitrous acid and some nitric acid, and in the third I will put some nitric acid only. The whole point of the experiment will rest on the fact that in the one case the metal dissolves rapidly in the solution of nitrous acid, that it dissolves less rapidly in the mixture of nitric and nitrous acids, and thirdly, that it dissolves still less rapidly in the nitric acid alone. This nitrous acid was obtained by the decomposition of silver nitrite. [Experiment shown.]

I would also draw your attention to some specimens which Mr. Cross has been kind enough to lend me, and which show another effect of adding to nitric acid a small quantity of some substance which shall either remove the nitrous acid as fast as it is formed, or else prevent its formation. Mr. Cross has found that if jute fibre be treated with nitric acid there is formed, among other substances, a yellow nitroso-product. In the case of sulphuric acid, the cellulose is simply hydrolysed. If a small quantity of urea is added to the nitric acid, then the action of the nitric acid upon the fibre is the same as the action of sulphuric acid. In fact, I incline to believe that many of the chemical changes in organic chemistry which we are accustomed to represent as taking place between nitric acid and the organic substances are conditioned by the presence of the nitrous acid.*

It may appear to be a presumption on my part that I, "a scholastic or professorial chemist" (adopting the classification of a recent writer), should venture to address a body of industrial chemists. So far as I can gather from the writer in question, the merit of the scholastic chemist is that he delivers drowsy lectures to half-slumbering audiences. If, however, to this somewhat soporific draught of scholastic chemistry I have succeeded in adding the slightest tincture of that which is practical, then this paper will not have been given in vain.

THE CHEMICAL CHANGES BETWEEN LEAD AND NITRIC ACID.

BY A. H. VELEY, M.A., THE UNIVERSITY MUSEUM, OXFORD.

The condition of reaction between metallic lead and nitric acid, whether pure or contaminated with small proportions of nitrous acid, present some points of importance on account of the use of this metal for the construction of acid-containing vessels. The effect also of the presence of nitric and nitrous acids in inducing the solution of metallic lead in sulphuric acid has attracted the attention of vitriol makers so long as the present methods of manufacture have been in vogue. In the present communication it is proposed to give a preliminary account of some experiments on the former of these problems, and to reserve the latter for some future date.

Spheres of pure metallic lead were supplied by Messrs. Johnson and Matthey; the nitric acid used was purified according to the process described. The specific gravity of each sample of acid was determined by means of a delicate pyrometer, and the percentage of free acid, calculated as HNO_3, was also estimated for the same portion by the usual process of acidimetry. At the outset a series of experiments were made to determine the effect of concentration of the acid, the temperature being kept constant. The apparatus and method of working is described in detail in my paper "On a Method of Investigating the Dissolution of Metals in Acids;† the same volume of 750 cc. was used throughout, and the duration of each experiment was one hour.

* Since the date of the meeting my attention has been drawn to experiments of Demuth and Meyer (Ber. der Chem. 22, 242, 550—553), which show that certain hydroxylbenzoic acid can be nitrated by nitrous acid.

† Jour. Chem. Soc. 1889, 761.

SERIES I.

Specific gravity $\frac{19^\circ}{19^\circ}$ of acid, 1·0891.

Concentration per cent., 15·76. Temperature 35°.

Weight of Sphere at Commencement.	Weight of Sphere at Conclusion.	Loss.	Mean Area in Mm. Sq.	Decimilligrammes dissolved per 1 Mm. Sq.
Grms.	Grms.	Grm.		
5·6937	5·6122	·0815	285·5	2·85
5·6122	5·5317	·0805	279·8	2·92
5·5317	5·4492	·0825	277·5	2·97
5·4492	5·3647	·0835	275·2	3·07
5·3647	5·2832	·0815	279·2	2·99
			Mean value	2·92

SERIES II.

Specific gravity of acid $\frac{19^\circ}{19^\circ}$, 1·1362.

Concentration per cent., 22·76. Temperature 35°.

Weight of Sphere at Commencement.	Weight of Sphere at Conclusion.	Loss.	Mean Area in Mm. Sq.	Decimilligrammes dissolved per 1 Mm. Sq.
Grms.	Grms.	Grm.		
5·1822	4·874	·2082	267·2	7·61
4·874	4·6824	·1926	260·6	7·35
4·6824	4·4932	·1892	253·3	7·47
4·4932	4·3062	·187	246·1	7·59
4·3062	4·1177	·1885	242·6	7·77
			Mean value	7·56

SERIES III.

Specific gravity of acid $\frac{19^\circ}{19^\circ}$, 1·1767.

Concentration per cent., 29. Temperature 35°.

Weight of Sphere at Commencement.	Weight of Sphere at Conclusion.	Loss.	Mean Area in Mm. Sq.	Decimilligrammes dissolved per 1 Mm. Sq.
Grms.	Grms.	Grm.		
4·2800	4·5897	·3903	263·2	14·84
4·5897	4·2185	·3712	251·3	14·77
4·2185	3·8912	·3270	228·8	14·29
3·8912	3·5882	·303	215·7	14·05
			Mean value	14·49

SERIES IV.

Specific gravity of acid $\frac{19^\circ}{19^\circ}$, 1·2123.

Concentration per cent., 34·43. Temperature 35°.

Weight of Sphere at Commencement.	Weight of Sphere at Conclusion.	Loss.	Mean Area in Mm. Sq.	Decimilligrammes Dissolved per 1 Mm. Sq.
Grms.	Grms.	Grm.		
5·2386	4·928	·3106	273·9	11·34
4·928	4·6273	·3007	261·21	11·51
4·6273	4·3509	·2764	251·34	10·97
4·3509	4·0801	·2708	238·37	11·35
			Mean value.....	11·29

SERIES V.

Specific gravity of acid $\frac{19^\circ}{19^\circ}$, 1·2171.

Concentration per cent., 35·35. Temperature 35°.

Weight of Sphere at Commencement.	Weight of Sphere at Conclusion.	Loss.	Mean Area in Mm. Sq.	Decimilligrammes dissolved per 1 Mm. Sq.
Grms.	Grms.	Grm.		
5·6743	5·3788	·2955	285·06	10·37
5·3788	5·1932	·2865	274·5	10·44
5·1932	4·9188	·2735	263·8	10·37
4·9188	4·6533	·2655	254·71	10·44
			Mean value	10·41

SERIES VI.

Specific gravity of acid $\frac{19^\circ}{19^\circ}$, 1·2516.

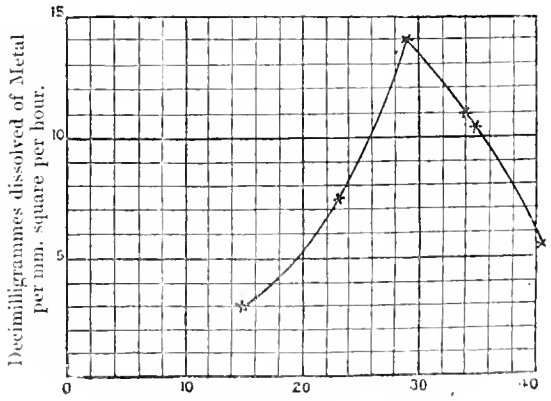
Concentration per cent., 40·31. Temperature 35°.

Weight of Sphere at Commencement.	Weight of Sphere at Conclusion.	Loss.	Mean Area in Mm. Sq.	Decimilligrammes Dissolved per 1 Mm. Sq.
Grms.	Grms.	Grm.		
5·778	5·618	·160	292·25	5·48
5·618	5·4618	·1562	286·11	5·58
5·2873	5·1308	·1565	274·55	5·66
5·1308	4·9773	·1535	270·03	5·68
			Mean value.....	5·60

The above results show that as the concentration of the acid is increased, the temperature being kept uniform, the amount of lead dissolved per unit time increases up to a maximum point and thence decreases. The behaviour of this metal under these conditions is unlike that of copper, mercury, and bismuth. The net result, however, in the case of lead is dependent upon two opposing causes: (1) the intensity of the chemical change between the metal and the acid which would tend to increase with increase of concentration; and (2) the decrease in solubility of the lead nitrate formed in the acid liquor under the same conditions. In order to obtain a more particular insight into the effect produced by the latter cause, the solubility of lead nitrate in four out of five samples of nitric acid was determined for the temperature of 35°, and compared with that of water under the same conditions.

Plate I.

Curve of Chemical Action between Lead and Nitric Acid of various concentrations.



The results are compared in the following table:—

Solubility of Lead Nitrate expressed in Parts dissolved per 100 Parts Solvent.

Concentration of Acid.	Solubility.
Per Cent.	
0	64·91
15·76	10·25
22·76	5·98
29·	3·01
40·31	1·62

The curve representing the solubility of the salt in terms of percentage proportion of nitric acid does not seem to be expressible by any simple form of equation; the phenomenon is possibly complicated by the formation of acid nitrates.

The effect of increase of temperature, concentration of acid remaining the same, increases as would, *à priori*, be expected, the amount of lead dissolved. The following series may serve as a comparison with those of Series V., the only alteration of condition being that of temperature.

Series VII.

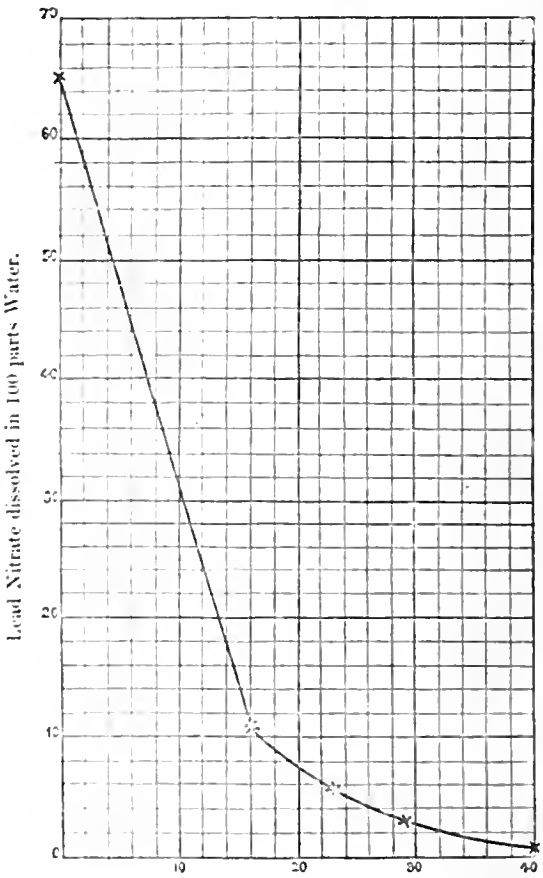
Specific gravity of acid $\frac{13}{16}$ 1·2516. Concentration per cent. 40·81. Temperature 10°.

Weight of Sphere at Commencement.	Weight of Sphere at Conclusion.	Loss.	Mean Area in Mm. Sq.	Decimilligrammes dissolved per 1 Mm. Sq.
Grms.	Grms.	Grm.		
5·1218	4·9933	·2285	276·45	7·9
4·9933	4·7968	·1965	269·41	7·29
4·7968	4·5188	·178	261·74	7·18
4·5188	4·3288	·18	254·7	7·07
4·3388	4·1693	·1785	248·92	7·19
			Mean value.....	7·32

These experiments, taken from a chemical standpoint, are quite in accordance with Faraday's investigations on the electro-chemical position of lead, which showed that the metal, when immersed both in concentrated and in dilute nitric acid, was electro-positive to the metal immersed in acids of intermediate strength. (Experimental Researches, Series XVII.)

Plate II.

Curve of Solubility of Lead Nitrate.



As previous experiments had shown that when lead dissolves in nitric acid, nitrous acid is produced, while the investigations upon the metals copper, mercury and bismuth had proved that the amounts of metal dissolved and of nitrous acid present were concomitant variable determinations of the nitrous acid were made in the course of the experiments recorded in Series V. and VII. The following results were obtained:—

Series V.

Experiment I.		Experiment II.		Experiment III.		Experiment IV.	
Time from Commencement.	Nitrous Acid in Mgrms. per 1 cc.	Time from Commencement	Nitrous Acid in Mgrms. per 1 cc.	Time from Commencement	Nitrous Acid in Mgrms. per 1 cc.	Time from Commencement.	Nitrous Acid in Mgrms. per 1 cc.
1	·0047	15	·0155	15	·0522	30	·0422
5	·0021	30	·0206	30	·043	45	·053
15	·0048	45	·0311	45	·049	60	·053
30	·0093	60	·041	60	·0533		
45	·0119						
60	·0172						

SERIES VII.

EXPERIMENT I.		EXPERIMENT II.		EXPERIMENT III.		EXPERIMENT IV.	
Time from Commencement.	Nitrous Acid in Mgrms. per 1 cc.	Time from Commencement.	Nitrous Acid in Mgrms. per 1 cc.	Time from Commencement.	Nitrous Acid in Mgrms. per 1 cc.	Time from Commencement.	Nitrous Acid in Mgrms. per 1 cc.
15	·019	15	·041	30	·047	30	·047
30	·034	30	·051	45	·047	45	·047
45	·049	45	·05	60	·044	60	·044
60	·053	60	·047				

The above results show that the amount of nitrous acid present increases gradually up to a maximum and constant point; the amount, however, is, under the conditions of experiment, comparatively small. From the results to be described in the sequel it follows that this slight increase in the amount of nitrous acid would have no material effect upon the amount of lead dissolved.

Effect produced by Rest.—In all the above series of experiments both the metal and acid were kept in motion. As the results of the investigations with the metals, copper, mercury, and bismuth had shown that the amount of metal dissolved by the nitric acid is increased to a marked extent by keeping both metal and acid at rest. On account of the increase of the amount of nitrous acid in the immediate vicinity of the metal, a comparative experiment was also made in the case of lead. The results obtained were as follows:—

(I.) CONDITION OF MOTION.

Concentration of acid, 35·35 per cent. Temp., 35°.

Weight of Sphere at Commencement.	Weight of Sphere at Conclusion.	Loss.	Mean Area.	Decimilligrammes dissolved per 1 Mm. Sq.
Grms. 5·7243	Grms. 5·4348	Grm. ·2895	285·3	10·3

(II.) CONDITION OF REST.

5·4348	5·3503	·0845	280·7	3·0

The amount of metal dissolved in the second experiment is less than a third of that dissolved in the first experiment. This difference of behaviour of lead to that of the other metal is here also due to the sparing solubility of the lead nitrate in the nitric acid and the saturation of the acid in the immediate vicinity of the metal with the salt formed.

Effect produced by Addition of some Substance added to Destroy the Nitrous Acid.—A number of experiments have been made with a view of preventing metallic lead from dissolving in nitric acid by adding some substance, such as potassium chlorate or hydrogen peroxide, which should destroy the nitrous acid; but though they have thus far proved unsuccessful, yet they have shown that the amount of metal dissolved is reduced to some appreciable extent by the presence of these substances.

Effects of Addition of Small Quantities of Nitrous Acid.—In order to determine the effect produced by addition of nitrous acid, two experiments were conducted under conditions precisely identical with those of Series V. The results are given below:—

Weight of Sphere at Commencement.	Weight of Sphere at Conclusion.	Loss.	Mean Area.	Nitrous Acid. Mgrms. in 1 cc.	Decimilligrammes dissolved.
Grms. 4·6533	Grms. 4·3828	Grm. ·2705	244·4	15·05	11·37
4·3828	4·1228	·258	233·72	21·5	11·02
			Mean value		11·19
			Mean value of Series V.		10·41

Thus the presence of nitrous acid increases to a slight degree the amount of lead dissolved. This point will, however, be more fully discussed in the sequel. It is worthy of remark that the effect of the presence of the nitrous acid is far less than in the case of the metals mercury, copper, and bismuth.

The Dissolution of Lead in Nitric and Nitrous Acid taken Separately and Together.—As previous investigations had shown that the metals mercury and bismuth dissolve very readily in a 1 per cent. solution of nitrous acid, and under these conditions the presence of nitric acid interferes with, rather than promotes, the interaction between the metals and the acids, a series of comparative experiments were made upon the amounts of lead dissolved in nitric and nitrous acids, either taken separately or together. Simultaneously the effect produced by alloying the lead with small proportions of antimony was also investigated. Spheres of alloys containing 5 and 10 per cent. of antimony were made from my instructions by Messrs. Johnson and Matthey, as it appeared that alloys of these compositions are in use for pumps and vessels to contain acids.

Three spheres of pure lead, the 5 and the 10 per cent. antimony alloy, were suspended, by mean of a glass arrangement, within the acid mixtures contained in three tubes, and placed under identical conditions. The time of each experiment was varied, according to circumstances, for each set of experiments. The temperature varied from 12° to 15°.

The nitrous acid used was obtained by the decomposition of recrystallised silver nitrite with hydrochloric acid. For each mixture the total acidity was determined by a standard solution of soda, and the amount of nitrous acid by a standard solution of potassium permanganate; the difference between these two values gives the amount of nitric acid present.

Experiment I.

Nitric acid, 1·5286 grms. in 15 cc. Temp. 15°.
Nitrous acid, Nil.

	Decimilligrammes dissolved per 1 Mm. Sq. per Hour.
Lead	2·22
Alloy, 5 per cent.	2·73
Alloy, 10 per cent.	2·69

Experiment II.

Nitric acid, 1·122 grms. in 15 cc. Temp. 15°.
Nitrous acid, Nil.

	Decimilligrammes dissolved per 1 Mm. Sq. per Hour.
Lead	·015
Alloy, 5 per cent.	·557
Alloy, 10 per cent.	·518

Experiment III.

Nitric acid, ·8562 } grms. in 15 cc. Temp. 16°.
Nitrous acid, ·122 }

Ratio of nitrous to nitric acid, 1·7.

	Decimilligrammes dissolved.
Lead	3·05
Alloy, 5 per cent.	5·99
Alloy, 10 per cent.	3·43

Experiment IV.

Nitric acid, 1·7062 } grms. in 15 cc. Temp. 15°.
Nitrous acid ·2219 }

Ratio of nitrous to nitric acid, 1 : 8.

	Decimilligrammes dissolved.
Lead	2·64
Alloy, 5 per cent.	4·90
Alloy, 10 per cent.	1·97

Experiment V.

Nitric acid, 1·2407 } grms. in 15 cc. Temp. 12°.
Nitrous acid, ·1701 }

Ratio of nitrous to nitric acid, 1 : 24·8.

	Decimilligrammes dissolved.
Lead	3·07
Alloy, 5 per cent.	3·87
Alloy, 10 per cent.	3·28

Experiment VI.

Nitric acid, 1·1721 } grms. Temp. 13°.
Nitrous acid, ·5089 }

Ratio of nitrous to nitric acid, 1 : 8·2.

	Decimilligrammes dissolved.
Lead	1·52
Alloy, 5 per cent.	3·13
Alloy, 10 per cent.	3·11

Experiment VII.

Nitric acid, ·684 } grms. in 15 cc. Temp. 15°.
Nitrous acid, ·2754 }

Ratio of nitrous to nitric acid, 1 : 2·5.

	Decimilligrammes dissolved.
Lead	15·01
Alloy, 5 per cent.	30·84
Alloy, 10 per cent.	29·9

Experiment VIII.

Nitric acid, traces } grms. in 15 cc. Temp. 15°.
Nitrous acid, ·158 }

	Decimilligrammes dissolved.
Lead	·8
Alloy, 5 per cent.	2·22
Alloy, 10 per cent.	1·98

From the above series of experiments the following conclusions may be drawn.

Firstly, metallic lead is attacked to a slight extent by nitric acid (whether concentrated or dilute), and also by nitrous acid, when the two acids are taken separately; it is attacked to a much greater extent by mixtures of the two acids, and the intensity of the reaction is the greater the more nearly is the proportion of nitric to nitrous acid.

This is especially marked in Experiment VII., in which the mixture used was obtained by the gradual addition of nitrogen peroxide to well-cooled water. This result may be due to a compound of nitrous and nitric acids as suggested by Armstrong.* In this case also the behaviour of lead is different from those of mercury, copper, and bismuth, which are attacked very readily by nitrous acid, less readily by mixtures of nitric and nitrous acids, and not at all by pure nitric acid.

Secondly, in most of the above experiments, the pure lead is less readily attacked than the alloy containing 10 per cent. of antimony, and this in its turn less than the alloy containing 5 per cent. of antimony. These differences are especially marked in the case of pure concentrated nitric acid (Experiment II.), and of the mixture of nitrous and nitric acid in nearly equivalent proportions (Experiment VII.); in the latter experiment the behaviour of the alloys was most remarkable, in that the lead dissolved with considerable evolution of gas, while the metallic antimony scaled off and fell to the bottom of the containing vessel. These scales were collected and weighed with the sphere.

It would not appear, therefore, that any especial advantage accrues in alloying lead with a small proportion of antimony for the construction of pumps or vessels through which nitric acid, whether pure or containing nitrous acid, might pass. These experiments, also, do not confirm in the particular case of nitric acid the received opinion of some writers, that whereas "most metals are all the less acted upon by acids the purer they are, but the contrary seems to be the case with lead."

The main conclusions to be drawn from the experiments described above may briefly be summed up as follows:—

(I.) The behaviour of lead towards nitric acid is different, except in the production of nitrous acid, from that of the metals, silver, mercury, copper, and bismuth.

(II.) Lead is attacked to a less degree by very dilute and concentrated nitric acid, but to a greater degree by acid of intermediate strength.

(III.) Lead is attacked to a less degree by nitric or nitrous acid, taken separately, but to a greater degree by mixtures of the two acids, the reaction between the metal and acid mixture being the more intense the more nearly equal in the proportion between the nitric and the nitrous acids.

(IV.) In the construction of vessels through which nitric acids or mixtures of nitrous and nitric acids might pass, there does not appear to be any advantage in alloying the metal with small proportions of antimony.

Discussion.

Mr. C. F. Cross wished to say a few words with respect to the specimens of fibres shown by the author. The particular form of fibre treated was the typical lignocellulose, or jute. It would be noticed that the specimen on the left showed the ordinary action of the non-oxidising acids, while the one on the right was almost completely resolved into cellulose and the yellow derivative of the lignone molecule (which is a complicated keto-alcohol),

* J. Chem. Soc. 1885, 456.

probably a nitroso body or an oxime. The advantage of working with carbon compounds, which had become so evident during the last 20 years, was that it enabled one to cast a light on the reactions which took place with inorganic compounds, by fixing the intermediate stages. In the case of nitric acid and the metal copper, for instance, the reaction no doubt proceeded through definite intermediate steps which could not be followed, but if one took a complicated molecule like the one in question, the number of probabilities involved in the reaction were extremely numerous. He might mention nitrites, nitroso derivatives, nitrolic acids, oximes, and the simpler nitrogen compounds, such as nitric and nitrous oxides and hydrocyanic acid, some or all of which appeared to be formed in the reaction. Dr. Will, who was now in this country, had published an important paper in the last number of the "Berichte" (p. 400), on the reaction of alkalis with the cellulose nitrates, in which he showed that the first product of the saponification, instead of being a di-nitrate as had been supposed by Eder, was an oxime, yielding oxypyrmic acid, of which he had isolated the phenylhydrazide. He mentioned that as indicating the complications which were always to be expected in the action of such complex molecules as the fibre keto-alcohols and nitric acid; but it was evident that the continued study of these reactions in the case of typical bodies would give us a systematic dissection of these bodies, and at the same time elucidate the actual mechanism of the reactions of the inorganic nitrogen compounds.

Mr. G. D. MacIndoe observed that one of the results of the paper would be that those who had been in the habit of using pure nitric acid, and had found it difficult to get the reaction to commence, would in future take care to have a small portion of nitrous acid present to start the reaction. It would also be a hint to nitric acid makers to point out to their customers that it was undesirable to press them too hard on the point of supplying it pure and free from nitrous acid, because possibly many of the complaints as to the quality of pure nitric acid arose owing to the absence of the small quantity of nitrous acid which Mr. Veley's experiments proved to be essential.

Mr. A. G. Bloxam confessed that at the moment he was more interested in the paper from the professorial than from the practical point of view. He would like to ask the author for further information as to how he accounted for the commencement of the reaction between the copper and the nitric acid. He had understood the author to say that the cause of the reaction was the impurities in the copper or other metal used. He would like to know whether there were any metals which would cause the evolution of nitrous acid from nitric acid, and if not, did Mr. Veley attribute the commencement of the reaction to voltaic action taking place between the copper and the foreign metal contained in it?

Mr. H. de Mosenthal had listened with great interest to the paper, which he thought contained hints of much practical value, especially that part which referred to the reaction of nitric and nitrous acids with metals. But he thought that the author had been somewhat too general in suggesting that the same results might apply to all organic substances. He hardly thought that the results of nitration would be obtained in certain cases so readily if nitrous acid were present. In fact, the presence of nitrous acid was to be avoided in certain cases. For instance, if it were required to obtain nitro-cellulose especially with a high percentage of nitrogen, he did not think that the presence of nitrous acid would assist, even in commencing the reaction. And he certainly would not like to add very much nitrous acid to the nitric acid in the manufacture of nitro-glycerin.

Mr. Bertram Blount asked the author whether he could give any further information as to the time occupied by the process of freeing the nitric acid from nitrous acid by means of air. He would also be glad to know whether Mr. Veley had found any other gas preferable to air for the purpose of driving off the nitrous acid.

Mr. Watson Smith observed that his friend Dr. Lunge, in his treatise on the sulphuric acid manufacture, had referred to the danger of over-steaming the last chamber of a series. Lunge said that the danger arose from the fact that when the sulphuric acid was reduced below a certain strength, the nitrogen compounds ceased to form nitrosyl-sulphonic acid, and at that reduced strength nitric acid instead of nitrous acid began to be found in the chamber acid, and the lead was attacked. He appeared to consider, therefore, that the solvent action on the lead was due to the nitric acid. According to Mr. Veley, however, it now seemed that nitrous acid, as such, would at once exert a powerful solvent action on the lead. Clemens Winkler had also investigated the question, which was an important one to the sulphuric acid manufacturer. It would be interesting to hear the evidence of Lunge and Winkler on the subject. If not already investigated, it seemed to him that it would be an interesting subject of inquiry to determine the exact circumstances under which the reaction of sulphuric acid containing nitrous acid in solution commenced operations on lead in contact with it, and whether nitric acid as such was really contained in chamber acid, say, of 80° or 90° Tw., in the last chamber of a set. It was certain that if nitrous acid directly attacked lead in presence of sulphuric acid, and if also it might pass, by a further step of oxidation, into nitric acid, there must be a point of equilibrium, on one side of which nitrous acid was reduced by lead and on the other nitrous acid was oxidised further to nitric acid. But it was difficult to comprehend that under the same circumstances nitrous acid could directly attack lead, suffering itself reduction, and also oxidise to nitric acid, which should then attack lead and suffer reduction. In other words, was it possible to conceive that in the same cycle of chemical changes nitrous acid was being oxidised whilst nitric acid was being reduced, if we granted, as Mr. Veley showed we must do, that nitrous acid attacked lead, whilst we were also told that nitric acid does so by other authorities?

Mr. W. Crowder said that he could reply to Mr. Smith's question at once. The point at which nitrous acid would begin to act upon the lead was somewhere about 60° or 70° Tw. The best way of ascertaining whether one had nitrous acid present to the injury of the chambers was this: as long as nitrous acid was present the chambers were of a dark-brown red; the instant one got too much steam it cut down the nitrous acid, forming nitric acid, and then away went the curtains. He had no doubt, therefore, that Mr. Watson Smith had correctly quoted Dr. Lunge in his remarks. He regarded Mr. Veley's paper as being of very great practical value. He was much interested in questions relating to the action of nitric acid on metals, especially in connexion with sulphuric acid chambers; and the paper had thrown some light on problems having reference to that action.

Mr. A. E. Fletcher said that in speaking of the action of nitric acid on organic compounds two separate actions had to be considered. In the one case there was the formation of a substitution compound, while in the other case they had to deal merely with the oxidising action of the nitric acid. In the formation of nitro-benzol, for instance, they required pure nitric acid, whereas for the oxidation of aniline the presence of nitrous acid was necessary, the one being a substituting, the other an oxidising action.

Mr. C. F. Cross said that he might refer to one or two notes in his book on the influence of nitrous acid on the results of nitrating fibres. Mr. de Mosenthal had touched an important part of the question in his remarks as to whether in the nitration of fibrous substances to form explosives, the presence or absence of nitrous acid would alter the character of the nitration in the direction of taking up more or less nitric acid in combination. He held in his hand the notes of some experiments of his, in one of which he had added 5 per cent. of nitrous acid on the nitric acid present, and in another case he had added urea. But the products of the nitration appeared to be in every respect unaltered; and, therefore, in the case of the nitration of fibrous substances the presence or absence of nitrous acid was without effect.

Mr. VELEY, in reply, said that he feared that his remarks regarding the nitration of organic compounds had been taken to a greater degree than he wished. So far as he could remember, he had said that it was just possible that nitrous acid was the effective material. It appeared, however, that some members gathered that he thought that in all cases nitrous acid was the essential substance, instead of, as he wished to convey, that it was *possibly* the essential substance. Mr. Bloxam had inquired how he explained the commencement of the reaction between the metals and the nitric acid. He had said in the course of his remarks that the commencement of the reaction might be due to either of two causes. Either the metal could lay hold of an amount of nitrous acid which could not be detected by any of the delicate reactions for nitrous acid, or, as he thought more probable, there might be a slight impurity in the copper, mercury, or other metal, whereby an electric current was produced, which formed an amount of nitrous acid sufficient for the metal to react well (*sub supra*). But with regard to the initial change being of an electric or chemical nature it was not his intention to enter into that question. He might remark, however, that in addition to the chemical investigations brought before the meeting, he had, in conjunction with Mr. Burch, made a number of experiments upon the electro-motive force of various cells containing platinum with copper, bismuth, mercury, and silver. It was found by means of a capillary or quadrant electrometer that the electro-motive force of a combination of copper, for example, nitric acid and platinum, was extremely small, viz., from 0·25 to 0·3 volt; but it increased rapidly to somewhere about 0·75 volt, provided pure nitric acid was used. If the slightest trace of nitrous acid was introduced, then the electro-motive force went to its maximum at once. The initial E.M.F. depended upon the purity of the acid. If ever the copper strips were touched by the finger, if ever there was the slightest impurity in the glass vessels, or if ever a slight impurity resulting from some previous experiment remained on the platinum, the electro-motive force went up to its maximum at once. In answer to Mr. Blount's inquiry as to the length of time required to purify the nitric acid, he could only say that the time depended upon the purity of the atmosphere of the laboratory. It would be practically impossible to purify the acid in a laboratory, for example, wherein a number of operations in organic chemistry were going on, and it would be almost impossible in presence of direct sunlight. There was no particular advantage in air, except that it was a convenient and cheap substance for blowing out the nitrous acid. He regarded the removal of the nitrous acid under those conditions as purely a mechanical blowing out, and in no way due to the oxidation of the nitrous acid to nitric acid by the air. As to the time required he could only say that it varied very much. Under suitable conditions, provided that no one else was working in the laboratory, and that the sun was not shining too brightly, the acid could be purified in an hour, and under less favourable circumstances it might require about half as long again.

He had omitted to mention the method employed for estimating the various amounts of nitrous acid. He had made use of a colorimeter somewhat different from those in ordinary use. It consisted essentially of two mirrors and a glass case, in which were placed two tubes, one containing the solution to be examined, and the other a standard solution of known strength. The first-named tube was filled up to a certain mark with the solution, and the other one was raised or lowered as the case might be until the tint of the two discs in the mirrors appeared the same. So far as he knew, this was a more convenient method, and one susceptible of greater accuracy than the mere looking down upon columns of coloured liquids, for it was possible to adjust the level so as to obtain the discs of practically the same tint. By that means the amount of nitrous acid present could be determined within 1—2 per cent., even in the extremely dilute solutions which occurred in the course of the investigations.

ON ALDEPALMITIC ACID.

BY J. ALFRED WANKLYN.

CONTINUING the investigation of aldepalmitic acid, I find that there is a very decided difference between the palmitic acid of palm oil and aldepalmitic acid in specific gravity, viz.:—

	Sp. Gr.
Palmitic acid	0·950 at 14·5° C.
Aldepalmitic acid	0·890 at 12·5° C.

The preparation and examination of the salts has likewise been proceeded with, and the aldepalmitate of potash, soda, ammonia, baryta, strontia, lime, magnesia, silver, and copper have been in my hands.

So far as I know, except the salts of the alkalis (which appear to be partially soluble with decomposition), the aldepalmitates are insoluble in water.

The magnesia salt is soluble to, at least, 2 per cent. in hot alcohol of sp. gr. 0·83, and is deposited from the solution on cooling down to 15° C. Some of the salts of this acid, and of the accompanying acid, which, as has been described, is absorbable by bibulous paper, are soluble in benzene; and the investigation is becoming very interesting.

Aldepalmitate of baryta, $C_{16}H_{29}BaO_2$, is a white powder insoluble in water. It is prepared by pouring ethereal solution of the acid into clear baryta water (moderate excess of baryta) and boiling. The resulting precipitate of baryta salt is washed with boiling water, dried at 100° C., extracted with ether, and again dried at 100° C.

Submitted to analysis it gave 2·063 grms. taken: 0·748 grm. $BaOSO_3$ by ignition with sulphuric acid.

—	Calculated.		Found.
C_{16}	192	..	..
H_{29}	29	..	..
Ba	68·5	21·31	21·32
O_2	32	..	..
	321·5	..	..

Aldepalmitate of silver, $C_{16}H_{29}AgO_2$, has been prepared by double decomposition, viz. by the action of nitrate of silver upon either the soda salt or the ammonia salt of the acid. The silver salt forms a very bulky white precipitate and indeed comes down in combination with alcohol if the precipitation be made in presence of alcohol.

The quantity of alcohol (and possibly also water) which is consolidated by this salt is most remarkable. Thus in one of the experiments the figures were:—

Weight of aldepalmitic acid = 2·7 grms., which was dissolved in alcohol and poured into a solution of nitrate of silver, a little ammonia being added. Weight of precipitate after washing and pressing with bibulous paper = 22 grms.

The 22 grms. of this strange silver salt when dried in the water-bath lost weight until it weighed 5 grms. It was then extracted with ether and again dried at 100° F. and finally weighed 3 grms., there having been a little mechanical loss.

The silver salt is thus shown to possess the extraordinary power of consolidating about five times its weight of alcohol (or of mixed alcohol and water).

This property of the silver salt is a hindrance to its employment as a means of investigating the equivalent of the acid, inasmuch as the enormous proportion of consolidated alcohol carries down foreign matter and contaminates the salt.

In the instance in which the soda salt was employed the resulting silver salt exhibited excess of residue on ignition. And in the instance when the ammonia salt was employed

the residue on ignition was deficient. The following are the data:—

I. Silver salt (from soda salt)—

	Grms.
Substance taken	1·412
Residue on ignition (Ag)	0·441

II. Silver salt (from ammonia salt)—

	Grms.
Substance taken	1·152
Residual silver	0·341

——	Calculated.		Found.	
			I.	II.
C_{16}	192	..	..	..
H_{29}	29	..	..	..
Ag	108	29·92	30·58	29·52
O_2	32	..	..	..
	361	100·00	..	..

If it should be deemed advisable to resort to the silver salt for the purpose of investigating the equivalent of aldepalmitic acid, I should try another method of preparation, and would take ethereal solution of the acid and oxide of silver.

This silver salt is not sensitive to light and will bear drying at 100° C. without changing its colour.

Aldepalmitate of lime, $C_{16}H_{29}CaO_2$, is a white powder, insoluble in water. It is prepared by boiling the acid with lime water and removing any excess of acid by means of extraction with ether. It is dried at 100° C.

It gave on analysis:—1·159 grm. gives 0·295 grm. $CaOSO_3$.

——	Calculated.		Found.
C_{16}	192	..	..
H_{29}	29	..	..
Ca	20	7·33	7·49
O_2	32	..	..
	273	..	..

Apparently the lime salt is capable of combining with alcohol, giving a compound of one molecule of the salt with four of alcohol.

Aldepalmitate of strontia, $C_{16}H_{29}Sr_2O_2$. The strontia salt is very peculiar. It was prepared by dissolving the acid in hot alcohol, filtering into strontia water and boiling. The bulky precipitate was pressed with bibulous paper and weighed, and then dried at 100° C. and again weighed.

The salt thus prepared was found to contain a small excess of strontia, yielding 16·2 per cent. of strontium. The theory requires 14·8 per cent. of strontium.

Another preparation of the salt gave 14·3 per cent. of strontium.

This salt is remarkable in several ways. Apparently it has no tendency to unite with alcohol, but combines with about its own weight of water, forming a massive white precipitate. Prolonged drying in the water-bath gets rid of all this water and the salt suffers a very manifest alteration and becomes like calcined magnesia in aspect.

Aldepalmitate of magnesia, $C_{16}H_{29}MgO_2$, prepared by boiling calcined magnesia with an excess of the acid in alcoholic solution. The hot alcoholic solution deposits the magnesia salt on cooling. It is a white precipitate, fusible on being strongly heated; dried in the water-bath it gave the following analytical result:—

Substance, 1·207 grms.; magnesia, 0·090 grm.

——	Calculated.		Found.
C_{16}	192	..	..
H_{29}	29	..	..
Mg	12	4·53	4·48
O_2	32	..	..
	265	..	..

Besides forming salts, this acid manifests activity in other directions. Its relations with alcohol have been noted and are very remarkable.

This silk-like substance is permanent, and has the power of staining paper. In fact a qualitative test for aldepalmitic acid may consist in getting this stain, which can be produced by very minute quantities of it. I have to notice next a beautiful experiment by Dr. Johnstone. That gentleman had the audacity to attack the butter itself with absolute alcohol, without going through the formality of a preliminary saponification. The details of this experiment he will himself publish shortly. But here are the products. This compound has been dried in the bath, and has lost about two-thirds of its weight; and the substances which I hold in my hand is aldepalmitate of glycerin united with alcohol, really a consolidate, I think. This is evidently one of the aldepalmitic consolidates with alcohol.

I believe that this acid is destined to play a very important part in animal and vegetable chemistry, in the chemistry of nutrition; and I mean to devote much attention to the investigation of its chemical history. What I have already done must be regarded as merely preliminary groundwork.

Discussion.

Mr. Otto Hehner wished to ask the author whether, since the subject of his paper was last brought forward, he had or had not estimated the iodine absorption of the body under notice. That absorption ought, as he had before remarked, to be a considerable one, and should set at rest the question as to whether this acid was or was not of the constitution which Mr. Wanklyn supposed. With regard to the author's statements as to the alcohol solidifying powers of his so-called aldepalmitic acid, he would point out that it was well known that a very small quantity of any solid fatty acid of high atomic weight was capable of solidifying a comparatively large quantity of alcohol. A very small portion of wax, for instance, would solidify many times its weight of alcohol. He had recently experimented in that way with stearic acid, and found that one part of it could comfortably solidify five parts of alcohol, which was the proportion which Mr. Wanklyn had stated to be characteristic of his compound. He would repeat that he would like to be informed as to the precise iodine equivalent of this acid, for that would convey more information as to its constitution than the preparation of any number of interesting salts of the compound.

Dr. C. R. Alder Wright was still somewhat at a loss to know what Mr. Wanklyn meant by the term aldepalmitic acid. If it partook at all of the nature of aldehyde, what were the functions of the oxygen groups in it? If it were an ordinary fatty acid it would be represented by some such formula as—

$$\begin{array}{l} C_{15}H_{29} \\ | \\ C{=}O \\ \diagdown OH \end{array}$$

wherein one oxygen atom was doubly linked on to a carbon atom and the other present as hydroxyl. He would like to know how Mr. Wanklyn imagined that the two oxygen atoms were connected with the carbon atoms in his aldepalmitic acid.

Mr. A. P. Hoskins wished to have some more definite information as to the character and appearance of the stains produced on filter-paper by the aldepalmitic acid combined with alcohol, as he had understood Mr. Wanklyn to say that those stains might be used as a test of the presence of the acid.

Mr. Watson Smith asked whether Mr. Wanklyn considered that the "solidification of alcohol by aldepalmitic" acid was a semi-combination similar in character to that in the case of water of crystallisation? Also, did he suggest that aldepalmitic acid was a weaker acid than palmitic acid, and that the glycerol present being too small in quantity for the formation of a possible triglyceride, that it acted with the aldepalmitic acid to form the kind of semi-compound with alcohol just referred to, in which the glycerol also acted as if glycerol of solidification (if not of crystallisation)? Hence, would Mr. Wanklyn consider that butter, as regarded the aldepalmitic glycerol compound, was of such a character? If so, it might afford some explanation of the higher degree of assimilability by the digestive organs possessed by it than was the case with ordinary oils and fats of the triglyceride order. These did not suit a great many stomachs, whereas butter was regarded as a general article of food, and was jealously guarded from adulteration by such foreign fats, &c. The stomach, in the case of butter fat, adopting Mr. Wanklyn's results, would have to deal with a more unstable compound than a true fat, and so have less difficulty in disposing of it by the aid of the digestive functions.

Mr. Wanklyn, in reply, said that as to the theory of the constitution of the compound he had formed no opinion, and the details he had given were simply the results of his experiments. In naming the acid he had been guided by the fact that it contained a smaller percentage of hydrogen than palmitic acid. That fact was brought out by the analysis. The hydrogen was eight-tenths per cent. too low, and the equivalent of the acid when he determined it turned out to be lower than that of palmitic acid. When he had the facts fully before him, he would form a theory, but not till then. That was the course that he had taken many years ago in a somewhat similar case. He was asked whether he had determined the iodine absorption of this body. He had not done so. He did not expect that there would be any. He had, however, commenced limited oxidation experiments on it, and had found that it was not readily attacked by oxidising agents. He regarded it as one of the permanent acids, and after the experience he had had during 30 years he was not staggered to find that it was apparently an unsaturated compound. The solidification of alcohol had been referred to by one speaker. Under that term he included a very great deal. If one mixed one part of aldepalmitic acid with five times its weight of alcohol and warmed the mixture, the acid dissolved, but on cooling the whole mass solidified, provided there were not more than five of alcohol to one of the acid. If there were much more, some of the liquid would run away. If one then put the semi solid mass on filter-paper and pressed it, the mechanically held alcohol was absorbed, and there remained the chemically combined body, and that chemically combined body contained nearly as much alcohol as the aldepalmitic acid taken. He had made a parallel experiment with palmitic acid, and under the same circumstances there was hardly any retention of alcohol by the palmitic acid. That was a hard fact, and was to his mind absolutely decisive as to the existence of this peculiar acid. With regard to the salts mentioned, he had prepared them carefully, and believed that they were in a state of tolerable purity. As to the nature of butter, he believed, judging from the facts that had come before him, and last of all from the interesting observations made by Dr. Johnstone, that butter was an exceedingly alterable fat, more so than any of the other fats. He believed that in butter they had not an ordinary glyceride, but what he would prefer to call a consolidate, in which the glycerin and the acid remained side by side in union. Further experience might lead him to discard that view, but at present it was the only conclusion he could come to. With regard to the stains, Mr. Watson Smith had some filter-paper stained by the acid more than a month ago. If Mr. Smith would exhibit them it would be seen that the stains were of a silvery white character.

Dr. Wright asked whether Mr. Wanklyn regarded his aldepalmitic acid as an acid of the acrylic series, of a formula such as he had already put on the blackboard.

Mr. Wanklyn replied that it was of that formula, but utterly different in composition. The hydrocarbon group in it was deficient in hydrogen, but he did not think that that necessarily made the acid unstable. It might be built up in a great many ways. The common hydrocarbons should be $C_{15}H_{31}$, but if it were $C_{15}H_{29}$ it was not necessarily unstable. In fact, he regarded this as an extremely stable acid.

Dr. Wright said that that being so, he was at a loss to see why Mr. Wanklyn should use the prefix "alde."

Mr. Wanklyn said that it was because he was an old chemist, and remembered the history of aldehyde. That body was so named because it contained less hydrogen than alcohol and so he had named his product aldepalmitic acid because it contained less hydrogen than palmitic acid.

Dr. Wright said that in that case it ought to be called dehydropalmitic acid. If aldehyde meant alcohol minus hydrogen, then aldepalmitic acid must mean alcohol minus palmitic acid.

Mr. Wanklyn replied that he considered that that would be clumsy nomenclature, and he preferred the name he had adopted.

Liverpool Section.

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Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

Meeting held on Wednesday, March 4th, 1891.

MR. A. NORMAN TATE IN THE CHAIR.

THE USE OF SULPHYDRATE OF CALCIUM IN THE MANUFACTURE OF ALKALI AND BY-PRODUCTS BY HADDOCK AND LEITH'S PROCESS.

BY J. LEITH.

The process which I have the honour to bring before you this evening has been protected in England and abroad by Mr. A. G. Haddock and myself.

It has for its object the manufacture of alkaline salts, and more especially sodium carbonate, and useful by-products, without the production of offensive waste.

The process as now worked out is simplicity itself, and although it is 15 or 16 years since I first turned my attention in its direction, owing to having accidentally got hold of a process proposed by the late Mr. Arrot, of Liverpool, it has only been arrived at step by step, and it is owing to Mr. Haddock's valuable assistance and co-operation that it has been completed so far as it is, or at all.

As you are all aware, the principal methods by which soda is at present made are two, viz., the time-honoured Leblanc, named after its inventor, and its more recent and successful rival the ammonia process. With the details of these processes by which practically the whole of the soda in this country is being produced, you are doubtless familiar.

Besides these, at least two or three others have been proposed, each having some excellent features, but all failing owing to unforeseen difficulties.

Let us first glance, as briefly as possible, at some of the merits and demerits of these several processes, especially as two of them to some extent led up to the Haddock and Leith process.

First in point of time came the Leblanc process, which has held its own for the last 100 years; and indeed, during the greater part of that time, it has had no serious rival. It is, in my opinion, still the best process for the manufacture of caustic soda, and at present about the only practical one for bleaching powder, as it yields the whole of the hydrochloric acid obtainable from salt, and for this reason will continue to be valuable for some time to come, although it is quite unable to compete with the ammonia process for the production of carbonate of soda.

A great drawback to the Leblanc process for many years has been the production by it of a large amount of offensive material, consisting of impure calcium sulphide, commonly known as vat waste. This waste has been a veritable *bête noir*. Its removal has always been a matter of great expense, and in thickly-populated districts such as Lancashire it is most difficult to get convenient ground to deposit it, owing to the continual evolution from it of sulphuretted hydrogen.

This nuisance has to a very great extent been overcome by the Chance-Claus process for eliminating the sulphuretted hydrogen by means of carbonic acid gas. But the bulk and weight of the waste is still further increased by this treatment, entailing yet greater expense for removal and depositing.

The ammonia process, which works directly from salt, produces carbonate of soda at a price which places the Leblanc process at a disadvantage of nearly 100 per cent., so that competition is out of the question, but has the great drawback of losing all the chlorine of the salt as a waste product in the form of calcium chloride. Until this chlorine is obtained in an available form, the process cannot be looked upon as perfect. It loses also one-third or more of the total salt operated on.

Another method I mentioned as proposed by Mr. Arrot, and which I here call the direct sulphide process, has the advantage that little waste is formed, and that the chlorine of the salt is obtained as hydrochloric acid. He proposed in 1859 to carry this on by fusing ordinary sulphate of soda with fine slack, producing sodium sulphide, which on being treated with carbonic acid gas precipitates bicarbonate of soda. This seems very simple, but unfortunately proved unworkable owing to the great destruction of furnace linings and loss of soda, due to incomplete decomposition, and other causes. I understand this process has been improved on lately. But I think it will still be found to have drawbacks. In order to get the sodium sulphide to fuse in the furnace, a considerable quantity of salt has to be added. This is chemically inert, and goes to contaminate the soda, and to render a portion of it valueless. A comparatively weak sulphuretted hydrogen gas will be evolved from the carbonating towers, which will be troublesome to treat satisfactorily for the recovery of sulphur.

Messrs. Simpson and Parnell proposed another method some few years ago. Briefly, it consisted in making salt-cake in the usual way, thereby producing hydrochloric acid, then decomposing the salt-cake by the Leblanc process, and afterwards using the vat waste produced to distil ammonium chloride, so getting another equivalent of soda direct from salt, as in the ordinary ammonia process. Unfortunately, although this method was tried with every advantage, it failed, owing to the difficulty of getting complete decomposition of the waste by boiling with ammonium chloride. About five years ago, when the process was brought under my notice, I had a series of trials made upon it, all of which led me to think that it would be troublesome to distil satisfactorily with waste. I afterwards made further trials on the waste with sulphuretted hydrogen, which acted very well indeed, and produced strong calcium sulphydrate, but, as I said, I only got on step by step, and it was not until about 12 months ago that I saw my way to work the gas—as shown in the drawing—through a series of vessels containing waste cream, for the production of calcium sulphydrate.

A trial of this on a large scale, treating about 50 tons of waste at a time, proved highly successful, and the distillation of ammonium chloride by the calcium sulphydrate produced was almost perfect.

At this point Mr. Haddock's chemical knowledge came in most valuable, and he at once proposed superseding the distilling operation altogether by using sulphate of soda instead of salt in the carbonating towers, and finally dispensing with the use of ammonia entirely.

Having now briefly reviewed some of the more apparent points of existing processes which are applicable to what I have to say later, I will describe briefly the principle and *modus operandi* of the Haddock and Leith process.

We make sulphate of soda by the usual method, thus obtaining the whole of the chlorine of the salt as hydrochloric acid. We then use about 56 per cent. of the salt-cake for caustic soda, made in the usual way, producing vat waste, which is then used as one of our raw materials for making a solution of calcium sulphydrate in the following manner:—

The waste is made into a thick cream with about an equal quantity of water. This cream is then blown into egg-ended upright cylinders A, arranged in series. The cylinders I have practically worked with each contain about 12 tons of vat waste. Weak sulphuretted hydrogen from the carbonators, about 30 per cent., is then blown through the vessels, and it is found to be completely absorbed by the waste going into solution, and rendering an equal quantity of sulphur contained in the waste soluble.

To complete an operation takes from four to five hours in each cylinder, rendering the sulphur contained in four vessels (equal to about 50 tons waste) soluble in about 20 hours, or allowing a little time for charging, discharging, and incidental stoppage of gas, say 50 tons of waste would be treated in 24 hours.

There is about 1 per cent. of sulphur still left in the waste out of the 11 to 13 per cent. originally contained in it. One-half to three-quarters of this undissolved sulphur is combined with iron, and cannot possibly be dissolved by sulphuretted hydrogen. This loss, amounting to about 8 per cent. of the total sulphur, occurs in any sulphur-recovery process and is inevitable.

Calcium sulphydrate liquor containing 14 per cent. soluble sulphur was obtained from these vessels, working with a gas containing 15 per cent. sulphuretted hydrogen, and 3 per cent. carbonic acid. If gas is made containing no carbonic acid there will be no difficulty in obtaining solutions testing 18 per cent. sulphur. Any alkali which has been left in the vat waste goes into solution along with the calcium sulphydrate, and is recovered as soda.

An equation will best represent what has occurred—

$$CaS + H_2S = Ca\,2\,HS.$$

Calcium sulphide in vat waste and sulphuretted hydrogen give calcium sulphydrate (soluble in water).

When all the available sulphur in the vat waste in the first cylinder in the series is rendered soluble it is disconnected, and the next in series made No. 1, a newly-filled cylinder being placed in connexion last in series. The finished cylinder may then be allowed to stand and settle. This is apparently a somewhat tedious process, and it may

be more desirable to filter off the liquor at once. I regret I have not been able to ascertain exactly what length of time it takes to settle in the large cylinders, but on letting it stand in a glass jar I noticed that several samples took 24 hours; probably it would come down sooner in a tall column, but at all events the sediment is rather light, and if I were erecting plant I would not be disposed to calculate on less than 20 hours settling. The clear liquor should then be run off into settling tanks G, as shown in the drawings, to remove the last traces of any sediment at all likely to discolour the sulphate of lime produced at a later stage. Water should then be added to the residue in the cylinder, the gas again turned on for a few minutes to thoroughly stir the mass and wash out the sulphur liquor entangled with the spent waste. These washings should be taken to make up a fresh batch of waste cream, and the residue, which is now about one-half the bulk of the original waste, being of no further use, should go to the tip.

So far I have only dealt with making the calcium sulphydrate from alkali waste, that being the article with which we as alkali manufacturers are most concerned; but you will easily understand that it can be made in exactly the same manner from various earths and minerals containing lime. Instead of Leblanc vat waste, an artificially formed sulphide can be used—of barium, strontium, or calcium—by heating the corresponding sulphate with coal in a reducing furnace. Or, lime may be made into a cream and used as the absorbent, and we are thus rendered independent of the Leblanc process, and also obtain a stronger solution of calcium sulphydrate, and have no sulphur to recover as all the sulphuretted hydrogen evolved from the carbonating towers is required for another batch, and acts only as a circulating medium for rendering lime soluble. In this case also, the calcium sulphydrate liquor would require very little settling, lime being altogether rendered soluble by sulphuretted hydrogen.

The next operation consists in dissolving the remaining 14 per cent. of sulphate of soda made. This may preferably be done by a perforated steam pipe which will serve to agitate the liquor and also keep it warm. Heat greatly increases the solubility and prevents crystallisation. The saturated solution so obtained (at about 125° F.) is neutralised by lime, or by some of the mother-liquor from a later operation, and passed into settling tanks M, as shown, to remove iron and any other impurities which might discolour the sulphate of lime formed in the next operation. One gallon of the clear liquor should contain about 5 lb. of sulphate of soda.

Having now obtained clear solutions of sodium sulphate and of calcium sulphydrate, these are run together into a wooden mixing tank L, provided with an agitator. Decomposition takes place as follows:—

$$Na_2SO_4 + Ca\,2\,HS + 2\,H_2O = 2\,NaHS + CaSO_4\,2\,H_2O.$$

Sodium sulphate and calcium sulphydrate and water give sodium sulphydrate and hydrated calcium sulphate.

Hydrated calcium sulphate separates out as a pure white precipitate, and sodium sulphydrate is formed in solution. The mixture is well agitated and run on to a filter, K, which retains the calcium sulphate, which is washed with water and pressed or otherwise dried for sale, as pearl hardening. The washings are used for dissolving salt cake for another operation.

The sodium sulphate liquor drawn off from the filters contains a little calcium sulphate dissolved in it (about ¼ per cent.), and as this, unless removed, would finally be converted into calcium carbonate, and contaminate the soda, the liquor is run into a mixing tank E as shown, a little of the mother liquor from the bicarbonate of soda added, and the solution passed through the settling tanks F, as shown, where the calcium salt quickly settles as carbonate.

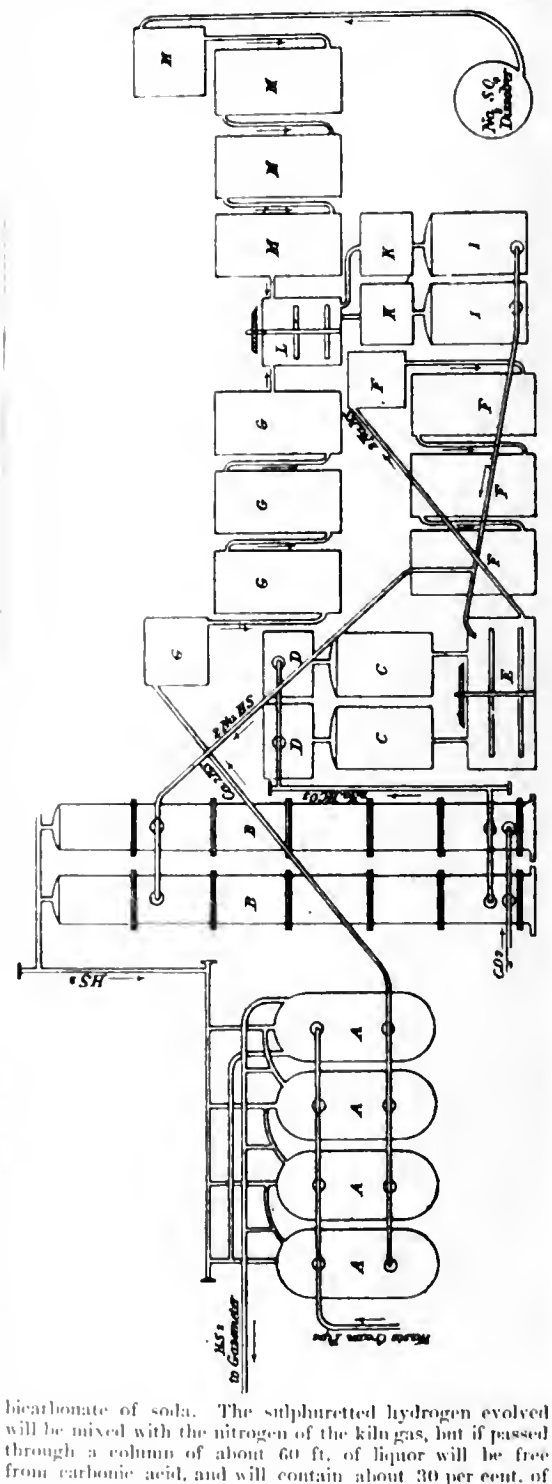
The clear sulphydrate of soda liquor is now placed in Solvays' or other ordinary carbonating towers B, and lime-kiln gas (as free as practicable from oxygen) pumped through.

Decomposition takes place as follows:—

$$2\,NaHS + (2\,CO_2 + N_2) + 2\,H_2O = 2\,NaHCO_3 + 2\,(H_2S + N_2)$$

Sodium sulphydrate and lime-kiln gas and water give sodium bicarbonate and sulphuretted hydrogen and nitrogen.

The blowing is continued until the sulphur is almost completely eliminated (down to about ·1 per cent.) and the alkali in solution will fall to an amount equal to about 3½ per cent. sodium oxide, the remainder separating as solid



bicarbonate of soda. The sulphuretted hydrogen evolved will be mixed with the nitrogen of the kiln gas, but if passed through a column of about 60 ft. of liquor will be free from carbonic acid, and will contain about 30 per cent. of sulphuretted hydrogen. If Leblanc vat waste is used to make the sulphydrate, about one-half of the gas evolved from the carbonating towers will require to be blown through the waste cream. The other half goes direct to the gasholder for subsequent combustion and recovery of sulphur.

When the decomposition in the carbonating towers is completed, the contents are blown on a filter D to separate the solid soda bicarbonate, which is freed from mother-liquor as perfectly as practicable, say by a centrifugal machine or vacuum filter, and roasted to soda ash.

The bicarbonate is very pure, as may be seen from the samples which have been made in the manner described. It requires no washing to yield an ash testing 58 per cent. Na_2O.

The filter liquor containing sodium bicarbonate, some sodium sulphate (which was formed in precipitating the small quantity of calcium sulphate in the sodium sulphydrate liquor) and a little sodium sulphide, may now be concentrated either to obtain soda crystals, for which it is very suitable, or to a strength equal to about 14 per cent. Na_2O, when it is placed in the carbonating towers again and blown with kiln gas until the alkali in solution falls to 3½ per cent. Na_2O. Three-fourths of the remaining alkali will thus separate as solid bicarbonate, and the final mother-liquor is used for neutralising salt-cake solution, and for precipitating dissolved calcium sulphate as described.

Various impurities, such as salt, from the salt-cake will gradually accumulate in the mother-liquor, and after going two or three times round the cycle it will be advisable to boil it down to complete dryness, and sell as 48 per cent. ash.

If the liquor in the carbonating towers is kept at a temperature of about 140° F., the absorption of the carbonic acid gas is more rapid, and the bicarbonate is denser and more easily separated from the mother-liquor. This, I think, is due to that temperature being about the critical point of formation and decomposition of bicarbonate, and that it keeps splitting up into neutral carbonate and carbonic acid gas in atomic form, and reforming. This may, or may not be the correct explanation, but we have observed that the decomposition is quicker at the temperature named.

The manipulation of the various solids, liquids, and gases will perhaps be more clearly followed from the sketch of the plant before you. I have placed all the various vessels in a line for the better exhibition of them, but you will easily understand that they may be placed in any convenient position for actual work.

Having described the working of the process, I will now enumerate the raw materials and the finished products, giving quantities of each.

The raw materials required are salt and sulphuric acid (producing of course salt-cake and hydrochloric acid), limestone and coke (producing CO_2), and Leblanc vat waste (producing calcium sulphydrate).

From these materials we obtain caustic soda, bleaching powder, sodium carbonate (as ash and crystals), calcium sulphate, lime and sulphur.

As we are all familiar with the manufacture of caustic soda and bleaching powder, I need not further mention them, but deal with the soda ash and by-products only. For every ton of soda ash manufactured we require:—Salt-cake, 28 cwt.; limestone, 22 cwt.; coke 3½ cwt.; Leblanc vat waste 60 cwt.; and of course fuel, about two to three tons. From these quantities we obtain soda ash, 20 cwt.; sulphate of lime, 30 to 34 cwt; sulphur, 5 cwt, and lime, 15 cwt.

	£	s.	d.
Cost of making 28 cwt. salt-cake and its hydrochloric acid at 35s. per ton salt-cake	2	9	0
„ making calcium sulphydrate from waste	0	2	6
„ fuel, 2½ tons at 7s.	0	17	6
„ limestone and coke	0	8	0
„ wages	1	2	6
„ Packages	1	2	6
Total cost for materials and labour	6	2	0
Producing 1 ton soda ash 58 per cent. at 13s. 8d. per unit	6	13	0
„ 1 ton 12 cwt. pearl hardening at 2l. per ton	3	4	0
„ 5 cwt. sulphur at 4l. 15s. per ton	1	3	9
„ 15 cwt. lime at 12s. per ton	0	9	0
„ 48 cwt. hydrochloric acid at 6d. per cwt.	1	4	0
Value of products	12	13	9
Less 3½ per cent.	0	8	9
	12	5	0

To the above account of cost must, of course, be added depreciation, f. o. b. expenses, &c. Probably about 2s. should be deducted, on the other hand, for discount on raw materials.

It has been mentioned, as a drawback to our process, that we make a very large quantity of hydrated calcium sulphate, or pearl hardening, and as the market for this is somewhat limited, that it would be difficult to dispose of all we make at the market price of this material, viz. 3l. 5s. per ton. I regret at the moment I am unable to state exactly what the consumption of pearl hardening is, but I know it is very considerable, and, like most other things, will increase if the cost decreases. There is, however, another unlimited outlet for this article for dressing calicoes and other piece goods, for which China clay is at present used. As you are aware, the value of good white China clay for this purpose is 35s. per ton ex quay Runcorn. As I have only valued the calcium sulphate at 40s. in the figures I have read, I am no doubt well within the limit of its value. I might just add that there is also a large amount of sulphate of lime used as plaster of Paris. Under these circumstances, I think the disposal of it would be no very difficult matter. In point of colour and cost it will hold its own against any pearl hardening in the market. As we can afford to throw it away, and still have a margin of profit equal to ammonia soda, it can certainly compete with both China clay and plaster of Paris.

I will now proceed to mention some of the advantages our process has over those at present in operation.

In the first instance, as you have seen, it is entirely a *wet* process. There is no furnacing in connexion with it, except in the final finishing of the soda ash. You are all aware that furnacing operations involve loss of soda, by volatilisation, mechanical carriage, formation of insoluble salts, and incomplete conversion. These various losses amount in the Leblanc process to about 15 per cent. of the total soda.

In our process there are none of these drawbacks; the liquors are well under control during the whole manipulation. They are easily tested and mixed in the proper proportions. Any mistake can be quickly detected by testing and immediately rectified; so that good results are not entirely dependent on the care and intelligence of workmen. We thus get a much larger yield of finished soda. We also get purer liquors, and consequently a purer finished product.

We have no offensive waste material as produced by the Leblanc process. This waste, instead of being a nuisance becomes a source of profit to that patient, long-suffering beast of burden, the alkali manufacturer, by this process, as not only does he recover the sulphur but also utilises the calcium contained in the waste, reducing it to about one-half of its original weight, the remainder being quite innocuous and inoffensive.

The Chance-Claus process recovers the sulphur from the Leblanc waste, as you know, but in a different manner, and with an expenditure of material which we save.

All the carbonic acid gas used in that process to eliminate the sulphur is lost, and also all the calcium of the waste, these uniting together to form a large quantity of carbonate of lime sludge, so increasing the original weight of waste very considerably, instead of decreasing it by about one-half, as we do.

The carbonic acid gas which we use eliminates the sulphur indirectly from the waste, but never comes directly into contact with it. It all goes to unite with soda, and is utilised except inevitable losses in transmission, and reappears in the finished ash.

The calcium united with sulphur in the waste is also rendered soluble and made use of by us as a carrier for sulphuretted hydrogen, and as a reagent for separating the fixed sulphuric radicle from sulphate of soda, replacing it by the displaceable sulphuretted hydrogen, and finally appears in one of the finished products.

The direct sulphide process, which I have already alluded to, also utilises the carbonic acid and the lime from the kiln, but the formation of the sodium sulphide is brought about by a furnacing operation at a high temperature, and it is well known that the conversion is not complete, that there is destructive action on the furnaces: this has been lessened,

is stated, by the addition of salt. But the yield of soda obtained is poor through losses before mentioned as being inseparable from a furnacing operation, and the added salt plays no part in the chemical reaction.

The sulphuretted hydrogen obtained by our process is also stronger, as we have a sulphydrate containing two equivalents of sulphur instead of a sulphide with one equivalent, the amount of diluent nitrogen being practically the same. Our gas is consequently more easily treated for sulphur recovery.

We claim advantages over the ammonia-soda method in that we use no expensive carrier, and, having no ammonia, we are free of its expense and losses. We have no distillations to perform to render *our* carrier re-available, and save on this account a large amount of fuel. We also obtain the chlorine of the salt as hydrochloric acid, and can thus make bleaching powder and other chlorine compounds, which has not yet been commercially accomplished by that process.

We first use the carbonic acid gas to produce bicarbonate of soda in the carbonators, and I would ask you to notice particularly that here we differ from the ordinary ammonia-soda process, inasmuch as we get the whole of the solution of sodium sulphydrate as bicarbonate quite free from contamination with ammonia and salt; it then only wants drying to be ready for the market as BICARBONATE or soda ash, whereas an ammoniacal solution only yields about two-thirds of the salt as bicarbonate, and even that is contaminated with 1½ to 2 per cent. of ammonia, besides salt. The salt has to be washed out and carries with it a considerable quantity of the bicarbonate, which is returned to the still with ammonium chloride, and finally passes down the sewer. After all this is done the remaining bicarbonate still contains ½ per cent. NH_3, which has to be recovered by a drying process, which is perhaps one of the most difficult and expensive operations in the whole cycle. Then our sulphuretted hydrogen, instead of idly passing on from the carbonators to the gasometers, is made to perform a useful operation in the journey and produce calcium sulphydrate for future use. It is true this throws a little extra pressure on the blowing engine, but this never exceeds 15 to 20 lb. on the square inch. Most of you know the cost of working at this extra pressure is very little compared to blowing steam direct into a column of liquor for distilling. I may say that I doubt whether this extra pressure is a cost at all, as it so improves the absorption of carbonic acid in the carbonators that it seemed to me, during the trial I had, that it was a decided gain.

I will now conclude this paper by only one or two further remarks.

1. This process wants no great outlay of money for plant, and does not in any way upset an ordinary Leblanc works. Anyone having a Chance plant wants nothing more than a few Solvay towers and old boiler shells for settling tanks to enable him to enter into competition with ammonia soda, and win the race even without counting his profits on bleach.

2. The reactions are brought about easily. There is no long-continued waiting on gases or solids to perform their work. The first and fundamental part of the process, making calcium sulphydrate, goes on just as surely as melting snow in hot water. The second, precipitating calcium sulphate from the liquor, takes place within two or three minutes from mixing. The third, precipitating the bicarbonate, goes on rapidly and smoothly, even more so than working with ammonia and salt, I think. There are no expensive materials to be lost by evaporation or otherwise. There is no severe action on the vessels employed, so far as I have seen. As all the operations are performed wet and cold, except a little evaporation of liquors and bicarbonate drying, I think the wear and tear on plant will be reduced to a minimum.

3. There are none of the usual engineering difficulties surrounding the process; anyone with ordinary intelligence may erect the plant, and depend on its working satisfactorily. All that is necessary is to select a piece of ground where good foundations can be got for the carbonating towers B. You are aware that the difficulty to get good ground for erecting ammonia-soda works is very great, as a supply of brine must be had, and unfortunately that very flow of brine is liable to undermine the works, and keeps one in dread of the whole thing coming down like a pack of cards any day. That process also wants an unlimited supply of cold water, which is not always available in a convenient position for the best ground to be selected. This large supply of cooling water, and the expense of pumping it, is quite unnecessary in our process.

One ton of 58 per cent. carbonated ash requires:—

	Gallons.		Lbs.
Calcium sulphydrate at 16 per cent. sulphur	802		
Sodium sulphate solution at 50 per cent.	614		
	1,479	Yields calcium sulphate	3,676
Water solidified with calcium sulphate	77		
Sodium sulphydrate containing soluble CaS	1,102		
Sodium bicarbonate (mother-liquor)	86	Calcium sulphate	81
		Lbs.	Lbs.
Sodium sulphydrate for carbonating with kiln gas	1,488	Yields 2,231 bicarbonate or	1,407 ash 58 per cent.
Water solidified with bicarbonate 24 gallons	88	„	41 „
Mother-liquor left in bicarbonate 64 gallons			
	1,000		
Liquor to evaporate from 3—4 per cent. Na O to 14 per cent.	1,050		
Sodium sulphydrate for carbonating with kiln gas	350	„ 1,014 bicarbonate or	641 „
Water solidified with bicarbonate 11 gallons	40	„	17
Mother-liquor left in bicarbonate 29 gallons			
	310		
Used for removing calcium sulphate above	86		
Evaporated for crystals	224	„	184
			2,240

Say 4 per cent. precipitates in first carbonating operation.

Cost of Raw Materials for 1 Ton Ash and By-products.

Leblanc Process.	£ s. d.	Ammonia Soda.	£ s. d.	Haddock and Leith.	£ s. d.
Salt-cake	2 16 0	Brine	0 1 6	Salt-cake	2 9 0
Fuel	1 1 0	Ammonia	0 7 6	Calcium sulphydrate	0 2 6
Limestone	0 9 0	Lime	0 13 6	Fuel	0 17 6
Wages	0 15 8	Fuel	1 0 0	Limestone and coke	0 8 0
Casks	0 7 6	Wages	0 12 6	Wages	1 2 6
		Packages	0 7 6	Packages	1 2 6
	5 9 2		3 2 6		6 2 0

Value of 1 Ton Ash and By-products.

Leblanc Process.	£ s. d.	Ammonia Soda.	£ s. d.	Haddock and Leith.	£ s. d.
1 ton ash	6 13 0	1 ton ash	6 13 0	1 ton ash	6 13 0
HCl	1 6 0			1 ton 12 cwt. F.H.	3 4 0
				5 cwt. sulphur	1 3 9
				15 cwt. lime	0 9 0
				48 cwt. HCl	1 4 0
	7 19 0		6 13 0		12 13 9
Less 3½ per cent.	0 5 6	Less 3½ per cent.	0 1 6	Less 3½ per cent.	0 8 9
Value	7 13 6	Value	6 8 6	Value	12 5 0
Cost	5 9 2	Cost	3 2 6	Cost	6 2 0
	2 4 4		3 6 0		6 3 0

Discussion.

The Chairman said that the paper was an important one and of very great interest to those engaged in the alkali manufacture, and could be well discussed, first as regards the general chemistry of the process, respecting which there would probably not be much difference of opinion; next, the practicability of carrying out the chemical reactions on a manufacturing scale; further, whether the manufacturing operation could be made a monetary success; and, lastly, how far the process could be grafted on to existing processes or how worked as quite an independent operation.

Dr. S. G. Rawson thought that much too high a price was allowed for the sulphate of lime obtained in the new process. In a works in which he had been interested at one time at St. Helens, they had prepared this substance at his suggestion by mixing together the waste liquors from the Weldon and wet copper extraction process. The resulting product, which was contaminated with a little iron mechanically carried down, was washed with the dilute hydrochloric acid from the condensing tower attached to the copper plant. All these raw materials, therefore, were waste products and were being run away in immense quantities, and the only expense incurred in the formation of the sulphate was in running together and mixing the solutions and then washing the precipitate. It would easily be seen how small this was, and yet so nominal was the price of the sulphate that with all these primary advantages no market could be found for it in quantity. Still less would this be the case with the enormous production which a general adoption of the process described in the paper would entail. Mr. Leith stated that the pearl hardening was used both for sizing paper and calicoes, though the least trace of sulphide left behind in it would spoil it for these purposes, and that it could also be utilised in the manufacture of plaster of Paris. Had this latter outlet actually been tried in practice, or was it only an hypothesis? He himself had attempted to burn it for this very purpose, but, owing perhaps to the semi-crystalline condition in which the sulphate was precipitated, the experiments had always been failures in his hands. The plaster always remained friable instead of setting hard when mixed with water. He did not think that the calcium sulphate should be looked upon as a source of revenue at all; anyhow it would be safer not to do so for the present.

Dr. F. Hurter said that in discussing the process it would be convenient to do as the Chairman had suggested, and to take the chemical reactions first. There would not be many chemists who would find fault with the process from that point of view. The process of Messrs. Haddock and Leith was one of those which, as Mr. Leith had expressed himself, attempted to remove the sulphur from the sulphate of soda by means of lime in the wet way, and was perhaps the most ingenious of them. Many chemists had attempted to causticise sulphate of soda directly by lime, when sulphate of lime was expected to result; but these processes failed owing to very incomplete reaction. Two years ago the Society had before them another process of similar character, the one invented by Mr. Staveley. In that process a solution of sulphate of soda was treated with lime and phenol, the latter substance bringing the lime into solution as phenolate of lime, and the phenolate of lime decomposed the sulphate of soda, producing sulphate of lime and phenolate of soda, which in its turn was decomposed by carbonic acid.

In the process just described by Mr. Leith calcium sulphydrate was the alkaline lime salt about to be used to decompose the sulphate of soda. The only question arising was how far was the decomposition complete, how great was the solubility of sulphate of lime in sodium sulphydrate solution? That would no doubt depend greatly upon the concentration of this solution, the more water it contained the more sulphate of lime would be dissolved. He would

like to have some information as to how far the reaction between calcium sulphydrate and sulphate of soda was complete.

Then the sulphydrate of soda was to be treated with carbonic acid gas, to convert it into bicarbonate of soda and sulphuretted hydrogen. Here again the question arose, to what extent could the sulphuretted hydrogen be turned out; could they remove the whole of the sulphur from the solution, or how much sulphide would be left? From investigations which had been made, it was known that sulphydrate of sodium was not as easily decomposed by carbonic acid as sulphydrate of calcium.

Looking at Mr Leith's figures he found that 15 cwt. of lime were produced per ton of 58 per cent. ash, and from this he gathered that Messrs. Leith and Haddock expected to have a good absorption of carbonic acid.

By this process of carbonating they would have a certain amount of bicarbonate of soda produced, and the question now was, what would become of the free sulphur which was originally contained in the waste, and which passed into solution as polysulphide? That quantity was usually sufficiently large to make him think that the ash made from this bicarbonate would not be 58 per cent. ash at all, but would be much weaker, owing also to the lime precipitated from any sulphate of lime.

Having produced a bicarbonate, they had left a solution still containing bicarbonate of soda, also any sulphate of soda due to incomplete decomposition, and also the common salt contained in the salt-cake. This solution must be boiled down to make soda ash also, and this would not yield soda ash of 58 per cent. According to Mr. Leith the calcium sulphydrate solution contained 16 per cent. of sulphur. He did not know what strength of sulphuretted hydrogen gas Mr. Leith would have at his disposal, but such as was obtained in the Chance process would hardly yield a solution so rich in sulphur, but the solution would contain only about 12 to 13 per cent. of sulphur. Without touching this point too closely he could only say that, having been allowed to see Mr. Leith's test sheets, he did not think that 16 per cent. of sulphur would be obtained regularly. As far as he could remember the highest percentage had been 14, and more often less, so that the amount of water which had to be evaporated was very considerable.

As far as the reactions did go, they no doubt took place as Mr Leith had stated.

Looking at the practical aspect of the process, it struck him on looking over the profits to be made by the new process, that not only must manufacturers stop that stupid old Leblanc process, which only realised 2*l.* per ton of ash, but even Brunner, Mond, and Co. must not look to any more of their splendid dividends, particularly when they remembered Mr Leith's warning about the liability of the works to tumble down any moment; they must all of them immediately adopt that beautiful process of Mr. Leith which brings 6*l.* 4*s.* per ton of ash profit, and if Messrs. Brunner, Mond, and Co. can pay handsome dividends on a profit of 3*l.* 6*s.*, what would Messrs. Haddock and Leith be likely to do with the 6*l.* 4*s.*?

He wished to know with how many tons of ash these figures had actually been obtained? He was afraid the calculations were more theoretical than practical. Thus for instance at the top of the list the Leblanc process was charged with 2*l.* 16*s.* for salt-cake whilst the Haddock and Leith process was charged with only 2*l.* 9*s.*, a difference of nearly 14 per cent; that meant no loss of salt-cake of any kind. Looking lower down they found a credit to Leblanc process for hydrochloric acid of 1*l.* 6*s.* and one to the Leith and Haddock process of 1*l.* 4*s.* How was it that the salt-cake used in the Leith and Haddock process produced more hydrochloric acid than the salt cake used in the Leblanc process? Then again he found that 28 cwt of ordinary salt cake would produce theoretically exactly the 32 cwt. of sulphate of lime credited to the Haddock and Leith process. As he had stated before, these calculations were more theoretical than the results of practical working, and the whole process seemed to him to turn really upon the value of the pearl hardening. Taking the 3*l.* 1*s.* from the 6*l.* 4*s.*, there is left 2*l.* 19*s.*, which is only a trifle more than the profit shown for the Leblanc process. But as Mr Leith had pointed out, his process depended upon the Leblanc process, and only about half the ash would be made by his own process, and therefore it was necessary to average the two profits whatever they might be.

In the Leblanc process carbonate of soda was at once obtained from sulphate of soda by heating it with limestone and slack, and the fuel used at the same time evaporated the resulting solution of carbonate of soda.

In the Leith and Haddock process the limestone had to be decomposed in a lime kiln, the carbonic acid had then to be pumped, at great cost, to the soda, and the sulphur had to be pumped to the lime. That operation, he was satisfied, would be very costly. Mr. Leith seemed to make very little of the additional pressure which he had to employ to force the sulphuretted hydrogen into the lime. In Widnes great trouble had been experienced with taps, and it was difficult to prevent them leaking and creating a nuisance. They were working generally under 40 lb. pressure. He was afraid that when working under 60 lb. pressure the difficulty would be very greatly increased.

The Leblanc process produced a soda solution containing about 200 grms. per litre of soda, and this was evaporated with waste heat.

The Haddock and Leith process produced a solution of only 70 to 100 grms. per litre, according to the strength of the sulphydrate of calcium, and would require special fuel for evaporating this weak solution. He was afraid it would be weaker still, for there were so many things to wash. There was the sediment from salt-cake to wash, there was the residue of the vat waste to wash, and the pearl hardening would require considerable washing. He doubted whether all these washings could be used in the process, and whether a great deal of this wash water would not require evaporation also.

Then the Leblanc process produced salts containing 48 per cent. of soda, which had to be calcined, while a great deal of the soda in the Leith and Haddock process was obtained as a bicarbonate precipitate of only 28 per cent. soda. This also required calcination, and was known to be much more costly for finishing than ordinary salts.

He did not see how Mr. Leith could arrive at such enormous profits; they were derived chiefly from the lime and the pearl hardening. The latter would have to be absolutely pure if it must fetch the price stated. He doubted whether it would be absolutely pure—absolutely free from sulphides, iron, &c. -and he was very much more afraid that the consumption would be very small. If it had to be thrown away, it would be equally heavy as alkali waste. He did not foresee any great future for the process, and doubted whether it had any advantage over the Leblanc process.

Mr. L. Carey drew attention to the fact that according to Mr. Leith's figures 14 per cent. of the alkali produced had to be made by the old process, which would proportionately lessen the profit on the total. With regard to pearl hardening, from the little experience he had he was led to believe that it would be difficult of sale, and that if all the sulphuric acid employed resulted in pearl hardening much of it would have to go to the waste heap.

Dr. T. T. Best remarked that he had tried an experiment regarding the precipitation of calcium sulphate from the sulphydrate liquor, and found that it gave beautiful long fine needles, only slightly coloured; they were quite silky and very quickly washed clean. He wished to know what amount of sodium sulphide was contained in the bicarbonate, and what percentage of sulphate this gave on calcining?

Mr. Allen thought there was very little to add to the critical remarks to which Dr. Hurter treated the process in question; but he would emphasise just one point in particular—the loss of alkali caused by the action of the oxygen of the limekiln gases on a solution of sodium sulphydrate, owing to the formation of hyposulphite, &c. This oxygen is a varying quantity, but should it rise up to 2—3 per cent. it would cause a serious loss of alkali, amounting certainly to 20—25 per cent. of the total. This is of course a point not to be overlooked, especially in a process which claims advantages in the yield of alkali in comparison with the Leblanc process. It is also intended

to add salt-cake to a solution of calcium sulphydrate, then to allow the whole to settle, draw off the clear liquor, and finally to run the gypsum on to filter-beds. This is an operation which would be accompanied with a considerable escape of sulphuretted hydrogen, and such as would give rise to difficulties in practical working.

Mr. Haddock replying, said that as the process had been already fully described as far as Mr. Leith and he could see it, he would not go further. Dr. Rawson had mentioned the expense of making pearl hardening from the waste liquors of chemical works, and the difficulty in selling it. So far they had not been able to make it pay, and they could easily understand why, because a series of operations had to be gone through, and a considerable amount of impurity to be removed to get pearl hardening only. Dr. Hurter had asked how much calcium sulphate solution was contained in the liquid: A sulphate of soda in liquid containing 10 per cent. of soda would dissolve ·55 per cent. of $CaSO_4\,2\,H_2O$. If liquors were taken on the strength of figures in the tables it would amount to 2 per cent. of the total salt-cake used. That is not lost in the first operation with the mother-liquor; in their first operation they take back into the sulphate of soda solution the greater part of this liquor. Dr. Hurter seemed to think that there would be a lot of wash-water. He (Mr. Haddock) failed to see that there was. They had to wash certain sludge from the waste to wash out the calcium sulphydrate, but this was used to make another batch of vat waste cream. The sulphate of calcium washings were used to dissolve salt-cake. Dr. Hurter seemed to think that they had taken theoretical quantities in their experiments, *e.g.* in the pearl hardening. That was so, calculated as *dry* $CaSO_4\,2\,H_2O$, but Dr. Hurter had overlooked the fact that pearl hardening as sold contained 20 per cent. to 30 the cent. of water, increasing its bulk by one quarter. If the price of the pearl hardening were knocked off, Dr. Hurter had said that would leave but little extra profit over the Leblanc system. He had knocked off 3*l.* 4*s.*, being the price put down as obtained for the calcium sulphate, but said nothing about packages or labour connected with the finishing of this. If it is to be considered as waste material then the labour connected with it and the packages must be deducted from the cost as given, the two items together amounting to about 1*l.* This would still leave a profit by the Haddock-Leith process under the most unfavourable circumstances of 3*l.* 19*s.* against 3*l.* 6*s.* by the ammonia method, and 2*l.* 4*s.* 4*d.* by the Leblanc.

Mr. Carey thought that the profits should be reckoned as the mean of those of Leblanc and Haddock-Leith, as about one-half of the soda had to be made by the former method in order to get vat waste. This is not so, as the figures given were for making soda *ash* by the Leblanc method, whereas it was proposed to make no ash by that method, but caustic soda only, for which it is still the best-known process.

Mr. Leith, in replying, said that as regards Dr. Hurter's question as to the solubility of the calcium sulphate in the sodium sulphydrate, only ½ per cent. of the former was left in solution, and this could be removed as stated in the paper. The liquors operated upon were brought down to 2·4 per cent., or 1 per cent. lower than stated in the paper, but he was unable to state whether it would be profitable to blow them so long as to reduce them to this percentage. Dr. Hurter had also pointed out that from less salt-cake they produced more hydrochloric acid than in the Leblanc process; there was a slight error here, and the quantity stated should be 46 cwt. instead of 48 cwt. Other speakers had said that they were making use of the Leblanc process in this new method. In answer to this he mentioned particularly in his paper that he had confined himself principally to the treatment of alkali waste, and that he was convinced that at the present moment the Leblanc process was the best for the manufacture of caustic soda. The next point Dr. Hurter had raised referred to the pressure employed in the vessels containing the sulphydrate. In the process he had described they did not work at anything like the pressure (40 lb.) employed in the Chance process; they had left the pressure behind in the carbonators and only had something like 15 to 20 lb. pressure on the first sulphydrate vessel.

Mr. Auer had referred to the removal of oxygen from the kiln gases. He (Mr. Leith) had shown that the oxygen must be completely removed; this was an absolute necessity in the working of the process.

In reply to the numerous statements made regarding the saleability of the pearl hardening, any quantity could be sold at 35*s.* per ton, whilst those who had paid close attention to the paper would have noticed that this product might be entirely thrown away, and still the process could compete with the ammonia soda process. Dr. Hurter was quite right in remarking that the sulphydrate was only 15 per cent., and some of it even less than 10 per cent., but that was when working with the gas obtained in the Parnell-Simpson process. In reply to Dr. Best he did not know how much sulphide was contained in the bicarbonate, but no sulphate of soda was found in the ash, as the carbonic acid driven off from the bicarbonate decomposed the sulphide first, reforming carbonate. The result of the last experiment he (Mr. Leith) made was an ash of 58 per cent. Na_2O, which was very uncommon.

Finally, he would state that the process had only recently been patented, and they had only operated on large samples so far as concerned the carbonating of the sodium sulphydrate; but the operations with waste were conducted on a large scale, 50 tons being treated at a time.

Manchester Section.

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Harold B. Dixon.	D. Watson.

Hon. Local Secretary:
J. Carter Bell,
Bank House, The Cliff, Higher Broughton, Manchester.

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

Meeting held Wednesday, 7th March 1891.

MR. IVAN LEVENSTEIN IN THE CHAIR.

THE TREATMENT OF SEWAGE.

BY GEORGE E. DAVIS.

We are met here to-night to consider one of the most important sanitary questions of the day. To those who live in small towns situated upon the banks of some large river, where mills and factories are not so abundant as they are with us, the population scanty, and the towns and villages few and far between, the subject will not be of such pressing importance as it is in this part of Lancashire, but to every member of the population, wherever situate, the rudiments of sewage treatment should be read and understood.

To no portion of the country is the question of sewage treatment of more importance than the watershed of the Irwell. Here we have a small river worked as hard as any river can be, turned in fact by many operations into one of the vilest streams in the world, while those tributaries of the Irwell, viz., the Irk and Medlock are, where they join

the main stream, much more foul in themselves than the sewage of many towns. Part of this foulness arises from manufacturing refuse, and the remainder from sewage. We may pause here to inquire

What is Sewage?

The sewage of non-manufacturing towns is easily contemplated. In some cases the excrementitious products are dissociated from the rainfall, the sewage proper being separately treated, while the rainfall is conducted by a separate system of sewers into the nearest river or water-course. This plan, which has been styled the "Menzies" or "separate system," has not found much favour, chiefly on account of the expense attendant upon a double system of sewers, but there is no doubt it is a good method of dealing with storm-water, which in the ordinary way mixes with the sewage and renders such a bulk difficult of treatment. When the "separate system" is not adopted, sewage and rainfall mix together and forms a liquid of very irregular composition.

It must not be supposed, however, that the liquid running from the rain-water sewers in the separate system is an *aqua pura*. The rain and storm-water is, of course, contaminated with the organic matter from the streets, and with the road detritus which gets washed down after heavy rains.

In addition to the foregoing, the sewage of manufacturing towns often contains much liquid refuse coming from factories, such as dye works, print works, paper mills, tanneries, and chemical works; in fact, the Rivers Pollution Act of 1876 expressly provided that facilities shall be given for manufacturers to use the sewers for the disposal of waste liquors.

Attention has lately been drawn to the provisions of the Public Health Acts Amendment Act of 1890, wherein the introduction of chemical refuse into the sewers is, under certain conditions, forbidden. It is to be hoped that local authorities are not relying on these clauses to sever their connexion from manufacturers' drains unless they are able to define clearly what the words "chemical refuse" mean. It is probable that those who drafted the Bill had some idea in their own minds of the kind of liquid referred to as "chemical refuse," and if so, it is a pity they did not impart that idea more clearly to those into whose hands the Act would eventually come.

Manufacturing refuse does not always render the sewage more difficult to treat, but when dyes and various colouring matters are thus introduced it is often difficult to secure absolute decolorisation of the liquid. In such cases, however, the small traces of colouring matters are of no importance when the effluent is turned into a river the water of which is not used for dietetic purposes, and even in such cases it is exceedingly difficult to obtain evidence as to the effect of such minute proportions upon the health of individuals. We do not object to drink our clarets or burgundies because they are coloured, or our soups because they are not water-white.

In the treatment of sewage, each town is a separate problem; I am often amused when reading of the visits of deputations to the Utopian Sewage Works of Melhora, or el-where, as the case may be, to find the opinions expressed, that, as that particular process worked well at Melhora it must answer anywhere and everywhere else.

Neither can I agree with the decision of the Local Government Board in laying down a hard and fast rule as to filtration through land. All circumstances must be taken into account, and local conditions and conveniences most certainly.

We come again to the question, what is sewage? to which a general reply may be given as: a water supply that has been polluted by reason of domestic and trade use. Food is boiled, the water thereby becomes charged with organic and mineral matters; garments are washed with soaps and alkali to remove the sudorific accumulations; floors are scrubbed and drains are disinfected, all adding to the pollution. When we add to this the excretory products, the liquid refuse of certain trades, we have a typical sewage of manufacturing towns.

Let us take the Salford water supply and the Salford sewage as an illustration:—

Parts per 100,000.

	Salford Water Supply.	Salford Sewage.
Suspended matters:—		
Mineral	..	4·47
Organic	..	7·84
Total	Nil	12·31
Total soluble solids	7·14	137·11
Loss on ignition	4·28	35·71
Total hardness	6·00	23·14
Permanent hardness	5·43	17·85
Temporary "	0·57	5·28
Chlorine	1·25	45·64
Alkalinity (H_2SO_4 neutralised)	Nil	24·89
Free ammonia	0·001	1·47
Albuminoid ammonia	0·005	0·55
Absorbed oxygen	0·06	17·68
Nitrates (calculated as HNO_3)	0·21	0·11
Soluble iron (as Fe)	0·04	0·91
" lime	0·84	13·21
" magnesia	0·93	3·80

If we reckon the Salford sewage to possess a daily volume of 10 millions of gallons we shall find there have been added, per diem:—

	Tons.
Suspended matters:—	
Mineral	2·0
Organic	3·5
Total soluble solids	58·0
Total hardness	7·7
Chlorine	19·9
Alkalinity	11·2
Total ammonia	0·9
Iron	0·4
Lime	5·6
Soluble organic matter (loss on ignition)	13·5

This gives us a very good idea of the quantities that have to be dealt with in a place such as Salford. The mineral suspended matters amounting to over 2 tons daily cannot be considered inimical to the public health, but the 3½ tons of suspended organic matters soon enter into putrefactive decomposition and become a nuisance.

The soluble matters added to the water daily and forming sewage amounts to no less than 58 tons. Of these, the mineral constituents can scarcely be considered injurious. The soluble organic matter, however, has to be reckoned with as being a highly putrescible impurity; it amounts to no less than 13½ tons daily, and contains in its original state nearly 1 ton of nitrogen, reckoned as ammonia. These complex nitrogenous substances are easily decomposed, forming much simpler compounds. They are acted upon by lime and other alkalis with the formation of substances more or less pungent in odour, and if allowed to enter into putrefactive decomposition, sulphuretted products are formed from the sulphur they contain, causing very unpleasant smells.

Fortunately these complex compounds form insoluble substances with many metallic bodies, and are precipitated from the solution in combination with them, and a variety of substances for the purification of sewerage has been proposed and re-proposed since the days when sewage first came into legal existence.

I should like to point out here that caustic alkalis and alkaline earths, such as lime, act very energetically upon

the soluble organic matters of sewage, and produce results which shall be shown to you later on.

To those who know the Irwell, Irk, Medlock, and Roch as they are, any argument insisting upon the purification of sewage will be superfluous, but I have already pointed out how readily the organic matter of sewage mud will enter into putrefactive decomposition.

If the suspended matters of sewage would quickly deposit themselves so that they might be retained, while a clear effluent passed on, there would be but little difficulty in improving the sightliness of the streams into which sewage now runs. The complete clarification of sewage by subsidence alone is, however, impossible, on account of the glutinous and albuminous nature of the intermedium; it is on this account also that continuous filtration, say through sand, is impossible, such a filter soon becomes clogged with fungoid or algoid growths, and ceases to act altogether.

But if the suspended matters are entirely removed, we have in the bulk of 10,000,000 of gallons of sewage $13\frac{1}{2}$ tons of soluble organic matter still to deal with. This must not be forgotten. I do not wish you to infer that it is necessary by any means to totally remove this soluble organic matter, but it is certainly necessary to alter its constitution, so as to render it as little capable of further decomposition as possible. I have already alluded to the albuminous nature of these $13\frac{1}{2}$ tons of soluble organic matter. Albuminous substances are characterised by their complex constitution, their easy decomposition, and their readiness to enter into putrefaction, by reason of which the nitrogen they contain goes chiefly to form ammonia, and the sulphur to produce sulphuretted hydrogen, so that the albumen molecule is completely broken up and entirely new substances produced, which are not so liable to further change.

The albumen molecule can also be split up by many chemical substances, and in most instances without the disgusting odour which manifests itself during the putrefactive process.

The soluble organic matter of such a sewage as Salford is slowly oxidised by contact with the atmosphere. This sewage requires $7\frac{3}{4}$ tons of oxygen daily to carry the oxidation to what I should call a safe point, or in other words, would abstract the oxygen completely from no less than 1,000,000 cubic feet of air daily.

When crude sewage is allowed to pass into a river, many changes too numerous to mention take place. When the rain-water also enters it contributes no little towards the general impurity, the road-detritus gets mixed up with organic matter and forms a silt at the mouth of every river which has large towns upon its banks. We may take the Tyne at Newcastle, the Humber at Hull, the Thames at Gravesend, the Itchen at Southampton, the Medina in the Isle of Wight, and the Mersey at Seacombe, as illustrations of the accumulation of organic matter and mineral substances that are brought down stream.

In the Archæological Journal for 1885 Mr. F. C. J. Spurrell gave an excellent account of the alluvial deposits of the lower Thames. He says "the old freshwater bed at what is called the mouth of the Thames had sunk much further below the sea-level than at Richmond by the time the sea had reached the latter spot, and in doing so had afforded room in its bed for successive deposits of mud and refuse." This mud is now dredged or dug up, mixed with carbonate of lime or chalk, and after some further treatment becomes Portland cement, not only in the Thames estuary, but on the banks of the mouths of all the other rivers I have just mentioned.

The following partial analyses will show the composition in silica, alumina, and oxide of iron of ignited alluvium used in the manufacture of Portland cement:—

—	*a.*	*b.*	*c.*	Average.
Silica.....	54·6	62·1	56·1	57·6
Alumina	16·7	16·6	16·7	16·6
Oxide of iron ...	8·8	7·5	10·6	8·9

The reason why these analyses are introduced here will be rendered apparent later on.

We may now pass to the

Pecuniary Inducements to the Treatment of Sewage,

and we shall find that most inventors have had an eye to extracting hidden wealth therefrom. The ammonia and phosphates have been the chief constituents sought to be turned to account, and at first sight it does seem strange that such valuable constituents should be wasted. The nitrogen contents of such a sewage as that of Salford are equal to 3 tons of sulphate of ammonia daily, or more than 20 tons weekly, of a weekly value to-day equal to 220*l.*, or 11,000*l.* yearly, and yet there is no process at present worked that would be able to extract that ammonia economically.

The problem is that of extracting three-quarters of a ton of ammonia from 50,000 tons of water, which it will be admitted is no easy task. It must not be forgotten that the ammonia principally resides in the soluble portion of the sewage, and this is in a great measure overlooked by those who have attempted to make a profit during sewage treatment.

We now come to the sludge. Some inventors tell us there is a mine of wealth in this—for use as a manure; if this be so, why is it that the managers of sewage precipitation works endeavour to produce the least possible quantity? My opinion is that its use as a manure is not a proper use, and that it can be turned to better account. The phosphates, the potash salts, and the organic matter will be best left out of the question, they can only be dealt with by irrigationists, and irrigation is not practical everywhere.

We may now consider some of the various processes that have been put into actual practice for the treatment of sewage, and of them we may first glance at

Filtration Processes.

Irrigation is essentially the most rational of all filtration processes. It is a filtration through soil permeated by the roots of plants, and the altered products of the sewage are absorbed thereby. I am not one of those who think that raw sewage should be applied to land, but I do believe that, wherever it is possible, the effluent from a precipitation process should be made to give up its valuable fertilising materials to growing crops, and by this I mean that precipitation should always precede irrigation. The value of sewage as a fertiliser lies in the effluent.

Filtration of sewage through ordinary garden soil, without any previous precipitation, was experimented upon in 1868 by a Mr. Edward Brown, who in a subsequent year attempted to treat the sewage of the workhouse at Slough by his method. I had the privilege of making the chemical tests upon this process, and have no hesitation in saying that it was a process that could not be applied to the sewage of a large place like Salford.

Many experimenters have found that a simple filtration through sand will purify sewage to a very great extent, and the same may be said with reference to the use of iron, carbon, coke, and other materials as the filtering medium. The filtration of raw sewage, however, is attended with many practical difficulties, amongst which the rapid clogging of the filters and the deterioration of the quality of the effluent after a very short time of usage are the most apparent.

Filtration, pure and simple, will only remove the suspended matters; but as in perfectly fresh sewage, more than the moiety of the albuminoids are insoluble, this will at once account for the improvement that takes place by filtration only. But it is difficult to avoid aëration taking place during filtration, and aëration is a wonderful purifying operation. In ordinary filtrations *per descensum* aëration takes place to some extent simultaneously with the retention of the suspended matters.

Oxidation and Reduction Processes

come forward next for our consideration; perhaps the least expensive is that of treating the sewage with a current of air.

I have already shown you that the organic matter of the Salford sewage requires the oxygen of at least 1,000,000 cubic feet of air daily. These are theoretical numbers. In practice, judging from other processes with which I am well acquainted, the quantity of air required would be at least 16 times this, and this volume would in the ordinary way have to be forced through a depth of not less than 6 feet of the sewage.

Sixteen millions of cubic feet per diem may roughly be called 700,000 cubic feet per hour, or 11,000 cubic feet per minute, so that by following gas-works practice or blast-furnace practice we may arrive at a very fair idea of the cost of aeration by these or similar means.

There is no doubt aeration is beneficial, and by itself retards putrefaction in a very remarkable manner. The late Dr. Angus Smith, in his last report as inspector under the Rivers Pollution Prevention Act, threw out a suggestion that probably a combination of the lime process with aeration would be the best that could be adopted. The reasons for this conclusion will be given presently.

Another way of aerating sewage would be to run it down a tower packed with suitable material and pass a current of air upwards, but then there would be the whole of the sewage to raise to a high level, the cost of which can be readily calculated. Undoubtedly the most perfect mode of aeration is that you see before you in the model plant now working. There the liquid is at small cost carried up as a spray or rain shower, and the small particles are completely surrounded by the atmosphere which is rushing forward through it.

After the process of oxidising with air we may consider the use of bleaching powder, of which 100 tons would be equal to 8 tons of oxygen, or in other words the Salford sewage would require 96 tons of bleaching powder daily to bring it to the same state of purification as can be accomplished in the laboratory. At its present price, this quantity of bleaching powder would cost over 576*l*., or over 200,000*l*. yearly.

Manganate of soda, and permanganates have been both proposed and used as oxidants for sewage, but as I am afraid the figures and cost of such, required for *complete* oxidation of the sewage, would be too enormous for contemplation, I forbear to present them to you. Of course I am prepared to be told that there are works wherein manganates are employed, and that the cost is not too excessive, but I may say it is an easy thing to purify the sewage "just a little." This "just a little" has been the bugbear all along the line. Works have been put up, with the best intentions no doubt, but after a year or two the chemicals have been reduced to "just a little," and consequently the soluble impurity has passed away unacted upon. The success of chemical reactions required that certain known quantities of materials shall take part in those reactions, and if those quantities are not present, the reactions will take place only in proportion to the quantities present.

Reduction processes have been but little studied. Electrolysis may be considered as coming under this head, but seeing that so much has been said upon a process of this kind just lately, it would be only a waste of time to recapitulate those remarks here. The rationale of the process does not seem to me to be completely understood as yet.

We must now turn to

Precipitation Processes.

It would be folly to attempt, in the short space of an evening's lecture, to describe all the various processes and chemicals that have been proposed from time to time for the treatment of sewage. The various precipitants require to be added in definite quantity and in proportion to the amount of the impurity present. It is easy to watch the effect of gradually increasing quantities of chemicals upon sewage, by the addition of such substances as sulphate of alumina, or persulphate of iron. Small quantities of persulphate of iron, such as 5 cwt. or 10 cwt. per million gallons, will not have much effect upon the soluble organic matter; when over a ton per million gallons is used, the effect is noticeable, but the maximum purifying effect is not reached with even 30 cwt.

No doubt it will be urged that the addition of 30 cwt. of such a substance as sulphate of alumina to the million gallons, of a sewage such as Salford, produces a very marked improvement, and hinders the commencement of any putrefactive change, and this is undoubtedly the case. This is also more marked with the persulphate of iron, which acts as an oxidising agent in addition.

The general action of precipitants of a neutral or slightly acid character is to form insoluble precipitates with some of the albuminous constituents of the sewage, and cause their deposition as sludge. It is precisely a similar action to that which takes place when a soluble mordant and a soluble colouring matter are brought together in a suitable intermedium, a reaction so well known in this district amongst the dyeing and printing industries.

What I wish to point out most clearly and definitely is, that the action is a chemical one; it takes place through the intervention of fixed and definite quantities, so that less than the required quantity will not purify, while more than is requisite chemically, though it generally accelerates the action, is wasted.

Many faults can be found with most of the precipitation processes. Of course, if we read the various pamphlets describing these processes, we shall discover that everything goes as gaily as a marriage bell. How is it, then, that some one process or another has not been universally adopted?

The cause is not difficult to discover. In the first case, the cost of chemicals to effect the maximum purification is too great to be borne long. Secondly, the production of sludge and its disposal is no small problem, as on account of its bulk and the large percentage of water it contains it is a very unmanageable product.

Whenever this question crops up at a Government inquiry we are always told that farmers are only too glad to get the sludge as a manure. It is not my intention to dispute this to-night; I often wonder whether the gentlemen responsible for these statements actually believe in the truth of them.

Up to this point I have omitted all mention of the lime process, because, although it is a precipitation process, yet the reaction goes much farther when sufficient lime is applied.

In the report of the late Dr. Angus Smith to the Local Government Board, issued in 1882, he writes:—"In the first proposals for purifying water by Thomas Henry, F.R.S., of Manchester, about a century ago, lime was used, and after precipitation carbonic acid was employed to neutralise any excess. Any excess of carbonic acid over the lime would be an improvement. Free lime in water is a great disadvantage. Indeed we must look carefully to our streams whenever lime is used for precipitation. It is a favourite poison for fish, and I have seen a clean solution from a precipitating tank become suddenly whitish on entering a river of clean water. The process was intended for purifying the river, but it was in reality adding a new poison."

In that report, Dr. Angus Smith further writes:—"Lime does not disinfect in such a way as to prevent putrefaction as long as aeration does, but it clears the liquid more thoroughly, and if the effluent is removed the putrefaction resulting cannot be equal to that which would take place in the aerated sewage after a certain time."

"This seems to lead to another point, namely, it is not best then, to use both processes—the lime and the aeration?"

For some years past we have been endeavouring to bring the late Dr. Angus Smith's ideas to a practical success.

The chief faults of the lime process as at present conducted are, that if only a small quantity of lime be used, say 7 or 8 cwt. per million gallons, the whole of it is seized upon by the free and loosely combined carbonic acid the water contains, and but very little, if any, purification is effected. The precipitate of carbonate of lime perhaps causes a more rapid deposition of the suspended matters present, but here its action ends. Upon the addition of more lime, say to 18 cwt. per million gallons, some of the soluble organic matter is acted upon, a partial resolution of the albuminoids takes place, and insoluble salts of lime are formed as a thick curdling precipitate which settles very readily.

I was anxious to show you the effect of adding 18 cwt. of lime to the million gallons of sewage, and as the remark was made in this room at our last lecture that laboratory experiments were not to be trusted, we place before you the results of the analysis of samples of the Leeds sewage before and after treatment in actual practice:—

Soluble Matter, Parts per 100,000.	Raw Sewage. *a.*	After 18 Cwt. Lime. *b.*	More Lime. *c.*
Total soluble solids	125·7	135·0	277·8
Loss on ignition	56·4	27·1	25·7
Total hardness.....	27·1	54·0	258·0
Chlorine	13·9	18·7	17·2
Alkalinity (H_2SO_4 neutralised)	31·3	31·4	220·0
Free ammonia	2·8	2·4	2·5
Albuminoid ammonia	0·4	0·26	0·14
Absorbed oxygen	18·0	11·7	4·2

These figures are very instructive; the water in column *b* possessed no greater alkalinity than did the raw sewage; it had a brownish tinge and a very bad odour, much intensified by standing one day in a warm room; the albuminoid ammonia had been reduced from 0·4 parts to 0·26 parts, or 35 per cent. removed. The loss on ignition had been reduced from 56·4 to 27·1, or 52 per cent., while the absorbed oxygen had sunk from 18·0 to 11·7 or 35 per cent.

A further quantity of lime was now added in the laboratory, and after well mixing it was allowed to settle clear. The clear fluid on being analysed gave results shown in column *c*, from which it appears that while the albuminoid ammonia had been reduced from 0·26 to 0·14 or 45 per cent., and the absorbed oxygen from 11·7 to 4·2 or 64 per cent., the loss on ignition had only been reduced from 27·1 to 25·7 or 5 per cent.; evidently the limit of its action upon the non-albuminous matter had been reached. The liquid represented by column *c* possessed a very peculiar odour quite distinct from that of column *b*, and was perfectly clear and water-white. This liquid was blown with air, when it soon lost all its odour, and appeared like an ordinary sample of tap-water. It was, however, highly alkaline, and so would be a very objectionable liquid to enter a stream.

I have now said enough to show you the chief faults of the lime process as it is at present practised. A small quantity of lime simply combines with the carbonic acid, and does not act upon the soluble impurities at all. A little more lime added, we will say, until the effluent commences to show the faintest trace of alkalinity to red litmus paper (say 18 cwt. per million gallons) produces a decided purification; but the highest degree of purification is not reached until at least two tons of lime have been added to the million gallons.

Now, on adding more lime to sewage, we get, of course, more sludge, and where sludge is difficult to dispose of, this is a serious objection to its production, the tendency being to cut down its formation to the lowest possible limit. But if sewage sludge could be turned to profitable account, the more sludge, of course, the more profit.

The effluent from sewage that has been treated by lime possesses a very peculiar and noisome odour, and if sufficient lime has been used to effect the maximum purification it is highly alkaline, is thus extremely poisonous to fish, and on account of its alkalinity soon enters into a putrefactive decomposition of the worst order.

If the foregoing objections could be overcome there is no doubt that all other methods of treating sewage would find in lime a powerful rival, even if it did not supplant them altogether.

We may say at once that we have succeeded in:—

First.—Removing the whole of the insoluble albuminoids.

Second.—Removing 65 per cent. of the soluble albuminoid matter.

Third.—Completely deodorising the effluent.

Fourth.—Restoring the neutrality of the effluent, and

Fifth.—Utilising the sludge at a profit.

The apparatus in which all these wonderful things are done is shown in the model now at work on the table before you. The lime is introduced in two separate portions; in the first mixer about 7 cwt. per million gallons are added which seizes hold of the carbonic acid at once. The mixture then flows into mixing tank No. 2, where a further quantity of about 33 cwt. of lime is added. The limed sewage now flows through a series of subsidence tanks in a constant stream, leaving the last tank, as you will see, a highly alkaline and peculiar smelling liquid. The odour of this liquid is certainly not a pleasant one, and the next step must be to deal with that odour in a satisfactory manner. You will notice, the liquid is perfectly clear, and that it is highly alkaline to the red litmus with which I mix it. The odour of the water at this stage is, no doubt, due to the vapours of several volatile organic compounds of an easily oxidisable nature, or such as are expelled when the partially treated sewage is submitted to aëration. This aëration takes place at the many weirs on the river Irwell, and the odours prevalent about these spots are too well known to require description. What nature does at the weirs, we do here in this aërating chamber.

The sludge produced by the lime remains behind in the subsidence tanks; we will return to it later on. The clear liquid leaves the last tank and passes into the aërating chamber, or rather it should be called the aërating and carbonating chamber. A very thin layer of this odorous and alkaline liquid lies upon the floor of the chamber, and flows over it in a constant stream; during its passage through, it is projected upwards in the form of a rain shower, and, through this rain shower of partially purified sewage, a current of warm air is made to flow, which displaces and oxidises the organic odours, and, further, a current of carbonic acid is also sent through the chamber, which is absorbed by the lime dissolved in the partially purified sewage, forming an insoluble carbonate of lime, thus changing the alkaline character of the sewage to one of neutrality, and bringing the excess of lime into such a form that it can be further utilised.

I must digress a moment here to say a few words respecting the atmosphere of this carbonating chamber. The atmosphere entering consists of a mixture of air and carbonic acid (both warm), or in other words, of carbonic acid, oxygen, and nitrogen. The carbonic acid is absorbed by the lime of the rain shower; some of the oxygen is also absorbed by the soluble organic matter, while the excess of oxygen and nitrogen escapes.

The ammonia of the sewage is, as I have already shown you, *the* valuable constituent, and when the sewage is strong, ammonia is found in the gases escaping from the aërating chamber. When this occurs it is the easiest thing in the world to collect it. The model before you shows how this can be done. The escaping gases are passed through a scrubber packed with suitable material kept moistened with an acid solution; the acid absorbs the ammonia, and the liquid draining from the scrubber can be readily utilised. I must, however, say that with sewages as weak in ammonia as that of Salford, there are only traces of ammonia to be found in the gases leaving the aërating chamber; but with some sewages, such as that of Aldershot, ammonia readily comes off in paying quantities.

We must now return to the liquid running from the aërating chamber. You will observe that it has a milky appearance. This has been produced by the transformation of the soluble lime into a white insoluble carbonate, and nothing remains now, so far as the sewage is concerned, but to settle out this carbonate of lime and to allow the effluent to flow away—anywhere. It is a neutral liquid, clear, bright, and free from odour, and if exposed to the air for any length of time does not deteriorate in quality. The sample in the bottle before you is the identical one that I showed you on December 3rd in last year.

But I fancy I hear some of you asking: How and whence are the currents of warm air and carbonic acid obtained? For this information we must now follow the sludge.

The sludge produced by the treatment of the sewage with, say 40 cwt. of lime, and deposited from the liquid before its entry into the aërating chamber, is run into a mixing tank at a lower level. The sludge produced by treating the alkaline liquid with carbonic acid and air in the aërating chamber, plus any mud formed in that chamber itself, is also run into the same receptacle.

We may now pause a moment to inquire into the composition of the mud or sludge that has found its way into the mixing tank. It contains free lime, carbonate of lime, organic matter, mineral substances, consisting chiefly of silica, alumina, and oxide of iron, together with a quantity of nitrogenous material that forms and evolves a considerable quantity of ammonia during drying and heating. In other words, it consists of the organic matter of the sewage, the lime that has been used in the precipitation, the road detritus, and the water. Upon drying this sludge, water and ammonia are given off; the residue loses its organic matter during calcination at a red heat, leaving lime or carbonate of lime mixed with the silicate of alumina and oxide of iron of the road detritus.

It is, however, with the *wet* sludge that we have to deal, a sludge containing nearly 90 parts of water in every hundred parts by weight; it must be dried, or semi-dried, before it can be dealt with; and of what use is it when it is dried? Sell it as manure, as we are told they do at Leeds and Bradford, says one; dig it into the land as they do at Birmingham, says another; run it over some low lying land, says a third, as they do in Salford. I have already stated that "its use as a manure is not a proper use, and that it can be turned to better account." It has already been shown to you how the road detritus and other substances are washed down to the mouths of rivers, from whence they are afterwards dredged. Mixed with chalk, dried, burned, and ground, they become Portland cement. A well-made lime sludge should contain all the elements for the manufacture of Portland cement of good quality, but the success of this manufacture principally depends upon the proper regulation of the materials used in the mixture.

When the slurry is run into the mixing tank from the first and second series of subsidence tanks, it must first be examined chemically and means taken to secure that for every 70 parts of lime present, calculated as carbonate of lime, there shall be also present about 30 parts of silicate of alumina of such a quality as is found in the mud of estuaries. I have examined the alumino-silicates of several lime sludges from sewages and find them to compare with those of cement slurry as follows:—

	Sewage Sludge.			Cement Slurry.		
	a.	*b.*	*c.*	*d.*	*e.*	*f.*
Silica	65·0	60·0	57·4	19·9	21·3	20·8
Alumina	26·5	21·4	27·5	12·2	9·7	7·9
Oxide of iron	4·9	12·1	15·3	7·4	5·1	4·2

At this point I am prepared to hear urged the criticism that there is nothing new in the proposal to make cement from sewage sludge, and that it has been attempted over and over again and failed. Just so. When it was first proposed to steam ships to America Dr. Lardner endeavoured to prove that such a state of things could never come about for a vessel could never carry coals enough to raise the steam, let alone find room for passengers or cargo. When the London Gas Company's Bill was before Parliament in the early days of this century one honourable member indignantly asked a witness, "Do you mean to tell us, sir, that you can get a light without a wick?" and when answered in the affirmative, he replied, "Ah, sir! You try to prove too much." We have heard enough of these things in our day—gas could not be used for cooking yet people cook by it; electricity could not be used for lighting yet the contrary has been proved; people could not possibly talk to each other 100 miles apart, yet it is now done. Inventions seem to have to struggle through four distinct stages, the first or receptive stage; many may be working at this but only a few are in the running for success; next comes the cold water stage, in which all interested parties use their utmost endeavours to sink the new idea, the vested interest parties look on with fear and trembling, the wiseacres predict nothing but failure, while the man who has turned his thoughts in similar directions feels himself aggrieved, robbed, plundered, and shorn of honour, so that he feels it necessary not to increase his own chances of success but to endeavour as far as possible to pull his neighbour down from the pinnacle upon which he desires to establish himself. The third stage is reached when some one or other of the numerous inventors has achieved success. By steadfast application, by steady and untiring work at the difficulties as they have arisen, he has swept them all away and awaits his reward. So soon as this stage is ended the fourth begins. It frequently commences by a few disappointed patentees announcing the supposed infringement of some pet patent of their own. As a rule such men have a bank balance of the most meagre description, and as they have all to gain and nothing to lose, a law-suit has no terrors for them. Apart from this, the vested interests and the wiseacres have now altered their tone, "no utility," "no utility," is the cry now, while not the smallest noise is made by those who are loud in asserting "there is nothing new in it," "it has been patented over and over again, years and years ago."

We expect this is what many will say when we tell them that we have not only succeeded in purifying sewage by means of lime, but also in making cement from the sludge at a profit. When Weldon brought his chlorine process to perfection he was first told it would not answer, and then when it did answer, that Gossage and not he was the true inventor. When Mond introduced the ammonia-soda process into Cheshire he was first told it could not be done on account of the loss of ammonia; the second opinion was, that it had been tried by many and had been given up, and was moreover "as old as the hills." So all new processes are treated.

We know perfectly well that sewage has been purified by lime before, limed water has been treated with carbonic acid, sewage has been treated with air currents, the air currents have been robbed of their ammonia, and several have tried to make cement out of the sludge. In spite of all this, where is now the works existing wherein the sewage of any town is treated on the lines I have already indicated?

But I have not finished; we are still at the mixing tank. As I have already explained, the mixture is ascertained to contain 70 parts of carbonate of lime to 30 parts of silicate. Ordinary sewage sludge, made with 18 cwt. of lime to the million gallons, I have always found to contain too much silicate, that is to say, too little lime, so that I see no difficulty in properly apportioning it to the needs of any particular district. On the other hand, suppose a very large excess of lime over the silicate has to be used to purify some very foul sewage, field clay, fire clay, or river mud, or crumbled-down shale banks, or even well ground ash-pit clinkers may be employed to bring up the proper proportion of silicate. A few partial analyses of these substances may not be uninteresting here:—

	Field Clays.			
	a.	*b.*	*c.*	*d.*
Silica	55·6	62·6	67·0	61·4
Alumina	34·5	27·6	17·6	24·0
Oxide of iron	9·6	8·6	9·0	14·0

	Coal Pit Shales.			
	a.	*b.*	*c.*	*d.*
Silica	48·0	47·4	56·4	55·8
Alumina	32·6	20·8	16·5	21·6
Oxide of iron	3·8	0·2	11·4	8·2

—	Clinkers.		Fire-clay.	
	a.	*b.*	*a.*	*b.*
Silica	43·4	83·0	46·7	57·2
Alumina	29·9	11·7	17·6	28·9
Oxide of iron	10·4	8·6	6·0	1·1

The sludge or slurry is then pumped into the drying chamber you see before you; it is a closed chamber, upon the floor of which the sludge lies, and is exposed to the waste heat coming from the cement kiln which is built at one end of it. By the time the kiln has burnt itself out, the sludge has become dry, and forms the next charge. The dried sludge is now packed into the kiln with intermediate layers of coke, the coke is lighted by a fire at the bottom of the kiln, and the charge drawn so soon as the particles commence to frit together. When drawn from the kiln in this state, it is known as "clinker," and, after being ground and sieved, becomes Portland cement.

We must now turn our attention to the course of the gases leaving the fireplace and kiln, as it is from this source we obtain our supply of warm air and carbonic acid gas. The combustion of the coke in the kiln, and also of the organic matter of the sewage sludge, together with that expelled from the carbonate of lime, give all the carbonic acid required, which passes forward into the drying chamber at a red heat. The heat, passing over the surface of the wet sludge, dries it, the vapour passing off mixed with much ammonia or its carbonate. This ammonia is arrested in acidulated water, the gases passing down scrubber through which they pass while still warm into the aërating and carbonating chamber, where they act upon the highly alkaline and partly purified sewage in the manner already described. You will thus notice that the carbonic acid is not sent out of the process; it comes round again and again, so that a fresh supply, such as is yielded by the burning coke in each operation, simply goes to make up the working loss.

The Salford sewage, treated this way, would yield 260 tons of cement per week. Some of you may think this a large quantity, but when I tell you that I used to inspect one works making 1,200 tons a week, and another making nearly three times that quantity, and that there are many others of similar magnitude in this country alone, you will, I imagine, not be frightened at 260 tons per week. Again, if only one-third of a grain of ammonia were extracted from a gallon of each of the ten million gallons of sewage, it would amount to no less than six tons per week, but the cement revenue is quite good enough without that coming from the ammonia.

The weekly cost of carrying out this system night and day, without taking into account interest on capital, depreciation of plant, and other incidental expenses, is, as far as we can estimate, as follows:—

	£
Lime, 140 tons at 10*s.*	70
Shale or clay, 70 tons at 5*s.*	18
Coke for burning cement, 50 tons at 10*s.*	25
Labour, 40 men at 25*s.*	50
Acid oils and sundries	47
Coals for steam	70
Balance, profit	365
	645
The revenue being:—	
260 tons cement at 45*s.*	585
6 tons sulphate of ammonia at 10*l.*	60
	645

Annual balance of revenue over expenditure..... £18,980

As to cost of plant, this cannot be excessive, considering it is only an ordinary cement plant, with carbonating chamber tacked on to the usual precipitation works. But there is this difference, that while a cement maker proper has to possess boats, and to dredge or dig for his mud, and to get his chalk, it is here pumped into his works ready mixed for him. And again the precipitation department need have no trouble regarding sludge disposal, or the alkalinity of its effluent; both have been well provided for.

ON THE RELATIONSHIP BETWEEN THE COMPOSITION OF GREY CLOTH AND ITS LIABILITY TO MILDEW.

BY ROWLAND WILLIAMS, F.I.C., F.C.S.

Most of you are doubtless aware of the great annoyance and pecuniary loss to which cotton manufacturers and merchants are subject, owing to the comparative frequency with which various kinds of damage, especially that generally known as mildew, occur in cotton goods. Rarely a week passes without a mildew case of greater or less importance cropping up in our midst, some firms having occasionally quite a long spell of bad luck in this respect. It seems to be the impression in certain quarters that the rage for heavy sizing, which has become so prevalent of late years, is mainly responsible for these cases of damage. I hope to show, however, that it by no means necessarily follows that heavily-sized cloth is, *ipso facto*, specially liable to become mildewed, and *vice versâ*, that a so-called pure cloth (*i.e.*, one containing the smallest proportion of size which it is possible to employ) may be attacked by fungoid growths much more readily under certain conditions.

The sizing ingredients most commonly used in the process of manufacturing grey cloth are starchy matters of various kinds, such as flour, farina, &c., tallow and other fatty substances, soap, china clay, and the chlorides of zinc, calcium, and magnesium.

Small proportions of starchy, fatty, and mineral substances are almost always present in even the purest grey cloths, while the lower grades of goods contain, in addition, large quantities of weighting materials, notably china clay and deliquescent chlorides.

With the view of preventing mildew during the manufacture of the goods, and more especially afterwards, an antiseptic is generally added to the sizing mixture. Zinc chloride is the substance used almost universally among cotton manufacturers for this purpose, and is consequently found to a greater or less extent in most kinds of grey cloth, from 1 to 3 per cent. being present sometimes in heavily sized goods.

It is, perhaps, hardly necessary for me to remind you that the most favourable conditions for the formation of mildew exist when cloth free from antiseptic ingredients, but containing a large proportion of starchy matter (especially of a nitrogenous nature), is exposed to the combined action of moderate warmth and dampness.

Thirty samples of cloth were taken for the experiments, to which I shall presently refer. Some of these were selected from a large number of samples which have been sent to my laboratory for analysis during the last few years, while the remainder were obtained from well-known manufacturers specially for the purpose of this investigation. The samples in question, which are the production of 20 different manufacturers, may be regarded as representative specimens of some of the principal makes and qualities in the Manchester market.

For the sake of comparison, I also examined two samples of bleached cloth, the one of rather low quality, in which a fair amount of starchy matter was present, the other almost absolutely pure and containing only a trace of starch.

All the samples were carefully analysed by the same methods.

In the accompanying table I have recorded the results of my analyses, also the length of time necessary for the development of mildew, when the cloths were placed under conditions favourable to the growth thereof.

What I have termed "mildew tests" were made as follows:—Equal sized pieces of each sample were put into clean dry bottles; carefully measured quantities of water were then run slowly from a burette on to each piece, so as

to cause gradual and uniform absorption, and the well-corked bottles containing the damp cloth placed in an apparatus which was kept at a nearly constant temperature of 95° F. The greatest care was taken, in order to insure, as nearly as possible, the same conditions throughout the series as regards the degree of dampness, temperature, &c. The cloths were examined several times daily, so as to detect the earliest indications of fungoid growths. I may add that the experiments were repeated four times, with practically the same results each time, and all the analyses were made in duplicate, so there can be no doubt as to their accuracy.

Taking the results as a whole, I think it must be admitted that there is not so close a relationship between the composition of the different cloths and their respective tendencies to become mildewed as might have been expected, according to preconceived ideas on the subject. I am making special reference now to the ratio between the zinc chloride and the magnesium and calcium chlorides, and also to the percentages of those ingredients in proportion to the total size present in any particular sample of cloth.

At the same time, most of the figures seem to point in the same direction, viz., that zinc chloride, if present in suitable proportion, does undoubtedly exert a preservative influence on heavily-sized cloth.

As regards the peculiar and somewhat discordant results obtained in the case of a few of the samples, I am unable to offer a really satisfactory explanation, but I think they are most probably due to the varying proportion of nitrogenous constituents in the different cloths.

	Grey Cloths.—Percentages.							
	1.	2.	3.	4.	5.	6.	7.	8.
Fibre	85·07	84·08	88·94	88·09	82·55	80·09	78·73	76·83
Moisture natural to fibre	6·96	6·79	6·71	6·64	6·60	6·41	6·29	6·15
Moisture in excess	·52	·84	·91	1·18	1·42	2·24	1·96	1·96
Starchy matters	3·82	5·27	4·38	2·23	5·53	6·34	8·98	10·23
Fatty and oily matters	·56	·83	1·41	1·82	·86	·85	1·12	1·29
Mineral matters	1·07	1·34	2·05	5·04	3·04	4·07	2·92	3·54
	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00
Consisting of:—								
Zinc chloride	·04	·04	·12	·69	..	·38	·21	Trace
Calcium chloride	.	..	..	..	·83	..	..	..
Magnesium chloride	·21	·14	·31	·72	·89	·57	·08	·19
Magnesium sulphate	.	..	..	1·55	..	·71	..	..
China clay, &c.	·82	1·16	2·22	2·08	1·82	2·41	2·63	3·35
	1·07	1·34	2·05	5·04	3·04	4·07	2·92	3·54
Mildew Test.—Fungoid growths first observed at the end of	67 hours	67 hours	96 hours	80 hours	44 hours	67 hours	96 hours	48 hours
	9.	10.	11.	12	13.	14.	15.	16.
Fibre	74·51	74·35	71·16	70·84	68·74	68·45	67·78	67·16
Moisture natural to fibre	5·96	5·94	5·69	5·67	5·49	5·47	5·42	5·37
Moisture in excess	2·98	2·47	2·22	3·03	3·41	4·07	2·84	2·81
Starchy matters	9·06	8·51	5·45	14·41	14·69	9·81	5·90	8·65
Fatty and oily matters	2·37	1·67	3·53	·81	2·66	1·97	2·73	2·09
Mineral matters	5·12	7·08	11·97	5·24	5·01	10·73	15·33	13·92
	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00
Consisting of:—								
Zinc chloride	·75	·83	·15	·73	·19	·49	1·11	·87
Calcium chloride	·04	·05	2·73	..	..	·11	..	·02
Magnesium chloride	·05	·81	·31	1·14	1·61	2·09	2·52	1·99
Magnesium sulphate	..	..	..	..	..	..	..	..
China clay, &c.	4·28	5·37	8·78	3·37	2·91	8·04	11·70	11·04
	5·12	7·08	11·97	5·24	5·01	10·73	15·33	13·92
Mildew Test.—Fungoid growths first observed at the end of	73 hours	73 hours	44 hours	48 hours	44 hours	44 hours	50 hours	58 hours

	Grey Cloths.—Percentages.							
	17.	18.	19.	20.	21.	22.	23.	24.
Fibre	66·85	65·01	64·74	62·29	61·81	61·21	60·55	59·26
Moisture natural to fibre	5·35	5·20	5·18	4·98	4·94	4·89	4·84	4·74
Moisture in excess	4·83	3·87	3·93	4·37	3·97	4·07	4·09	4·01
Starchy matters	6·03	12·67	9·33	13·50	11·08	13·17	13·96	10·11
Fatty and oily matters	2·77	1·81	1·83	2·15	1·39	2·85	2·61	3·20
Mineral matters	14·17	11·44	14·99	12·71	16·81	13·81	13·95	18·68
	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00
Consisting of :—								
Zinc chloride	1·01	·42	·70	·72	·73	·89	·45	1·07
Calcium chloride	..	·06	·12	..	..	..	..	·22
Magnesium chloride	1·74	2·17	1·63	2·11	2·04	1·90	2·18	2·11
Magnesium sulphate	..	..	..	..	..	..	..	..
China clay, &c.	11·42	8·79	12·54	9·88	14·04	11·02	11·32	15·28
	14·17	11·44	14·99	12·71	16·81	13·81	13·95	18·68
Mildew Test.—Fungoid growths first observed at end of	54 hours	44 hours	54 hours	44 hours	44 hours	67 hours	48 hours	68 hours

	Grey Cloths.—Percentages.						Bleached.—Percentages.	
	25.	26.	27.	28.	29.	30.	1.	2.
Fibre	57·54	57·27	49·81	48·37	46·64	46·48	75·54	91·66
Moisture natural to fibre	4·61	4·58	3·98	3·87	3·73	3·71	6·04	7·91
Moisture in excess	5·11	4·29	4·12	7·31	5·62	8·34	1·87	..
Starchy matters	16·72	13·67	12·25	13·64	15·63	12·06	4·09	·20
Fatty and oily matters	1·31	3·46	1·42	2·97	5·93	4·40	·18	·17
*Mineral matters	14·71	16·73	28·42	23·84	22·45	25·06	12·28	·06
	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00
*Consisting of :—								
Zinc chloride	2·39	·62	·60	·68	·15	·22	..	..
Calcium chloride	..	·74	1·16	·09	2·82	·03	..	..
Magnesium chloride	·91	2·52	2·38	3·50	·93	3·87	..	..
Magnesium sulphate	·18	..	..	..	..	..	..	..
China clay, &c.	11·23	12·85	24·28	19·57	18·55	20·94	12·28	·06
	14·71	16·73	28·42	23·84	22·45	25·06	12·28	·06
Mildew test.—Fungoid growths first observed at the end of	126 hours	44 hours	139 hours	67 hours	44 hours	44 hours	69 hours	75 hours

NOTE ON THE APPLICATION OF ALIZARINE IN LEATHER DYEING.

BY H. KOECHLIN AND E. KNECHT, PH.D., F.I.C.

The application of alizarine to fibres other than those of vegetable origin is of comparatively recent date. Even 10 years ago alizarine colours on wool were practically unknown. But when, through the breaking up of the alizarine convention, alizarine was brought into the market at cost price, wool dyers began to direct their attention to this and allied colouring matters, and now large quantities of the so-called alizarine dyes are used in the production of fast shades on loose wool, stubbing, and yarn. That their superiority over other colouring matters is recognised by merchants, and probably also by the public, is revealed by the fact that special prices are sometimes quoted for alizarine dyed goods as distinct from such that are dyed with other colouring matters.

The application of the alizarines in silk dyeing is of still more recent date, but the demand for alizarine-dyed silks has hitherto been restricted to embroidery yarns, sewing silk, and stripes for trouserings. Latterly, alizarine colours have found more application in the dyeing of silk plush for seals and fast fancy shades.

The usual method adopted in wool and in silk dyeing is to mordant the material first with salts of chromium, iron, aluminium or tin (for wool, chrome is principally employed), and after washing off or soaping (with silk) to dye with the colouring matter or mixture of colouring matters in such a manner that the material is entered cold or lukewarm, and the temperature of the dye-bath is gradually raised to the boil and kept at this point until the bath is exhausted. The actual formation of the colour lakes only begins at about 90° C., and is completed between this temperature and boiling point in from 20 minutes to half an hour.

For the application of alizarine or nitro-alizarine in leather dyeing, this procedure is prohibited by the fact that leather will not stand a higher temperature than about 50° C. without becoming rotten.

In order to render the production of colour lakes with alizarine on leather possible at low temperatures, we adopted a principle which had been previously employed by one of us to wool, viz., padding the material first with a solution of alizarine rendered slightly alkaline with ammonia, and then developing in solutions of alumina, chromium, or iron salts. If the pieces are dried after having been padded in the alkaline colour solution and are then printed with thickened acid or stannous chloride, a variety of white or coloured figures can be obtained on coloured grounds. Thus, if the goods padded in the ammoniacal alizarine solution and dried are printed with stannous chloride and then passed through pyroligneous of iron, an orange pattern is obtained on a violet ground.

The application of this principle of padding first with the alkaline colour solution and then developing in the mordant solution has also proved itself applicable in leather dyeing. In the practical application, the comparatively strong, slightly ammoniacal alizarine solution (or in the case of nitro-alizarine, a solution of the monosodium salt) is first applied to the leather by means of a brush or pad, and the colour lake is then formed by a subsequent treatment in the mordant solution. Ordinary alum or nitrate of iron are liable to precipitate a considerable amount of unchanged alizarine in the leather, and it is therefore preferable to use these salts as basic as possible.

In this manner a large variety of useful and fast alizarine shades may be produced on leather without incurring any damage to the material.

NOTE ON THE CARBONISING OF WOOL IN PRESENCE OF SILK.

BY EDMUND KNECHT, PH.D., F.I.C.

What is technically known as "carbonising" consists in destroying by chemical means cotton or other vegetable matter in woollen fabrics or rags. This is effected either by passing the material through dilute sulphuric acid or aluminium chloride, and drying (wet method) or by exposing the material to an atmosphere of dry hydrochloric acid gas (dry method). By this treatment the vegetable matter becomes disintegrated, and can afterwards be beaten or shaken out as a fine powder. Thus, in the case of rags, the more valuable fibre, the wool is readily freed from its admixtures, and may be worked up again. Now silk is a more valuable fibre than wool, and since these two frequently occur together in fabrics such as umbrella cloths, silk warp Henrietta's, &c., it appeared to me desirable that a method should be forthcoming by means of which the wool might be destroyed, leaving the silk free to be worked up again into yarn.

When this problem first presented itself, it occurred to me to be a matter of impossibility to solve it, both fibres being of animal origin, and both being similarly affected by various reagents. But in trying the comparative action of acids and alkalis on the two fibres, I noticed that wool is considerably more susceptible to the action of alkalis and less susceptible to the action of acids than silk is. Thus I found it possible by boiling the mixed fabric with very dilute alkali to destroy the wool and leave the silk comparatively strong. But a safer method is based upon the difference in the behaviour of the two fibres towards pure water at high temperatures. If the mixed fabric (say, consisting of silk warp and woollen weft) is heated with water for some time to about 130° C., it will be found that the wool is so changed that it can be readily rubbed to a powder, while the silk remains comparatively unacted upon. My experiments were carried out in sealed glass tubes. The application of the principle on the large scale should not present any difficulties, and the process might find some industrial application either in the regeneration of silks from waste or in the textile industries.

NOTE ON THE FORMATION AND DIRECT FIXATION OF INSOLUBLE TARTRAZINE ON ANIMAL FIBRE.

BY EDMUND KNECHT, PH.D., F.I.C.

The colouring matter, which is known as ***tartrazine***, is the only commercial representative of an interesting class of dyestuffs discovered by Ziegler, and known as the osazone colouring matters. They are formed by the action of primary aromatic hydrazines or their sulphonic acids on

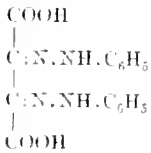
di-ketones containing the group | like benzil, phenan-

threne quinone, dioxytartaric acid, &c.

Commercial tartrazine is obtained by acting upon one molecule of dioxytartaric acid with two molecules of phenylhydrazine para-sulphonic acid in hydrochloric acid solution. Its composition is represented by the formula—

In wool-dyeing tartrazine is of great value on account of its fastness to light. In this respect it ranks with indigo as one of the fastest dyes we possess. Towards milling, however, tartrazine is not absolutely fast, and it was with a view of producing a yellow colour which was absolutely fast to light and milling that I endeavoured to fix the unsulphonated colour on the fibre.

If dioxytartaric acid and phenylhydrazine are mixed in hydrochloric acid solution in the proportion of one molecule of the former to two of the latter, no change takes place at first, but the liquid soon becomes yellow and after some time an orange yellow precipitate begins to settle. The reaction takes place more rapidly on boiling. The insoluble yellow precipitate is the elementary tartrazine—



By immersing silk or wool in a solution prepared as described and raising the temperature gradually to the boil, I found that the whole of the colour, instead of being precipitated in the bath, became assimilated by the fibre. The colours thus obtained are not so bright as those obtained with commercial tartrazine.

Contrary to my expectations, the insoluble colouring matter showed itself to be less fast to soap than the ordinary sulphonated product. Experiments which were made with a view of fixing insoluble tartrazine on cotton by dyeing were unsuccessful, but probably the formation of the colour on the fibre in calico-printing would take place in presence of an organic acid. It may also be fixed according to a patent recently taken out by a continental firm of colour makers, by printing insoluble tartrazine, chromium acetate and thickening, and then steaming. The colour thus obtained is said to be characterised by its great fastness.

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H. Forth.	J. T. Wood.
E. Francis.	

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Hon. Local Secretary:
R. L. Whiteley, University College, Nottingham.

SESSION 1891.

April 30th:—
Mr. Jno. R. Ashwell. "Some Properties of Calcium Sulphate."
Mr. R. Lloyd Whiteley. "An improved Oil-bath."
Messrs. R. L. Whiteley and J. T. Wood. "Notes on Lowenthal's Process for Tannin Estimation."

ON A RAPID METHOD OF SOLUTION IN THE COLD.

BY J. BERNARD COLEMAN, A.R.C.Sc.I., I.I.C., F.C.S.,
UNIVERSITY COLLEGE, NOTTINGHAM.

SOME time ago, wishing to ascertain the solubility of a salt in water, I conducted a few experiments to determine the time required by different salts to form a saturated solution in cold water. The first method employed was as follows:—The salt, coarsely powdered, was enclosed in a fine muslin bag, and suspended in the *upper* part of a vessel filled with distilled water: in this way, the water in contact with the salt becomes nearly saturated, and falls to the bottom of the vessel, fresh water, or water not so fully saturated, taking its place; thus the process of solution is continuous.

In the experiments recorded in the next page, on the salts $CuSO_4.5\,H_2O$ and $KClO_3$ respectively (Method 1) it will be seen that at least 12 hours, probably more, are required for complete solution. This method is therefore tedious, and cannot be performed in one working day.

The discrepancies noticed in this series, and also in the second series (Method 2) are due to the experiments sometimes lasting throughout the night, in which case the percentage obtained would be from a quantity of the solution taken out in the morning, thus the percentage would be low, as the *mean* temperature during the night was low. On the other hand, if the solution were taken at night, the percentage would be high, since the mean temperature of the solution during the day was higher. In Method 3 the temperature was constant.

In all cases the percentage of salt dissolved was obtained by taking out a quantity of the liquid by means of a pipette, filtering, rejecting the first portion of the filtrate, the remainder of the filtrate being received in a weighed stoppered bottle and then weighed. From this solution the weight of $CuSO_4\,5\,H_2O$ was obtained by estimation as CuO and calculation into $CuSO_4.5\,H_2O$. In the case of the $KClO_3$ it was evaporated to dryness in a tared dish, dried at 100° C. and weighed as $KClO_3$.

The next method (Method 2) employed was a modification of the above. In addition to keeping the solid near the surface of the liquid, a vigorous shaking took place about every half-hour. The salt, coarsely powdered as before, was put into a stoppered cylinder, one-half full of water; a vigorous shaking was applied, and the cylinder inclined, so that the salt remained near the surface of the water in the cylinder. As mentioned, the shaking was repeated about every half-hour, and the cylinder inclined as before. On reference to the table (Method 2), it will be that, although the method is more rapid than the previous one, it is not probable that solution would be complete in the case of the $CuSO_4.5\,H_2O$ in much less than 10 hours.

Both the preceding methods are too long for, say, ascertaining the solubility of a salt in a solvent at a *fixed* temperature; in fact, it is difficult to regulate the temperature for so long a period without slight variations.

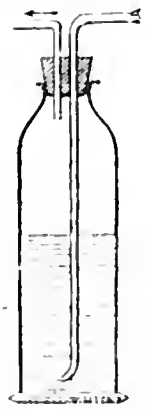
Eventually I found that, by simply passing a current of air through the coarsely powdered solid, suspended in water, complete solution could be obtained, in some cases in the space of 15 minutes, and in most cases before the expiration of an hour.

The process is conducted as follows: the solid is put into a glass cylinder half filled with distilled water. The mouth of the jar is tightly stoppered with an india-rubber cork, through which pass two glass tubes. One of the glass tubes has inserted in the upper end a plug of cotton wool to keep out dust, the lower end is drawn out a little and bent, as shown in the Figure, and passes to the bottom of the cylinder; the other tube just passes through the cork. Before use the cylinder is surrounded by a vessel containing water of the temperature at which the solubility of the solid is to be tested; the short tube is then connected with a water aspirator. A continuous current of air thus passes through, forcing the solid through the liquid in a circuitous path. In the experiments recorded in the table (Method 3)

	$CuSO_4 5H_2O$				$KClO_3$			
	Length of Time.	Temperature.	Time of Day when taken.	Percentage.	Length of Time.	Temperature.	Time of Day when taken.	Percentage
		°C.				°C		
First Method. Suspension in beaker	6 hours	17	Evening	25·88	6 hours	17	Evening	5·22
	12 hours	17	Evening	25·355	12 hours	17	Evening	5·905
	26 hours	16	Morning	25·39	32 hours	17	Evening	6·38
	50 hours	16	Morning	25·95	50 hours	16	Morning	5·61
Second Method. In cylinder with occasional shaking	6 hours	17	Evening	23·53	6 hours	17	Evening	5·75
	12 hours	17	Evening	25·43	12 hours	17	Evening	6·07
	26 hours	16	Morning	24·87	32 hours	17	Evening	6·67
	50 hours	16	Morning	25·22	50 hours	16	Morning	5·54
Third Method. Aspirating air through cylinder	15 minutes	17	.. ..	23·82	15 minutes	17	.. ..	5·80
	30 minutes	17	.. ..	25·64	30 minutes	17	.. ..	5·73
	1 hour	16	.. ..	25·345	1 hour	16·5	.. ..	5·71
	2 hours	16·5	.. ..	25·43	2 hours	16·5	.. ..	5·80
	3 hours	16·5	.. ..	25·25	3 hours	16·5	.. ..	5·835
	*6 hours	16·5	.. ..	24·675	6 hours	16·5	.. ..	5·83
Fourth Method. Boiling, and cooling down rapidly	9 hours	16·5	.. ..	25·28	9 hours	16·5	.. ..	5·685
	1 hour	16·5	.. ..	25·575	1 hour	16·5	.. ..	5·81
	2 hours	16·5	.. ..	25·55	2 hours	16·5	.. ..	5·81

* Aspirator stopped for 1½ hours.

the $CuSO_4 5H_2O$ and $KClO_3$ in solution, were estimated in the manner described above; it will be seen that 15 minutes sufficed for complete solution of the $KClO_3$ and



half an hour for that of the $CuSO_4 5H_2O$. Probably an hour would be the limit of time required for the complete solution of any salt.

For the sake of comparison, I contrasted the lasts results with the results tabulated in Method 4, *i.e.* boiling up the coarsely powdered solid with water, and rapidly cooling down to the required temperature with continuous stirring. Although in this method there is the fear of supersaturation occurring, still the results agree very closely with Method 3.

The advantages of the aspiration method consists, (1) in the comparatively short time required for solution; (2) no expensive apparatus, such as water motors and revolving mechanical agitators, is required. In places where high-pressure water is not available, steam may be substituted by simply attaching a flask of boiling water to the aspirator, and it will be found to answer as well.

The aspirator used in these experiments is that known as Geissler's.

The objections to this process are, (1) the solution may be supersaturated by the air causing evaporation during its passage through the liquid; (2) that readily oxidisable substances are excluded.

The first objection may be overcome by passing the air through water before passing it through the body undergoing solution; thus rendering the air moist.

The second difficulty can usually be met by employing coal-gas in place of air, care being taken that the oxygen and carbon dioxide present in the coal-gas are thoroughly absorbed by alkaline potassium pyrogallate.

I determined the solubility of $FeSO_4 7H_2O$ in the following manner as a test case.

The coal-gas was passed through three U-tubes with 9-in. limbs, filled with pumice soaked in alkaline potassium pyrogallate. This procedure was found to have removed all the carbon dioxide and oxygen in the coal-gas.

The gas was then passed through the coarsely powdered $FeSO_4 7H_2O$ in the manner described (Method 3).

The following results were obtained with two estimations:—

$FeSO_4 7H_2O$.

Time.	Temperature.	Percentage.	Per Cent. of Fe″ Salt before Aspiration.	Per Cent. of Fe″ Salt after Aspiration.
Min.	C.			
30	15	33·76	99·07	99·00
30	15	33·75	99·07	99·03

The above examples show that the process is also useful for oxidisable substances, since the amount of iron oxidised during the passage of the gas increased 0·07 per cent. only.

The percentage of ferrous iron in the original salt (99·07), and also after aspiration (99·01), was determined by the bichromate method.

I have to thank Messrs. Smith, Halls, and Adams, students in the chemical laboratory, for considerable analytical help.

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Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

SESSION 1890-91.

April 6th (Glasgow):—
Election of Office bearers.
Mr. F. J. Rowan. "Notes on the Physical Conditions existing in Shale-Distilling Retorts."
Mr. J. S. Thomson. "The Determination of Impurities in Paraffin Scale, &c."
Mr. J. Gray. "An Apparatus for determining Flash-Points of Heavy Mineral Oils."

May 4th (Edinburgh):—
Dr. J. B. Readman. "The Manufacture of Phosphorus: Part III."
Dr. J. Clark. "The Direct Estimation of Arsenic in Minerals and Metals."

Meeting held at the Societies' Rooms, 207, Bath Street, Glasgow, on Monday, 2nd March 1891.

MR. E. C. C. STANFORD IN THE CHAIR.

ON THE REVISION OF CONSTANTS EMPLOYED IN THE ANALYSIS OF FATS AND OILS.

BY R. T. THOMSON, F.I.C., AND H. BALLANTYNE.

Part II.

In our previous paper on this subject (see this Journal, Vol. IX., p. 588), we stated that our object was to revise the constants of various oils, and to record these for each individual oil, and not only for each class of oil. Several of the oils for which we gave constants formerly have been mislaid, and one or two have changed somewhat by exposure to light and being insufficiently stoppered, according to the description already published by one of us (see article on "The Effect of Exposure under Certain Conditions upon some Constants of Oils," by H. Ballantyne, in this volume, p. 29). In the accompanying table of "constants in oil analysis" will be found that portion of our results which may fairly be regarded as useful in oil analysis. In it are included figures for fresh specimens of olive and other oils, and the old and new results of the oils formerly partially examined. We have also stated the percentage of free (oleic) acid in each sample, and although this cannot be looked upon as a constant, yet it serves a purpose in indicating to some extent the condition of the oil, and shows how little, if any, a high free acidity affects the results of analysis.

Iodine Absorption.—The first column in the table contains the iodine absorptions, and there is little to add to our remarks in Vol. IX., p. 587. It was there noted that the variation in iodine absorption for different olive oils was greater than usually stated. Since then we have found one half a per cent. higher still, so that the iodine value ranges from that of Gioja (79 per cent.) to that of Mogadore olive oil (86·9 per cent). We have also examined a rape oil with an iodine absorbing power of only 99·1 per cent., which is the lowest figure we have yet obtained for that oil. The sample of rape oil given in our former table as 110·1 should have been actually printed 10 per cent. less; so that the highest iodine absorption for rape oil stands at 105·6 per cent.

Potash Neutralising Power.—It is perhaps worthy of note that the figures in our table respecting olive oil do not represent such a great variation between each individual oil as those given by Koettstorfer, Stoddart, and Valenta, but they are in close accord with those of Archbutt. With rape oil also the difference in potash neutralising power agrees with Archbutt's results, and is not so marked as that stated by other observers. Of the five specimens of linseed oil examined by us, the limits lie between 19·00 and 19·28, while those of nine specimens tested by other observers, and recorded by Allen, vary from 18·74 to 19·52. With our four different specimens of seal oil there is only a difference of 18·93 to 19·37, while Stoddart and Deering, testing an equal number of samples, show differences to the extent of 18·90 to 19·60. In all cases, while our iodine absorptions have, on the whole, shown wider variations, our results of potash neutralising power have exhibited narrower differences, for oils of the same class, than other observers.

Unsaponifiable Matter.—A knowledge of the percentage of unsaponifiable matter in genuine oils is of great importance, as on this depends how much of that ingredient must be reckoned as mineral or rosin oil in an adulterated sample. Hitherto we have had to be content with Allen's quite correct statement that the proportion present in oils and fats is not more than 1·5 per cent., and usually much less. It is quite possible, however, that much greater use might be made of the unsaponifiable matter in detecting adulterants. It will be observed in the table of constants that olive, refined cotton-seed, unrefined arachis, and linseed oils contain about the same proportion of unsaponifiable matter, and therefore the determination of that constituent in a sample, say, of olive oil, would not serve to show any adulteration with either of the other three oils. But the presence of a considerable proportion of rape oil would tend to have a lowering effect on the percentage of unsaponifiable matter. Again, in marine oils it is a remarkable fact that seal oils contain only about one-third of that contained in whale, cod, and menhaden oils; therefore, if an abnormally high percentage of unsaponifiable matter (not due to mineral or rosin oil) were obtained in seal oil, there would be a presumption at least of adulteration with menhaden or other fish oil. Of course more determinations of "constants" of various qualities of these oils may be necessary to establish such distinctions on a firm basis. But, in the meantime, the analysis of oils cannot be made with such scientific accuracy as to warrant us to dispense with even the slightest guide to the determination of their purity.

It may be noted in passing that in the estimation of the unsaponifiable matter, if the ethereal layer is equal in volume to the lower layer of soap solution, four-fifths or 80 per cent. of the ingredient may be determined by one extraction. The other fifth may be allowed for by adding one-fourth of that obtained by the first extraction, or by a second extraction, especially if the proportion expected is large.

Of the *specific gravities* of the various samples there is nothing special to remark.

Specific Temperature Reaction.—This is simply a modified way of recording the results of Maumene's temperature reaction with strong sulphuric acid. Broadly stated, and divested of all the little necessary precautions, Maumene's test shows the rise in temperature by mixing together 50 grms. of the oil and 10 cc. of sulphuric acid. Various observers have shown that a slight difference in the strength of the acid affects the rise in temperature very considerably, so that a careful taking of the density, or a gravimetric or volumetric estimation has been recommended. The density

and gravimetric test may both be objected to on the ground that their accuracy would be impaired should the acid contain any sulphates of metals, but no such objection can be urged against the volumetric method. But a much simpler test even than the latter may be applied to the acid, and on this is based what we have named the specific temperature reaction. It simply consists in mixing 50 grms. of water with 10 cc. of the sulphuric acid (each at 20° C.), and registering the highest temperature reached. The amount of water is best measured from a pipette at 15·5 C., and the sulphuric acid should be run in from a pipette which will deliver the 10 cc. in one minute. During the addition the mixture should be vigorously stirred with the thermometer, and the highest temperature reached rapidly read off, as it only remains constant for a few seconds. Care should be taken in measuring the water, as a material error may come in if a little less water should be employed. For instance, one gramme less of water will give a higher reading of 0·8 C. The oil being tested in precisely the same way, it is only necessary to divide the rise in temperature obtained with water into that obtained by the oil under examination. The answer is the specific temperature reaction compared with water as 1, which is the customary mode of expression; but in our table we have recorded the results compared with water as 100, in order to dispense with decimals.

In applying the test some precautions are necessary, and a few details in manipulation must be observed. The oils must be carefully weighed, and the acid added to them exactly as with water, except that even more vigorous stirring is necessary during and after the addition of acid. In all the experiments made in this way no abnormal rise in temperature by local superheating was ever observed. The rise was fairly steady up to the highest point, at which it remained constant for 50 or 60 seconds. In the cases of linseed, cod, seal, and menhaden oils the tests had to be made with a mixture of 20 grms. of these oils and 30 of olive oil of a known specific temperature reaction.

The tests were performed in a thin beaker surrounded with cotton wool, but it was found that the shape of the beaker had a considerable influence on the rise in temperature. Thus, with sulphuric acid of 96·8 per cent. in a beaker 3 in. high and 2 in. wide, water showed a rise of 41·7°, while Malaga olive oil gave a rise of 39° C. In a beaker 4 in. in height and 2 in. in width the water recorded 43·7°, and the same oil 41°, being a difference of 2° in each case. When the specific temperature reaction of the oil is calculated out, we obtain 93·5 and and 93·8 for the respective beakers; and such results are as close as need be. From these data we gain the valuable precaution that the oil or oils to be examined must be tested in the *identical* vessels in which the test with the water is made. In Maumené's original method of testing oils no account whatever is taken of using different vessels, and by it there is no means by which allowance can be made for a fresh beaker when the first one is broken; unless indeed a few beakers are always kept which have been tested against each other. By adopting the specific temperature test all that is necessary is to standardise a new beaker with water and sulphuric acid, and make the experiments in it with the oils to be tested, using the new temperature reaction with water as the standard.

It is a well-known fact that acids of different strength give widely different results in taking Maumené's temperature reaction of oils, and therefore some experiments were made to ascertain if this also affected the specific temperature reaction. Three different strengths of sulphuric acid were used, and the results of their treatment with water and several oils are given in the following table:—

TABLE SHOWING THE RISE IN TEMPERATURE AND SPECIFIC TEMPERATURE REACTION WITH SULPHURIC ACID OF DIFFERENT STRENGTHS.

Sample.	H_2SO_4 of 95·4 per Cent.		H_2SO_4 of 96·8 per Cent.		H_2SO_4 of 99 per Cent.	
	Rise in Temperature C.	Specific Temperature Reaction.	Rise in Temperature ° C.	Specific Temperature Reaction.	Rise in Temperature ° C.	Specific Temperature Reaction.
Water	38·6	100	41·4	100	46·5	100
	36·7	95	39·4	95	44·8	96
Olive oil	.. ..	.. ..	36·0	94	43·8	94
	34·0	88	38·1	92	44·2	95
Rape oil	49·0	127	.. ..	.. ..	58·0	124
Castor oil	34·0	88	37·0	89	.. ..	.. ..
Linseed oil	104·5	270	.. ..	.. ..	125·2	269

An examination of this table shows how even a little difference in the strength of the sulphuric acid may largely affect the temperature test as usually reported; while the specific temperature reaction is influenced only to a comparatively small extent. In one case with an olive oil the strongest acid shows a considerable discrepancy when the result is compared with that of the weakest, but nothing like the difference brought out by a comparison of the rise in temperature alone. The vast superiority of the specific temperature reaction to the usual method of recording results is most clearly shown with linseed oil, which indicates a difference of nearly 20 in 125 between the weakest and strongest acid, when the specific temperature reaction only exhibits a variation of 1 in 270. To obviate the obtaining of abnormal results, due to difference in strength of sulphuric acids, we use an acid which gives with water a rise of from 42 to 44°, when the experiment is conducted in a beaker about 4 in. in height and 2 in. in width. Sulphuric acid conforming to this test will contain from 95·5 to 97 per cent. of real sulphuric acid.

It may perhaps be as well to note that the proportion of acid to oil or water must in no case be altered, for as already explained 1 grm. too little water means a higher rise in temperature by about 0·8°. With oils, on the other hand, the effect is usually to give a considerably less rise, so that by inattention to exact weighing and measurement, a double error may easily be introduced.

When 50 grms. of the oil cannot be spared, the quantities of oil and sulphuric acid may be halved, and the results compared with those obtained with half quantities of water and acid. In such circumstances the specific temperature reactions are precisely the same as those quoted in the table for the double quantities, but the reading of the thermometer must be done more sharply in the former than the latter case.

It is almost unnecessary now to point out that this reaction may be utilised as a valuable adjunct to the iodine absorption and other constants, for the detection of such oils as rape and cottonseed in olive oil, and for other analyses which will suggest themselves to all chemists.

As a general rule, an oil possessing a high iodine absorption has also a high specific temperature reaction, but the rise in the latter is not always directly as that in the former. The reason the specific temperature reaction cannot be relied on with the same assurance as the iodine absorption is because it shows in some cases large variations for the same class of oil. This defect is not noticeable in any of the olive, cotton-seed, castor, or seal oils we have examined, but some of the figures obtained from arachis, rape, and linseed oils are extremely and unexplainably different. Thus, rape oils vary from 125 to 144, arachis from 105 to 137, and linseed no less than from 270 to 349; and yet all the other constants agree within reasonable limits. In spite of these defects, and in consideration of the state of knowledge with regard to the chemical constitution of oils, the specific temperature test may be relied on, when judiciously used, as a valuable constant in the analysis of oils.

Valenta's Test.—Some seven years ago this test was introduced by Valenta, and, as is well known, consists in heating equal volumes of the oil and of glacial acetic acid (sp. gr. 1·0562) until perfect solution is obtained, and then observing at what temperature turbidity appears. In his second volume on "Commercial Organic Analysis," Allen states that a little difference in the strength of the acetic acid does not matter, and suggests that certain variations in the turbidity temperature of different specimens of the same kind of oil is due to a difference in the proportion of free fatty acids contained in them. In compiling the following table, which contains the results of our experiments, we have kept these two suggestions in view.

TABLE SHOWING THE TURBIDITY TEMPERATURE OF VARIOUS OILS BY VALENTA'S TEST.

Name of Oil.	Free (Oleic) Acid per Cent.	Turbidity Temperature (°C.) with Glacial Acetic Acid of — Sp. Gr. 1054·2.	Sp. Gr. 1055·2.	Sp. Gr. 1056·2.
		°	°	°
Olive (Gioja)	9·42	65	80	91
Olive (Gioja) free acid removed.	None	87	..	..
Olive (Syrian)	23·88	42	..	..
Olive	5·19	78	96	..
Olive	3·86	85	100	111
Arachis (commercial)	6·20	76	92	112
„ (French refined)	·62	96	114	Not completely dissolved.
Rape	2·43	110	Not completely dissolved.	„
Rape	1·54	105	„	„
Linseed	·76	61	78	90
„ (Baltic)	3·74	42	59	71
„ (East India)	·79	57	..	..
„ (River Plate)	1·21	56	..	..

An inspection of the above table shows that ascertained facts fully bear out Allen's theory with regard to the decided influence on Valenta's test of the presence of varying proportions of free fatty acids in oils. This is well illustrated in the case of the Gioja olive oil, which was tested as first obtained, and after removal of the free acid by agitation with caustic potash solution. It will also be observed that with all the oils given on the table, the turbidity temperature is high when little free acid is present, and becomes lower as the proportion of free acid rises. The difference of 22° between the results obtained with the acid and the acid-free Gioja oil shows that each per cent. of free fatty acids lowers the turbidity temperature by 2·33°, and this correction might be applied to get the "constant" of the acid-free oil. If we make these allowances for the other three olive oils on the table, we find the corrected temperatures would be 97, 90, and 94° respectively, when the strongest acetic acid is employed.

The influence of the free acids contained in arachis and linseed oils would appear to be much greater, and those of rape oil considerably less, than those in olive oil. Thus each class of oil would require a special correction for free fatty acids, and when we come to mixtures of oils their composition would actually require to be known before a correct turbidity temperature could be calculated. These facts alone are sufficient to show the hopeless unreliability of Valenta's test.

It is a noticeable fact that the statement generally made with regard to the insolubility of rape oil in glacial acetic acid is true only so far as the acid recommended by Valenta and the absolute acid of Oudemann's table are concerned. The highest strength of acid given on our table dissolves rape oil containing about 2½ per cent. of free acid at 110°, and would probably dissolve the acid-free oil at 115° or 116°.

It will also be seen from the table that a comparatively slight variation in the strength of the acetic acid contributes very seriously to the obtaining of discordant results. Thus a difference of 0·1 in the specific gravity means a variation of about 1·5° in the turbidity temperature; and one accustomed to taking specific gravities of strong acids knows well that the highest skill in manipulation is necessary to take densities within such close limits.

Taking all these facts into consideration, we are forced to the conclusion that Valenta's test is surrounded with too many conditions to be of any practical value in the general analysis of oils.

A few words of explanation must here be given with reference to the strengths of the acetic acid used in the above tests. The strongest acid (sp. gr. 1054·2) was purchased as pure glacial acetic acid, and we were much struck with the low specific gravity it showed as compared with the lowest (1055·3) for glacial acetic acid in Oudemann's table. The strength of this acid was determined by making several acidimetric titrations with caustic soda solution, which had been standardised against normal sulphuric acid. In every case phenolphthalein was employed as indicator, as it is the only one which gives a perfectly satisfactory end reaction with acetic acid. The normal sulphuric acid was in its turn carefully tested both by volumetric tests with pure sodium carbonate and gravimetric determinations as barium sulphate.

The other two acetic acids (sp. grs. 1055·2 and 1056·2) were prepared from the strongest one by mixing together known quantities of the acid and water. These also were titrated, and the results obtained agreed well with the proportions added together. The following are the average results of the various tests, most of which agreed exactly, while the others came within very narrow limits.

TABLE SHOWING STRENGTHS OF GLACIAL ACETIC ACID.

Specific Gravity of the Acid at 15° C. (Water at 15° = 1,000).	Per Cent. by Weight of Real Acetic Acid ($C_2H_4O_2$).
1054·2	99·1
1055·2	98·5
1056·2	97·9

It may be mentioned that the specific gravities at 15·5° were exactly the same as these. From these results it is apparent that chemically pure acetic acid will possess a specific gravity of about 1,053, and that what we now look upon as glacial acetic acid actually contains 1½ per cent. of water. Applying the well-known tests for water in glacial acetic acid, we found that the first-mentioned acid in the foregoing table is very easily miscible with an equal volume

TABLE OF CONSTANTS, &c. USED IN THE ANALYSIS OF OILS.

Nature of Oil.	Colour of Oil.	Iodine Absorption.	KOH neutralised.	Unsaponifiable Matter.	Specific Gravity at 15·5° C. (Water at 15·5 = 1,000).	Specific Temperature Reaction (Water = 100).	Free (Oleic) Acid.
		Per Cent.	Per Cent.	Per Cent.			Per Cent.
Olive (Candia)	Dark yellow	81·5	18·90	1·05	916·0	92	7·48
„ (Gioja)	Green	79·0	19·07	1·05	915·6	89	9·42
„ (Gioja freed from acid)	Green	79·0	19·07	.. ..	915·2	.. ..	None
„ (Levant)	Yellow	82·2	19·02	1·13	917·1	90	3·86
„ (Malaga)	Dark yellow	85·0	18·80	1·04	916·5	94	4·46
„ (Mogadore)	Yellow	86·9	18·91	1·14	916·9	93	6·03
„ (Mitylene)	Yellow	83·6	18·95	1·17	916·4	92	10·38
„ (Syrian)	Greenish-yellow	83·0	18·95	1·42	914·1	92	23·88
„ (for dyeing)	Pale green	78·9	19·00	1·16	915·4	Too much changed.	9·67
„ (for cooking)	Yellow	83·1	19·20	1·39	915·1	92	4·15
„	Yellow	83·1	19·09	1·17	916·8	94	5·19
„	Yellow	86·4	18·90	1·10	914·5	94	11·28
„	Greenish-yellow	88·2	18·93	1·30	914·8	95	3·86
Cotton-seed (crude Egyptian)	Dark red brown	109·0	19·09	1·12	927·4	163	2·53
„ (refined Egyptian)	Yellow	108·3	19·16	1·07	922·2	170	·12
„ (refined)	Yellow	106·8	19·35	1·07	922·5	169	·27
Rape or colza	Pale yellow	99·1	17·34	·62	913·8	127	2·88
„ „	Yellow	100·5	17·39	·65	911·1	135	4·54
„ „	Yellow	104·1	17·06	·63	914·5	141	2·53
„ „	Yellow	105·6	17·53	·70	916·8	133	2·43
„ „	Yellow	100·1	17·25	·58	916·2	125	6·24
Arachis (commercial)	Yellow	98·7	19·21	·94	920·9	137	6·20
„ (French refined)	almost colourless.	98·4	18·93	·54	917·1	105	·62
Linseed (Baltic)	Yellowish-brown	187·7	19·28	1·28	931·5	349	3·74
„ (East India)	Yellow	178·8	19·28	1·09	931·5	320	·79
„ (River Plate)	Yellow	175·5	19·07	1·20	932·5	320	1·21
„	Yellow	173·5	19·00	1·06	932·5	270	·76
Castor (commercial)	Very pale yellow	83·6	18·02	·37	967·9	89	2·16
„ „	Very pale yellow	83·9	17·86	·30	965·3	92	1·40
Southern sperm	Dark yellow	81·3	13·25	37·41	880·8	100	2·64
Arctic sperm (bottle-nose)	Yellow	82·1	13·04	36·32	879·9	93	1·97
Whale (pale)	Yellow	110·1	18·88	1·82	919·3	157	1·22
Seal (cold-drawn pale)	Pale yellow	145·8	19·28	·50	926·1	225	1·80
„ (steamed, pale)	Pale yellow	142·2	18·93	·38	924·4	212	1·46
„ (tinged)	Brown	142·4	19·07	·42	925·7	220	8·20
„ (Norwegian)	Dark yellow	132·1	19·16	·51	925·8	223	7·33
Cod (Newfoundland)	Red-brown	160·0	18·82	1·50	924·9	243	23·31
„ (Scotch)	Brown	158·7	18·52	1·87	925·0	240	9·73
„ (medicinal)	Yellow	166·6	18·51	·87	926·5	272	0·36
Menhaden	Brown	160·0	18·93	1·60	931·1	306	7·57
Mineral	Yellow	12·8	None	100·0	873·6	..	None
„	Brown	26·1	None	100·0	880·0	..	None
„ (Russian)	Yellow	8·7	None	100·0	905·5	..	None
Rosin oil	Yellow	67·9	..	..	986·0	..	..

of carbon bisulphide; the second requires a little more warmth of the hand to thoroughly clear it; while the third remains slightly opalescent, unless a higher heat than that of the hand is applied. The first and second acids on the table are miscible with as much as 15 times their volume of turpentine (and probably with much more), but the third shows distinct opalescence when mixed with four times its volume of that reagent. Thus the carbon bisulphide and turpentine tests, if applied as described, can only detect the presence of two or more per cent. of water in acetic acid.

We have not yet made any systematic experiments with the colour tests for oils, but a few were made with Pattinson's modification of Bechi's nitrate of silver test for cotton-seed oil. The rape oils in the table all give a more or less darkening of colour, but the olive and arachis oils are not affected. Too much dependence is often placed on these tests generally, and a thorough revision is required in order to determine their exact value, and under what circumstances they are valid and not open to objection.

Discussion.

The Chairman said that Messrs. Thomson and Ballantyne had gone into the subject with their usual accuracy. He thought they had shown the great difficulty there still was in finding a really good test to distinguish a certain oil in the presence of another.

Dr. G. G. Henderson said that this was one of those papers which one could not discuss on merely hearing it read, while at the same time it was a paper of the utmost value to all interested in the examination of oils, and this for two reasons, firstly, because it put aside misconceptions, and secondly, because it gave positive information on different points. His object in rising was not to criticise the paper, but simply to say a word in praise of the very ingenious modifications in Maumené's test, which had been shown. It had always seemed to him that this test was in an unsatisfactory condition, as one could easily see from the second table, where it was shown that a very small difference in the strength of the sulphuric acid made a large difference in the rise of temperature.

Mr. J. Pattison said he should like to ask if Mr. Thomson could give any explanation of the variation in the iodine absorptions of the linseed oil. Were these entirely different kinds of linseed oil? Also the variation in the iodine absorption in the mineral oil seemed to be very great. Were these oils obtained from different sources, and were their gravities different?

Mr. R. T. Thomson, in reply, said that the modifications in Maumene's test of which he spoke were due to Mr. Ballantyne. With reference to Mr. Pattison's remarks the variation of the linseed oils was very great. They had some pure oils lower indeed than 173 in iodine absorption. He might mention that the highest one, 187·7, was Baltic oil, the 178·8 was East Indian oil, the 175·5 was River Plate oil, and of the lowest one he did not know the source. With regard to the mineral oils the gravities varied pretty much as shown in the table. The one with 8·7 of iodine absorption was a Russian oil, the one with 26·1 was a Scotch mineral oil, and of the third with 12·8 he did not know the source.

Meeting held in the Philosophical Institution, Edinburgh, on Tuesday, February 3rd, 1891.

DR. J. B. READMAN IN THE CHAIR.

ON THE CORROSION OF IRON.

BY ROBERT IRVINE, F.C.S., F.R.S.E.

This may well be called the "Iron Age," for it would be as difficult to point to any structure or mechanical appliance from which iron is absent as it would be tedious to enumerate the multitudinous uses in which it is employed at the present day.

In olden times it was valued above gold and silver. At the present time its initial value is a mere trifle (even in its purer forms), but its true value lies in its almost universal adaptability.

The subject, therefore, of its corrosion is of such vast importance that I have gathered together a few "*out of the common*" instances of the destruction of its useful properties.

The processes of smelting deprives the ore of the oxygen and other bodies with which the iron is combined, and at the same time adds to it impurities which make it less able to withstand corrosion, subsequent fusion with basic bodies and air being necessary to deprive it of these impurities. Curiously enough cast iron is less subject to oxidation than the purified wrought iron or steel. This is in part due to the silicious skin formed by the combination of the molten iron with the sand of the mould.

Their comparative liability to oxidation according to Mallet is as follows:—

Cast iron	100
Wrought iron	129
Steel	133

According to Gmelin the purest iron rusts most quickly, and the presence of sulphur and iron accelerates the rusting, whilst phosphorus seems to retard it. It is only when exposed to damp air containing carbonic acid that rusting or oxidation takes place, due, according to Calvert's observation, to galvanic action, protoxide, and subsequently carbonate of the proxtoxide, being formed, which in turn is changed to sesquioxide by the absorption of oxygen; ammonia being at the same time formed from the nascent hydrogen of the decomposed water and the nitrogen of the air.

A second form of corrosion is familiar to us when iron is exposed to the smoke of cities containing a large proportion of sulphurous and carbonic acids, which, forming soluble salts with the iron, are removed by water. Sea-water, on account of the quantity of magnesium salts and carbonic acid present, has a powerful solvent action on cast and wrought iron. Besides this, when iron is exposed to the action of sea-water in the presence of dead or decomposing organic matter, owing to its well-known action in the deoxidation of alkaline and earthy sulphates—

$$MSO_4 + 2\,C = 2\,CO_2 + MS$$
$$MS + CO_2 + H_2O = M_2CO_3 + H_2S,$$

sulphide of iron is produced. A familiar example of this process occurs in the muds of tidal rivers and harbours, the iron present in the clay combining with the liberated sulphur to form sulphide of iron, and we may assume from this source most of the iron pyrites deposits take their origin.

A typical instance of this kind of corrosion came under my notice when removing an iron chain which had been used as a mooring in sea-water. When taken from the water it was thickly coated with living and dead animals. The sulphur from the deoxidised sulphates had combined with the metallic iron to form a skin fully an eighth part of an inch in thickness, and the chain was correspondingly weakened to this extent.

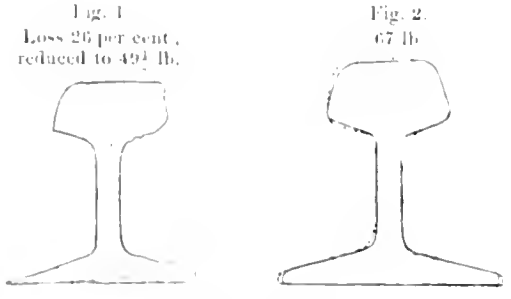
Of another form of the corrosion of iron, evidently due to galvanic action set up between two forms of the same metal, we have many instances. In one case the pans in which crude saltpetre was dissolved were made of cast, whilst the steam pipes and stirrers were made of wrought iron. The cast iron was unaffected, but in a short time it was found the wrought-iron fittings had become so corroded or wasted away that they had to be replaced. On cast-iron pipes and fittings being substituted the corrosion ceased.

Again, wrought-iron boilers in combination with cast-iron pipes, are used for heating purposes. The boiler is rapidly wasted away and rendered useless. In the same manner the cast-iron fittings of the steam boiler tend to corrode the portion of the malleable iron upon which they are fixed.

In the fitting of propellers for steam vessels the former are usually made of cast, and the tunnel shaft of malleable iron. After a time the propeller becomes loose on account of the combination of the two unlike metals causing corrosion of the same nature.

When malleable iron rails are fixed in iron sleepers, as on our railways, the corrosion of the weaker metal is very apparent. The serious nature of this action is exemplified in the following extract from *Engineering* of December 1890:—

"An important fact in regard to the wear of railway rails is notified, and illustrated in the last number of the *Engineer*. Two sections of the same rail are given showing the comparative wear of the rail, in a period of seven years, in a tunnel, and on the open railway. The difference is very remarkable. The rail laid in the tunnel has lost nearly half the area of the lower flange, the rounded extremities are pared down to knife edges, and about one quarter of the area of the upper flange is eaten away, more on one side than the other, leaving an irregular-shaped mass. This alarming increased wear and disintegration in the tunnel is, of course, due to atmospheric causes; but in this case is taken as establishing the general tendency of rails to behave in this way in tunnels, it is a fact of serious importance in regard to the laying and maintenance of tunnel roads. A tunnel is exactly the place where one may suppose that a defective condition of the rails might most easily escape observation; yet it appears that this is where it is most likely to occur within a given space of time."



67-LB. RAILS.

Fig. 1.—Laid in tunnel six years
Fig. 2.—Laid outside tunnel six years } Both exposed to same traffic, wear, and tear

Musconetcong tunnel, Lehigh Valley Railway, nr. New York.

From *Engineer*, 1890, p. 539.

The "atmospheric causes" here clearly point to this example of corrosion as of the same category as those already mentioned.

In connexion with this subject it is abundantly manifest that the use of two dissimilar forms or kinds of iron becomes a source of danger and loss.

If plates of cast and malleable iron are placed in water, and wires from each connected with a galvanometer, deflection of the needle at once takes place, whilst if both plates be either of cast or malleable iron no galvanic action ensues.

It naturally follows that any structure if it is to be free from the danger I have referred to should be composed of the same variety of iron; and, by observing this matter (although a very simple rule), the constructors of the Forth Bridge, where mild steel was used throughout in its construction, have doubtless avoided the mistake made in the construction of the old Tay Bridge, which was a combination of cast and malleable iron, neither being of very good quality. After its destruction, the commission appointed by Government to inquire into the cause of its collapse found that the rivets of the malleable iron portion had become loosened, and the evidence all pointed in the direction that this bridge was so constructed that it formed a huge galvanic circle in which the malleable iron was weakened beyond the point of stability.

The universal use of paint in the preservation of such structures is well known, but I consider the use of all metallic pigments has a tendency, wherever the iron is not thoroughly covered, to provoke the danger they are intended to remedy.

A varnish such as boiled linseed oil alone, which, on exposure to air, dries up into a tenacious elastic coating, seems to me to be the proper material to be used for the protection of iron structures.

Discussion.

Mr. D. B. Dott said that, for the protection of iron, he thought that turpentine was coming to be recognised as the best material for the first coating, which should be followed up with a drying oil.

The Chairman said he was glad to learn that steam boilers should be made entirely of the one material; viz., malleable iron. He had noticed that in the blow-off pipe of a steam boiler that the cast-iron pipe, which was connected with the malleable iron boiler, was very often corroded. It was also interesting to see the sketch of the rails that had been submitted, showing the marked difference in the wear and tear of the rails inside and outside of the tunnel.

Journal and Patent* Literature.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

On the Corrosion of Iron. R. Irvine.

See pages 237—238.

The Purification of Water for Industrial Purposes. M. Zabrowski. Bulletin des Fabricants de Papier and Chem. Trades J. **8**, 39.

The author publishes two new methods for the softening of water, which are stated to give satisfactory results.

In the first process, hydrated baryta is placed in a filter press which is traversed by the water to be purified and produces an effluent, showing only 1 or 2° of hardness. Hydrated baryta, which is now largely used in sugar

* Any of these specifications may be obtained by post, by remitting the cost price, *plus* postage, to Mr. H. Reader Lack, Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C. The amount of postage may be calculated as follows:—

If the price does not exceed 8*d.*	½*d.*
Above 8*d.*, and not exceeding 1*s.* 6*d.*	1*d.*
„ 1*s.* 6*d.*, „ „ 2*s.* 4*d.*	1½*d.*
„ 2*s.* 4*d.*, „ „ 3*s.* 4*d.*	2*d.*

refining and is easy to procure, precipitates all the bases, lime, magnesia, &c., as well as the sulphuric and carbonic acid, so that the carbonates and sulphates of lime and magnesia, which are the most harmful substances, are precipitated by one treatment.

According to the other process, hydrated oxide of lead is employed instead of baryta and precipitates the carbonates, sulphates, and chlorides. It is necessary to obtain the hydrated oxide of lead cheaply, and the following ingenious method has been devised by Villon for this purpose.

A solution of sodium nitrate is placed in a vat, divided into two compartments by a diaphragm; lead electrodes of large surface are placed in the solution and the current from a dynamo then passed through. The sodium nitrate is decomposed, caustic soda being formed in the negative compartment and nitric acid at the positive pole, from which it dissolves a certain quantity of lead, forming lead nitrate. When the current has passed through the liquid for a certain time, the solutions are run from the two compartments into a second vat and there mixed by means of an agitator. The soda precipitates hydrated oxide of lead and itself forms sodium nitrate; the solution is then filtered and the nitrate solution again submitted to electrolysis. When the baryta or lead oxide is used up, it is replaced by freshly prepared oxides.

The purification by barytes is more perfect than that by lead oxide. According to Villon, the use of the filter press can be avoided by employing plumbate of sodium (a solution of lead oxide in caustic soda). The precipitate is simply allowed to settle out, and the water obtained shows a hardness of about 2° or 3°.

PATENTS.

Improvements in Apparatus for Concentrating Solutions, Drying Substances, and like purposes. D. Herman, St. Helens. Eng. Pat. 20,049, December 13, 1889. 6*d*.

A CIRCULAR pan has flanges which dip down into the liquid, gaseous pressure being used beneath it to carry the main weight of it, the residual weight being carried by rollers or other device. The pan is caused to rotate by any convenient means, and is enclosed in a furnace, in which heated gases and products of combustion, preferably from gaseous fuel, pass over the pan. The furnace is so constructed that a portion of the pan projects beyond the walls, in order that access can be obtained to every portion of it during its rotation. Scrapers are used for moving solid matter from the centre towards the circumference.—E. S.

Improvements in Furnaces for Burning Tan and other Refuse Material. C. A. Brown, Exeter. Eng. Pat. 1170, January 22, 1890. 6*d*.

VERTICAL pockets or chambers are made in the side walls of a furnace and filled with tannin refuse. By means of a weighted cover placed upon the top the material is pressed down and continuously fed into the bottom of the furnace.

Two or more furnaces may be built side by side so that the pockets may discharge into two adjacent furnaces, in which case a larger pocket must be used.—D. A. S.

Improvements in or Connected with Apparatus for Filtering Liquids. A. Capillery, Vigan, France. Eng. Pat. 1307, January 24, 1890. 1*s*. 1*d*.

THIS invention relates principally to the shape and arrangement of the channels on plates for filtering presses, set out with a view to provide for the proper distribution of the liquid over the whole filtering surface. It refers to several ways of grouping and holding the plates together, and also gives various designs for grids to be placed between the filtering cloths, one of which is indicated in the accompanying figure:—

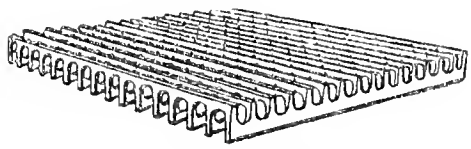


PLATE FOR FILTER PRESS.

When the plates are placed in position, with the necessary filtering cloth between, and tightened up by a screw or screws, their circumferences may either form a continuous closed receptacle for the retention of the liquor, or they may be of a construction to require insertion into another closed vessel. There are seven claims and three sheets of drawings.—B.

Improvements in Apparatus for Separating Liquids from Solids. H. W. Deacon and V. C. Driffield, Widnes. Eng. Pat. 1948, February 5, 1890. 6*d*.

A VESSEL in the form of a perforated truncated cone has its larger end downwards. The upper end is closed by a cover, preferably dished, and securely attached to the cone. The lower end is closed by a cover, also dished, and of such a size as to leave the full area of the cone so as not to impede the discharge, by gravitation, of the solid filtered material when the cover is removed. This cover, as well as the vessel, is lined with filtering medium. The material to be treated, in the form of a mixture of solid and liquid, is admitted through a pipe, which passes through the upper cover, until the desired pressure is attained. This pipe is perforated and extends nearly to the bottom of the vessel, and at a subsequent part of the process can be used as a syphon to withdraw a certain amount of unfiltered liquid, and thus loosen the solid material from the walls of the vessel. The solid material is discharged by the removal of the lower cover, and should it fail to fall out, steam, admitted through a small pipe passing through the upper cover, hastens the discharge. The filtered liquid may be collected in a moveable tray placed under the conical vessel.—E. S.

Improvements in the Treatment of Solutions or Liquids for the Purpose of Concentration or Evaporation, and in Apparatus therefor. A. Fryer, Wilmslow. Eng. Pat. 2427, February 14, 1890. 8*d*.

THE inventor constructs apparatus for evaporating or concentrating liquids at low temperatures, by employing a conical metal dish, very shallow, and fitted with a slight rim all round the edge. The dish is secured with its centre to a spindle placed at a slight angle with the perpendicular, from which it deviates to the extent of the angles formed by the sides of the cone, so that, thereby, one of those sides is made to assume the horizontal position. Into the small cavity formed by the horizontal segment of the dish and by part of the projecting rim, the concentrating liquor is fed, whilst heat is at the same time applied underneath that part. On the rotation of the spindle with the dish, the inner surface of the cone takes up a thin film of the liquid and carries it all round the circle for the purpose of evaporation, which is further assisted by the action of air fans. A renewed film is carried off with every revolution, and the continuous withdrawal of the surface of the cone from the neighbourhood of the source of heat conduces to evaporation at low temperature, and prevents damage to delicate substances through excess of heat. The dish may receive heat at several points, and this, combined with regulation of the speed and of the supply of liquor and air, admits of very accurate adjustment to the required temperature. There are two drawings and four claims.—B.

Improvements in Centrifugal Machines. J. Imray, London. From "La Société Nouvelle des Raffineries de Sucre de Saint Louis," Marseilles, France. Eng. Pat. 2774, February 20, 1890. 8*d*.

This invention relates to centrifugal machines employed in treating sugar or other substances, and is specially adapted for continuous working by causing the filtering surface to travel along with the material which is pressed against it, and which is thus kept continuously cleared from obstructions; this renders the machine more effective, as well as uniform in action. A revolving drum is divided into six compartments, each in the form of the sector of a circle. At its outer or widest part, two horizontal rollers are mounted, one at the top, the other at the bottom, and around them passes a web of filtering fabric, which is supported against the centrifugal force by vertical rods. The two rollers being moved by suitable gearing, the inner surface of the filtering fabric is caused to travel upwards, and in so doing it receives at its lower part the water for washing; the central portion receives the material to be filtered, whilst steam is received at its upper part. As the inner surface ascends, it carries the material with it and discharges the liquid into a compartment between the rollers. As the outer surface travels downwards the solid material it carries is thrown by centrifugal action into the stationary case and discharged. A brush near the lower roller clears the filtering fabric before it re-ascends.—E. S.

Improvements in and relating to Evaporating Apparatus. R. Harvey, Glasgow. Eng. Pat. 3907, March 12, 1890. 8*d*.

This invention relates to the shape and position of steam and vapour inlets, and to the use of deflecting plates in tubular upright multiple-effect evaporating apparatus, and can be made clear only in connexion with the drawings and description of the specification.—B.

Improved Apparatus for Separating Liquids or Solids from Vapours or Gases in which they are Suspended. E. Jones, Leeds. Eng. Pat. 4594, March 24, 1890. 6*d*.

This invention is intended to produce the effect known as "drying steam," but can be applied generally to the separation of liquids or solids from vapours or gases in which they may be suspended.

The apparatus consists of a chamber, preferably square in cross section, in which are two series of inclined, transverse parallel blades or deflectors arranged intermediately at a certain distance apart, and forming a sinuous course for the steam. The wet steam enters the separator with a certain velocity, and striking against the blades, causes the watery particles to be deflected and run out through suitable openings in the lower series of blades. This action being repeated at each blade the steam is sufficiently deprived of its moisture.—E. S.

Apparatus for Drying Sugar or Like Substances. R. Pzillas, Brieg, Germany. Eng. Pat. 10,893, July 12, 1890. 6*d*.

See under XVI., *page* 264.

Improvements in or appertaining to Mercurial Pumps. W. P. Thompson, Liverpool. From Dr. A. Raps, Berlin, Germany. Eng. Pat. 14,807, July 28, 1890. 8*d*.

This invention has partly for its object an apparatus for automatically working mercurial pumps of any kind. It is here described as applied to Töpler's air pump. The apparatus consists of a mercury reservoir connected with the pump by a flexible tube, and by a second tube from its upper part, with a three-way cock, connected with a pressure conduit or with the atmosphere. The mercury reservoir rests on one side of a balanced lever working on a pivot, the other side carrying a short lever connected with the three-way cock, and also a counterbalance weight automatically adjusted to slide between two collars, according to the larger or smaller amount of mercury in the reservoir, which is thus brought alternately in connexion with the pressure conduit or the atmosphere. In the former case, the mercury is forced into the pump, and in the latter, the compressed air being allowed to escape, the mercury falls back to the reservoir by its own weight.—E. S.

Improvements in Distilling and Condensing Apparatus. H. H. Lake, London. From E. Bolton, Cincinnati, U.S.A. Eng. Pat. 17,718, November 4, 1890. 8*d*.

This invention comprises a combined distilling column and condenser, having an unusually large cooling surface for the vapour to come in contact with, formed by a series of coils preferably arranged one above the other. For most purposes three series are found to be sufficient. The coils of each series are connected alternately at their outer and inner ends, the upper coil of each being provided with an independent inlet for cold water, and each lower coil with an outlet for the hot water, and communicating with a common elevated receptacle. The vapour escaping from the still passes successively through the three series, and escapes through an outlet deprived of most of its heat and impurities. For fuller details of the construction and working of the apparatus the specification must be consulted.—E. S.

Improvements in or Appertaining to Liquid Strainers. J. McEwen, Manchester. Eng. Pat 17,984, November 8, 1890. 6*d*.

The improvement consists in employing the sponge, or other elastic material used as a strainer, as a ready and efficient means for regulating the speed of filtration. This is done by compressing the sponge, or releasing it, by means of an external screw acting on a loose plate inside the strainer. The screw apparatus being supported by clips on lugs on the outside of the case, can be readily removed when the pressure is withdrawn, and the sponge or other material can be removed for cleaning or renewal.—E. S.

An Improved Compound for Preventing and Removing Incrustation in Steam Boilers. J. L. Wade, London. Eng. Pat. 18,451, November 15, 1890. 4*d*.

Caustic potash and esparto grass are boiled in water until the grass is reduced to a pulp, when finely-powdered sumac is added, and the whole further boiled until converted into a homogeneous mass. To this is then added (each being in solution) potassium carbonate, potassium chloride, sodium silicate, Irish moss, and, lastly, creosote and green mineral oils. These being added, the mixture is converted into a pasty mass, and according to the variation in the composition will either solidify or remain semi-fluid on cooling. The quantities of the various ingredients vary according to the quantity and nature of the scale-forming impurities in the water and on the condition of the boiler.—E. S.

Improvements in Continuous Evaporating Apparatus. O. Schulz, Brieg, Germany. Eng. Pat. 18,751, November 20, 1890. 6*d*.

A case, provided with dome, gauge, and other suitable fittings, encloses the evaporating pans, placed one above another, and with their ends arranged alternately, and mounted on rollers. Angle-iron rims are secured to the pans and hold between them and the upper flanges of the pans, corrugated plates, by their edges, and slightly inclined to facilitate the flow of the liquid. The liquid to be evaporated is led by a pipe to the higher part of the corrugated plates, and flows through a passage at the lower end of the pan into the one below, and so through the series to

an outlet, being heated as it passes over the pans by steam admitted to them below the corrugated plates. One wall of the casing may be made removable for convenience in removing the pans, cleaning, &c.—E. S.

Improved Methods of and Apparatus for Evaporating and Concentrating Solutions. J. A. Morrell, Lansdale, Penn., U.S.A. Eng. Pat. 19,110, November 25, 1890. 8*d*.

The inventor proposes to evaporate concentrating solutions that have hitherto been treated at low temperatures by exposing them to high temperatures, but so rapidly as to prevent any injury to the matter which is to be recovered from the liquid. The accompanying diagrams indicate one of the arrangements as proposed for saccharine matter.

Fig. 1.

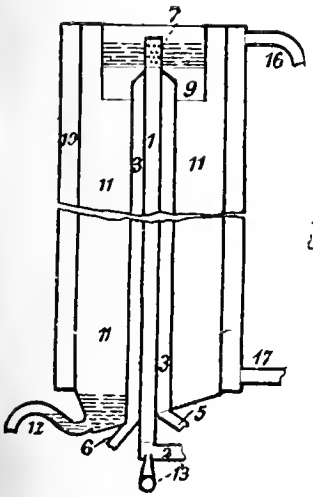
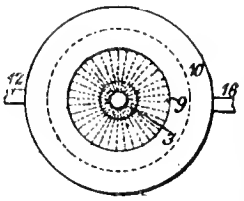


Fig. 2.



Apparatus for Evaporation and Concentration.

The tube (1) is closed at the upper end except for a number of small perforations (7) just under the head. The heated solution enters at (2) and issues through the perforations under pressure. The jets impinge against a circular screen (9), and are atomised. The superheated steam jacket (3), with inlet and outlet (5) and (6), surrounds pipe (1), and heats the liquid therein to above the normal boiling temperature, whilst the whole is enclosed in the chamber (11) surrounded by the steam-jacket (10) with inlet and outlet (16) and (17), which is kept at a still greater heat. The concentrated fluid or granulated matter which has been thrown down from the screen is withdrawn from the conical bottom through the outlet (12), and the fluid may be re-introduced for further manipulation. Heated and compressed air and gases may be introduced through (13) at the bottom of pipe (1) to aid in the dispersion of the liquid at the upper end, and the resulting vapours may be withdrawn in any desired way. The drawings show four different arrangements of apparatus in connexion with saccharine matter, milk, &c., and there are eight claims.—B.

Improvements in Vulcanisers. J. H. Gartrell, Penzance, and F. Knoeferl, London. Eng. Pat. 20,005, December 8, 1890. 6*d*.

The invention relates to improvements in dental vulcanisers in which a copper or other vessel is closed by a steam-tight lid. The vulcaniser is constructed of hammered or rolled copper in one piece throughout, and is preferably cylindrical. The top is thickened to form a shoulder, and has lugs to carry the lid. The lid is made of gun-metal or other suitable material. The drawing attached to the specification shows two methods of fixing the lid. In one it is attached to lugs on the vessel by means of a hinge, and is tightly clamped down in position by a screw passing through a moveable bow fixed on opposite sides of the vulcaniser. In the second the lid is secured by two bent clamping levers working on other lugs on opposite sides of the vessel, and which when brought into position over the lid are kept there by a screwed collar worked by a handle. The lid is hinged to one of the clamping levers.—E. S.

II.—FUEL, GAS, AND LIGHT.

On Standard Sperm Candles. W. C. Young.
See pages 185—191.

Incandescent Gas Lighting. W. Mackeau.
See pages 196—199.

Coal Separating and Washing Plant. Engineering, 1890, **51**, 184—185, and Engineer, 1890, **71**, 171.

The increasing scarcity of good coal-beds in this country has rendered it necessary to consider the question of profitably working inferior or dirty seams of coal. A method, therefore, which would offer the advantage of freeing the coal from heavy and deleterious impurities, and at the same time practically avoiding all waste of coal, ought to merit attention.

Such a process is that devised by Lührig, which is carried out on the pit-bank, and consists of two distinct operations, carried out in (1st) a dry separation plant, and (2nd) a washing plant, where everything from nuts to the finest smudge is automatically operated upon.

The tubs on leaving the cars travel along a platform, and by means of tumblers discharge their contents on to jigger screens, where the large coal gravitates to picking tables or bands, while the small coal drops through into a storage bunker underneath, which is in communication with the washery. The larger pieces of shale or stone and intergrown coal are separated by hand on these picking tables, the stones being thrown into shoots leading to the waste heap, while the dirty pieces of coal are thrown by shoots to a coal-breaker, where they are broken up, the shale and brassy pieces being thereby detached from the fragments of coal, which latter are delivered to the storage bunker. The small coal from the storage bunker is raised by an elevator to the top of the building, where it is sorted in a revolving drum or screen into four different sizes, viz., nuts, beans, peas, and dust; this preliminary sizing greatly facilitates the subsequent washing.

The different sizes over $\frac{5}{16}$ in. pass through spouts into separate washing jiggers, which are specially designed to deal effectively with large quantities and with the pieces of coal intergrown with shale. To win all this coal, these nut washers separate, by means of their specific gravity, the several sizes of nuts into three classes; 1st, clean washed nut coal; 2nd, coal intergrown with shale or brasses, &c.; and, 3rd, "clean dirt." The clean nut and pea coal is delivered over drainers into hoppers ready to be loaded into waggons. The intergrown coal is conveyed by a worm to an elevator to be lifted and further broken up by a roller mill provided with rollers 16 in. wide and 29½ in. in diameter. The broken product is rewashed on one of the nut jiggers and a clean coal obtained from it, the refuse passing to the pit.

The fine coal under $\frac{5}{16}$-in. size from the revolving screen passes, along with the overflow water from the nut-coal jiggers into a grader consisting of a series of pyramid-shaped boxes in which the current of water deposits the coal in different sizes according to its gradually decreasing velocity. These boxes supply through apertures in the bottoms of the pyramids the fine-coal jiggers which are provided with felspar beds through which the dirt settles to the bottom of the machine to be thence delivered to the refuse pit.

The clean coal from all the fine-coal jiggers is carried with the overflowing water from these machines to a small

draining drum, made of copper sheets with very small holes, which separates the pearl coal from the finest coal, the pearls being raised to a hopper for fine coal while the finest coal passes along with the dirty water into a sludge recovery apparatus, which is a very notable feature in this process. The apparatus consists of a travelling creeper which slowly works in a long pit extending underneath the fine-coal jigger floor and on which the finest coal dust continuously collects and is removed by an elevator to a suitable hopper while the water overflows at the further end of the sludge pit into the clear-water tank to be again used for washing along with a small supply of fresh water.

Modifications of the above process are arranged for producing coal for special purposes, viz., coke making, &c., and from various classes and mixtures. The loss of pure coal in the refuse varies from ¼ per cent. to 1 per cent.

—O. H.

PATENTS.

Improvements in the Production of Coke for Foundry and other Purposes. F. A. Jones, St. Albans. Eng. Pat. 11,920, July 26, 1889. 8*d*.

This invention is intended to produce from a comparatively poor coal a higher percentage of hard coke capable of bearing the burden in a blast furnace, than can be obtained in an ordinary beehive oven. The coking operation is effected by passing hot gaseous products of combustion over the charge of coal, forming a hard skin on the coke and serving to expel and carry off the sulphur and other products immediately there generated instead of permitting them to remain and become reabsorbed by the coke.

The coking chamber has, preferably, an inclined floor leading down to a door in front by which the coke may be withdrawn in a solid block. By this process coking can be effected at a lower temperature.—D. A. S.

Improvement in Burners or Apparatus for Burning Petroleum or other Oils or Volatilizable Fluids. H. Lindley and I. Browett, Salford. Eng. Pat. 11,226, July 12, 1889. 8*d*.

This is a Bunsen burner or apparatus for burning heavy oils so as to avoid the use of wicks and obtain a smokeless flame. The gas is caused to issue in jet like form, and carries with it air for combustion, the air and gas being previously intimately mixed and warmed. The gas generator which is also described consists of a coil of wrought iron pipe.—D. A. S.

Improvements in Method for Effecting the Operations Involved in the Production of the Gas technically known as Water Gas, and the Apparatus therefor. B. H. Thwaite, Liverpool. Eng. Pat. 12,266, August 2, 1889. 11*d*.

By means of an automatic arrangement the periods of air blast, or steam and air supplied to fuel (for revivifying the fuel), and steam supply are controlled.

The water gas being forced into a holder raises it to a specific height, when by means of a projecting piece on the outside of the holder, a weighted lever is released, and falling down opens the air valves, closes the gas escape valve, and reverses the steam supply so that the latter sets in motion a Roots blower, or is turned into an aspirator or injects the air into and through the fuel. When the holder has descended a certain distance it commences to close the air valve and afterwards opens the steam and gas valves, and water gas is again produced raising the holder once more until it reaches a height sufficient to reverse the valve. In descending, a chain passing round the pulleys and attached to the holder and to a weighted lever opens the air, and also reverses the steam and gas supply. The air used is preferably superheated.

There is also a combined safety and reversal valve arrangement.—D. A. S.

Improvements in or connected with Apparatus for the Manufacture of Water-Gas, applicable for Gas Engines and other purposes. J. R. Paisley, Colnbrook. Eng. Pat. 15,797, October 8, 1889. 8*d*.

In this invention a producer is constructed of wrought iron or other suitable material lined with firebrick.

The openings by which the fuel is fed into the apparatus are closed by ball valves of sufficient weight to remain closed against the pressure of gas. Round the edge of the top of the producer there is a suitable water-tight flange for the purpose of retaining water to keep the top cool. Steam and air are forced in at the bottom, and the gas rises to the top and escapes through holes in such a way as to be led down through the outer part of the producer and become superheated, finally escaping through channels to the hydraulic main.

This superheating does away with the objection of excess of moisture, and further, an equable temperature is maintained by passing the gas through coils of pipe in a tank of water kept at an even temperature. By these means a gas of more uniform quality of gas is said to be produced.

—D. A. S.

Improvements in the Method of Generating Gas for Heating and other Purposes, and in the Apparatus used therefor. D. Dixon, London. Eng. Pat. 16,795, October 21, 1889. 8*d*.

This is an arrangement made by the combination of two gas producers, one working with up-draught and the other with down-draught, whereby the producer-gas obtained from the one can be caused to pass by means of a blast together with steam, through other fuel previously raised to incandescence in the adjoining producer. In this way, in addition to making water-gas by converting the steam into carbon monoxide and hydrogen, the incandescent fuel in the second chamber reduces the carbon dioxide which is always present in producer-gas into carbon monoxide, and converts the tarry and sooty hydrocarbons given off in the first chamber into permanent gases. A product is thus obtained having a higher percentage of heating material than ordinary producer-gas and free from tar and soot.

There are two sheets of drawings.—D. A. S.

Improvements in Coking, and in Coke Ovens and Plant connected therewith. T. D. Rock, London. Eng. Pat. 17,954, November 14, 1889. 8*d*.

This is an arrangement whereby any number of coking ovens or chambers are combined in a block in such a way that each oven or chamber with its flues, cooling chamber, &c. is entirely independent of any other, and can be put out of use for repairs without affecting the use of any other oven. Each oven is practically a gas retort, and the gases are removed either into a gas-holder or common supply pipe, and brought back for consumption at any one of the ovens.

To enable a start to be made, and in order to be able to regulate the temperature, one or more gas generators are also used.

Each charge is retained in a chamber adjoining the coking oven during the coking of the next charge, so that its waste heat may be utilised. The gases are moreover allowed to pass close to these cooling charges before combustion. It is claimed that the retention of the coke in this latter chamber from which air is excluded improves its condition.—D. A. S.

Improvements in Apparatus for Separating or Extracting Tar and other Impurities from Gas. Kirkham, Hulett, and Chandler, Limited, and J. Chandler, London. Eng. Pat. 18,831, November 23, 1889. 6*d*.

This is an upright scrubber with horizontal plates for washing gas. In each plate is formed a series of holes which on their lower sides are provided with nozzles or

extensions adapted to dip into cups or trays arranged on the plate beneath them, which cups or trays are designed to be filled with water or other purifying liquid. For further details the specification must be consulted.—D. A. S.

Improved Means and Appliances for the Production of Pure Carbonic Oxide Gas. T. Williams, London. Eng. Pat. 19,096, November 27, 1889. 8*d*.

See under XX., *page* 270.

Improvements in Closing Devices for Vessels containing Inflammable Liquids. F. Deimel, Berlin, Germany. Eng. Pat. 19,432, December 3, 1889. 6*d*.

This device is meant to prevent explosions of inflammable liquids even when poured from a vessel into a fire. The vessel is provided with a stopper of cork saturated with paraffin to prevent shrinkage. Through the centre of the stopper passes a tube which only extends into the neck of the vessel. The lower end is plugged with wire gauze. The part outside the cork is provided with a lateral curved tube. The upper end is closed, except that it allows of the passage of a second narrower tube, which also passes through the gauze plug and extends to the bottom of the vessel. At its lower end this second tube is slightly curved. The upper end rises higher than the spout and then curves back outside to below the lower end of the first tube. It terminates in a spherical head fitted with wire gauze.

—F. W. T. K.

An Improved Apparatus for Washing Gas. W. W. Horn, London. From C. W. Jarrell, Shelby, U.S.A. Eng. Pat. 788, January 15, 1890. 8*d*.

This is a scrubber for washing gas, having an inverted cup-shaped deflector above the inner end of the supply pipe. Circular inclined water shelves are arranged centrally within the vessel, one above another. Water is injected by means of spray pipes located above these shelves. The gas is thus caused to take a zigzag course in its passage upwards, and is washed by the spray.—D. A. S.

Improvements in Furnaces for Burning Tan and other Refuse Material. C. A. Brown, Exeter. Eng. Pat. 1170, January 22, 1890. 6*d*.

See under I., *page* 239.

Improved Method or Process for the Gasification of Fuels, and Apparatus therefor. W. L. Wise, London. From E. Solvay and L. Semet, Brussels, Belgium. Eng. Pat. 1349, January 25, 1890. 8*d*.

This gas generator is distinguished by having no grates which, however, are replaced by vertical walls along which the oxidation takes place. It has also a steam and air-superheating apparatus. The generator is shown in Figs. 1,

Fig. 1.

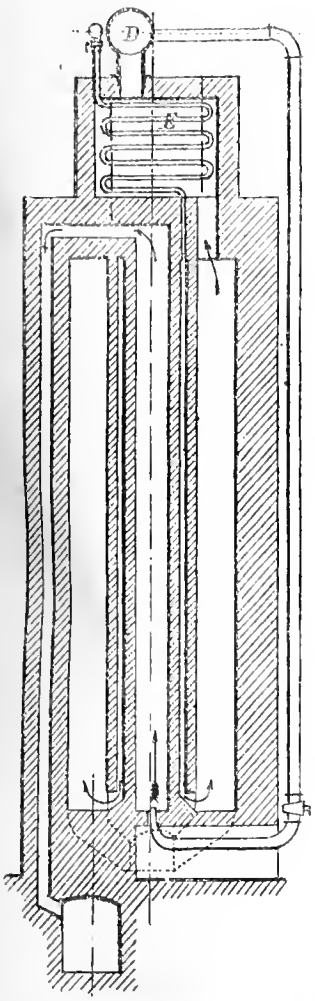


Fig. 3.

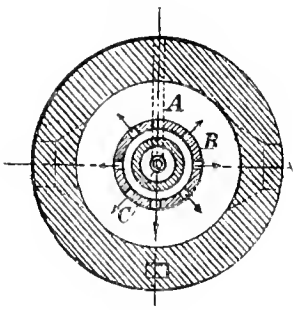
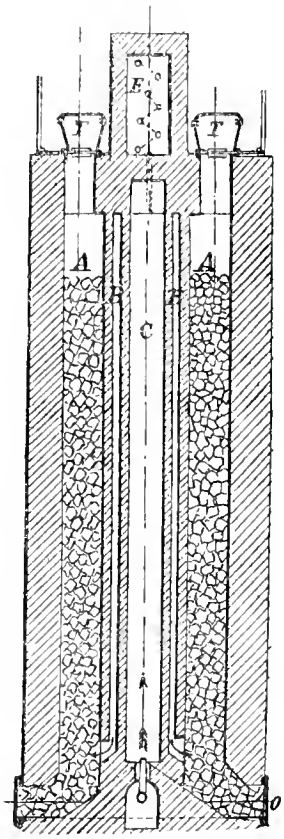


Fig. 2.



Apparatus for the Gasification of Fuels.

2 and 3, Figs. 1 and 2 being vertical sections at right angles to each other, and Fig. 3 a horizontal section of this arrangement. A is a chamber for the fuel to be gasified, which may be of annular or rectangular form. B shows the passages for steam or steam and air communicating with the lower end of the chamber A. C is the heating flue where part of the gases are burned with air to heat B. D is a pipe or collector for the gases produced. E is a coil for superheating the steam and air. The steam and air necessary for the gasification are caused to regenerate or absorb the heat carried off by the gases of distillation and combustion, and are then passed into the regenerator of the Ponsard or similar type, which is arranged as near as possible to the gas generator. The superheating is thus effected without additional cost, and the small quantity of air mixed with the steam is not sufficient to check the favourable part played by the steam in the production of ammonia, even at a high temperature. Thus solid fuels can be gasified into a cold rich gaseous product without any loss due to the conversion, and without cost, theoretically, for heating whilst producing a high yield of ammonia. The gases produced are capable of producing the highest temperatures and are not diluted with nitrogen like those from gas generators used with air alone.—D. A. S.

Improvements in the Construction of Apparatus for Generating and Burning the Vapours of Oil or other Combustible Liquids, and in the Arrangements of their Application to Lighting and Heating. B. J. B. Mills, London. From A. Seigle-Goujon, Lyons, France. Eng. Pat. 1883, February 4, 1890. 8*d*.

This invention relates to arrangements of apparatus for producing light and heat, which burn the vapours of combustible liquids and themselves generate these vapours as they are required.

For details the specification must be consulted.

—F. W. T. K.

Improvements in Apparatus for Heating Liquid and Gaseous Bodies. B. J. B. Mills, London. From A. Seigle-Goujon, Lyons, France. Eng. Pat. 2055, February 7, 1890. 8*d*.

The object of this invention is the intense heating of steam boilers or similar apparatus, and generally of liquid or gaseous bodies, without smoke by the use of Bunsen burners. Each burner is formed of a tube, trumpet-shaped at its entrance and contracted at its exit, and a number of them is so arranged that when placed one within the other without touching, to allow of the admission of air, they form a flue for the passage of the flame, which is supplied by a gas injector. The invention is adapted to the production of steam in ordinary and circulating generators. In the former the burners are simply placed in the middle of the liquid to be vaporised contained in an ordinary boiler; and in the latter the liquid to be vaporised circulates around the burners, which themselves form the generator. The modes by which this is effected is shown on the drawing accompanying the specification.—E. S.

Improvements in the Process of Treating Incandescents for Use with Gas Lamps or Burners. C. Dellwik, Hyde Park, Ill., U.S.A. Eng. Pat. 2110, February 8, 1890. 6*d*.

The luminosity of incandescent burners made of lime, alumina, magnesia, &c., is alleged to be increased by partially coating that part of the burner which usually becomes most intensely luminous with certain heavy metals of high conductivity, such as chromium, niobium, tungsten, cobalt, copper, platinum, or iridium, or with their oxides, or with mixtures of these oxides with certain substances which become highly luminous when incandescent such as the oxides of zirconium, yttrium, lanthanum, didymium, &c., or with the latter oxides alone. Coloured light may be obtained by the application of some of these oxides to the burner, the oxides of chromium, tungsten and cobalt giving a yellow shade, copper, platinum and iridium a red shade, didymium a green shade, and so forth. The burners are prepared by painting them with a solution of the selected oxide, drying and firing at a high temperature.—S. B. A. A.

Improvements in the Manufacture or Treatment of Gases containing Carbonic Oxide, such as Water-Gas and Producer-Gas, to render them Odorous. F. Scudder and H. G. Colman, London. Eng. Pat. 2341, February 13, 1890. 4*d*.

To render water-gas odorous it is proposed to add a volatile organic sulphide produced by acting on acetone with sulphuretted hydrogen in presence of a dehydrating agent such as hydrochloric acid, with or without zinc chloride. The moderate quantity of steam used to carry the sulphide to the gas to be impregnated is sufficient also to volatilise the sulphide.

The volatile organic sulphide (thio-acetone, or sulphurised acetone) above referred to can be prepared by mixing 5 parts by weight of acetone (boiling point 133°—137° F.) with 4 parts by weight of hydrochloric acid, sp. gr. 1·16, cooling the mixture to 60° F., and adding 1 part by weight of zinc chloride. This mixture, which should always be freshly prepared, is treated with sulphuretted hydrogen preferably in a series of vessels; if four vessels be used the first can be removed after the sulphuretted hydrogen has passed through for 8 or 10 hours, and a fresh vessel placed at the end of the series.

The resulting product contains an oil and an aqueous solution of which the former contains the larger quantity of thio-acetone. The oil can be drawn off or the raw mixture distilled in a current of steam at atmospheric pressure, the distillate being allowed to flow directly into an odourising reservoir.

The odour is perceptible and lasting and not liable to be lost, or appreciably diminished by condensation. The gas should be purified by hydrated iron to remove any free sulphuretted hydrogen.—D. A. S.

Improvements relating to the Carburetting or Enrichment of Coal and Other Gas, and to Apparatus therefor. H. S. Maxim, Crayford, and G. S. Sedgwick, London. Eng. Pat. 2559, February 17, 1890. 1*s*. 1*d*.

The main features of this invention are the following:—The gasoline, naphtha or other suitable hydrocarbon is admitted into the evaporating cylinder from a reservoir at a higher level by means of an automatic arrangement which only allows of the passage of the hydrocarbon when the evaporating cylinder has become and is being heated by the steam. The reservoir is kept supplied from a second one at a lower level by means of a pump. The hydrocarbon vapour is either forced directly into the main or into a branch which leads from and returns to the main by means of an injector. In the latter case the force with which the vapour escapes from the injector creates the necessary current of gas in the branch. The valve of the injector is combined with an index for showing to what extent the injector is open, and consequently to what degree the gas is being carburetted. Other means can be employed for drawing gas from the main, carburetting it, and again returning to the main. In all cases the hydrocarbon is volatilised.—F. W. T. K.

Improvements in Apparatus for Use in the Photometric Examination of Gases. W. Foster, London. Eng. Pat. 2671, February 19, 1890. 6*d*.

The gas enters a vertical tap or cock, the plug of which is fixed. A passage for the gas is made along the longitudinal axis of the plug, and this passage terminates laterally. A mass of metal carrying a number of arms can be rotated on this plug so that the passage in each arm can be successively brought into communication with the lateral

opening. When this is the case the particular arm lies in the direction of the photometer bar. The arms can be provided with different burners. When a flat flame burner is used, it is inserted into a special kind of tap at the end of the arm by means of which the supply of gas to the burner does not vary in quantity or pressure in whatever position the flame be viewed.

Two modifications of the apparatus are also given.

—F. W. T. K.

Improvements in Apparatus for the Production of Lighting Gas. H. L. Müller and W. Adkins, Birmingham. Eng. Pat. 4197, March 18, 1890. 8*d.*

This is an invention for charging gas machines using gasoline, whereby the same may be done continuously and the pressure be regulated. The arrangement is intended primarily for the "Alpha" apparatus, and consists of a rectangular pillar-shaped chamber which is partitioned off transversely by shelves which form a series of obstructing trays. Gasoline can be charged in at the top and flow as required into the gas machine at a uniform pressure.

Two sheets of drawings accompany the specification.

—D. A. S.

Improvements in or connected with Valves for Hot Gases. J. von Langer and L. Cooper, Leeds. Eng. Pat. 4225 March 18, 1890. 6*d.*

The principal object of this invention is to provide a valve suitable for controlling the flow of hot gases or air. The valve is a hollow disc or plate, preferably circular, and is provided with a hollow flange adapted to dip into an annular cup containing a suitable liquid or solid packing material, and is mounted on a hollow vertical spindle (or spindles) guided by stuffing boxes, and is enclosed in a cast-iron casing. The spindle forms a continuous passage through the interior of the valve, and supplies it with cooling liquid, which is admitted through a flexible pipe attached to the lower end of the spindle, and is discharged through a similar pipe at the upper end.—E. S.

Improvements in Apparatus connected with the Manufacture of Gas. J. A. Kelman, London. Eng. Pat. 4324, March 19, 1890. 8*d.*

A washer or scrubber of square or rectangular shape is described, which is provided with a series of partitions mounted with short tubes, each tube having a dome shield provided with tangential vanes for breaking up the gas as it issues from the dome. A special condenser is also provided. This arrangement is illustrated by drawings.

—D. A. S.

Improvements in Furnaces to Promote Combustion. T. Norman and H. T. Simpson, Sheffield. Eng. Pat. 7886, May 22, 1890. 6*d.*

One or more air inlet pipes or conduits are carried vertically through the brickwork of a furnace to the bridge, pass horizontally through the bridge and terminate under the bridge in an air chamber which communicates with the back of the fire-box by upwardly inclined slits opening a little below the ends of the firebars. A steam jet forces air into the open external end of the conduit, and the mixture of air and steam is thus superheated in its passage through the conduit and firebridge before reaching the fuel.—S. B. A. A.

Improvements in Furnaces. L. C. Cohen and E. Hermann, Paris, France. Eng. Pat. 10,398, July 5, 1890. 6*d.*

This invention refers to improvements in furnaces previously patented.

The mouth of the furnace is so constructed that the rotary lower jaw is either in the form of a sector with its fulcrum at the lower end, or of highly curved form with its fulcrum at the upper end, so that the movement of the jaw presses the fuel into the main grate, and causes fresh fuel to fall into the space made by the movement of the jaw. The slide grate is also altered so that the ashes fall through at the rear and combustion cannot go on in the front.

There are two sheets of drawings in the specification illustrating this.—D. A. S.

Improvements in Methods of Producing Combustible Gases for Heating and Lighting Purposes, and in Apparatus therefor. B. H. Thwaite, Liverpool. Eng. Pat. 13,574, August 29, 1890. 11*d.*

By means of specially-contrived valves, water-gas and generator-gas are made in the same producer so as to obtain a gas of fixed and uniform quality, which is afterwards invested with highly thermic and luminous qualities by the injection of oil or liquid hydrocarbons into and over the fuel. A pair of generating vessels are used; the gases from the first vessel are aspired to the second vessel through a connecting flue, and pass descensionally through the latter. To enrich the gas, liquid hydrocarbons or oil are injected preferably under high pressures, which may be directed either into the producer in which the descensional flow of gas is taking place, so that the volatilised gas may pass directly into the mains without decomposition of hydrocarbons, or may be directed into the ascending flow of gas, and fixed or rendered permanent during its passage through the fuel. There is an automatic arrangement for solid fuel feeding, and special valvular and aspiratory arrangements which cannot well be explained without reference to the drawings accompanying the specification, of which there are four sheets.—D. A. S.

Improvements in and Relating to Apparatus for Withdrawing Coke from Ovens and for similar Purposes. W. R. Lake, London. From N. O. Goldsmith, Cincinnati, U.S.A. Eng. Pat. 14,968, September 22, 1890. 11*d.*

The invention relates to a new and improved device for drawing coke out of ovens. It comprises a driving device operated by an engine, preferably mounted upon a car which can be run to and fro in front of the oven, having an oscillating table, upon which is mounted the guides for the reciprocating arm carrying the pulling claws, with suitable mechanism for stopping, starting, tilting, and swinging the reciprocating claw arm in a horizontal and in vertical planes, all of which is done with power furnished by the boiler.

The apparatus cannot be described without reference to the drawings accompanying the specification.—F. W. T. K.

Coal-Gas Generating Apparatus. J. J. Thomas, Pennsylvania, U.S.A. Eng. Pat. 17,000, October 24, 1890. 8*d*

This is an improved method of connecting two series of inclined (30°) retorts by having two saddle pipes and a connecting chamber with a valve located between the receiving chambers of each series so that the gas from either side may be mixed as desired with the gas of the other side before reaching the liquid seal in the hydraulic main. There is also a special travelling car for charging with a separate pocket for each retort. The retorts are constructed with contracted discharge ends. Each retort is 26 inches wide at the receiving end, and contracts to 20 inches. The contraction at the lower end causes the coals to be evenly distributed over the bottom of the retort. The gas from each series passes up through the receiving chamber and saddle pipe to the hydraulic main. When one of the series of retorts has run two hours the bottom lids are opened and the coke discharged, and the retort refilled as before. The valve being opened the hot gases rising from the retorts running more than two hours will pass and mix with the gas from those last charged. Thus the rich cold gas from fresh coal would be heated by the poor hot gas from the partly distilled coal and the mixed gases will pass the liquid seal as a rich and more permanent gas than if they had passed singly.—D. A. S.

An Improved Compound for Treating Fuel. H. H. Lake, London. From The Standard Coal and Fuel Co., Boston, U.S.A. Eng. Pat. 17,466, October 31, 1890. 4*d*.

A MIXTURE of saltpetre and sal-ammoniac in the proportion of 75 parts by weight of the former to 25 parts of the latter, forms a non-deliquescent easily transportable mass which may be dissolved in water when required and the solution sprinkled over coal or other fuel.

The saltpetre provides oxygen for the thorough combustion of the fuel whilst the sal-ammoniac moderates the reaction and tends to hold back the smoke until thoroughly consumed.—S. B. A. A.

An Improved Compound for Treating Fuel. H. H. Lake, London. From The Standard Coal and Fuel Co., Boston, U.S.A. Eng. Pat. 17,470, October 31, 1890. 4*d*.

A MIXTURE of 37 parts by weight of saltpetre and 63 parts of Glauber's salt is claimed for the same properties and purposes as the mixture in the preceding specification.

—S. B. A. A.

An Improved Compound for Treating Fuel. H. H. Lake, London. From The Standard Coal and Fuel Co., Boston, Eng. Pat. 17,484, October 31, 1890. 4*d*.

A MIXTURE of 33 parts by weight of saltpetre and 67 parts of common salt is claimed for the same properties and purposes as the preceding mixtures.—S. B. A. A.

Improvements in Furnaces. H. H. Lake, London. From R. L. Walker, Boston, U.S.A. Eng. Pat. 17,727, November 4, 1890. 6*d*.

IN the improved furnaces the grate is made in two sections, the hinder and smaller of which is a rocking grate, and a deflector is arranged so as to direct the products of combustion of the fuel on the front section of the grate over the bright fire maintained on the movable grate by sufficient agitation. The products of combustion are in this way completely and economically consumed. In another modification the ash-pit is in addition divided into two chambers corresponding with the two sections of the grate and the rear chamber is provided with an air blast.

—S. B. A. A.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

Alexeev's Apparatus for the Treatment of Naphtha Tar and Naphtha Residues. Proc. Russ. Techn. Soc. **23**, 24—28, and **24**, 1—13.

THE principle of this apparatus being that the light hydrocarbons evolved in the course of distillation are forced back into the boiler and mixed with the crude material, it is particularly useful for decomposition of the heavy naphtha constituents, hitherto used merely as fuel, into lamp oil and

Fig. 1.

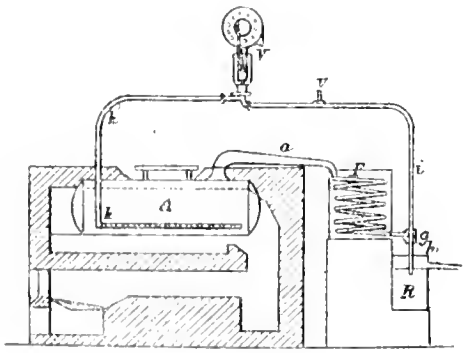


Fig. 3.

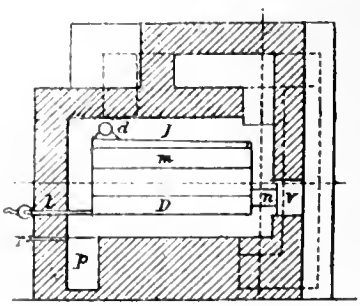
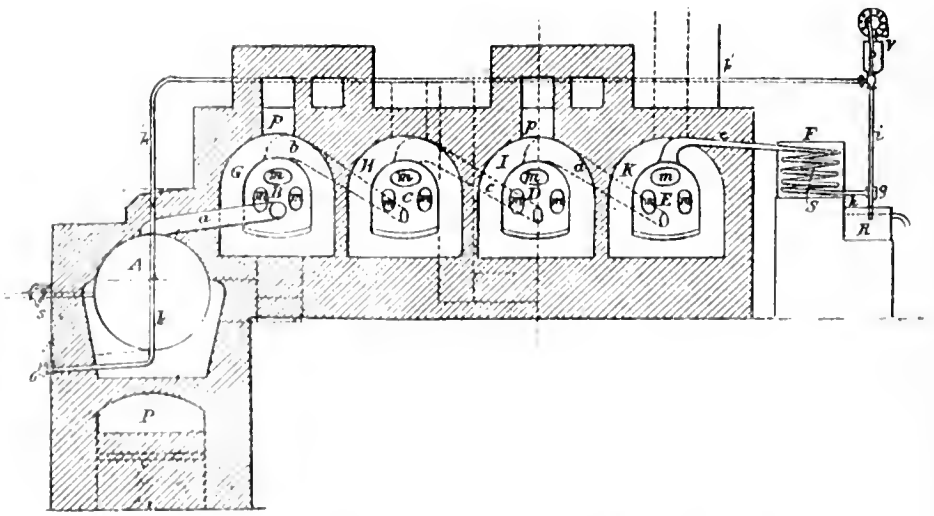


Fig. 2.



APPARATUS FOR THE TREATMENT OF NAPHTHA PRODUCTS.

vaselin. In Fig. 2, a front section of the apparatus, A is a boiler continually fed by naphtha tar or residues through the pipe *s* and heated from below. The pipe *a* leads vapour and gases from the boiler into the first condenser B, surrounded by a chamber G, and heated from the main hearth P, through heating flues *p p*. There are seven such condensers (of which only four are shown) B, C, D, E, &c., and seven corresponding chambers G, H, I, K, &c., connected by pipes *a*, *b*, *c*, *d*, &c. The last chamber is connected by a pipe *e*, with a final condenser and coil F, which ends in a branching pipe *g*; here, while the condensed liquid is flowing through the pipe *h* into the receiver R, the still gaseous hydrocarbons are sucked up the pipe *i* by an air pump V, and are subsequently forced through the pipe *k'* into the boiler A, where the perforated end of the pipe *k* is lying along the bottom, as in Fig. 1, which represents a section of a simpler apparatus with a single condenser. The farther the chamber is from the hearth the lower is its temperature and the lighter is the product condensing in it. Fig. 3 is a section of the chamber I surrounding the condenser D, with flues *m* (for increasing the condensing surface), and a discharging pipe *l*; *p* is the heating flue with a damper *r*.

The difference of temperature between the extreme points of the apparatus being about 280° (from 360° down to 80°), the various products of naphtha from the heaviest vaselin to the lightest sorts of "benzoline" are condensed in the intermediate condensers.

This apparatus is adopted in several naphtha works in Russia, and gives very satisfactory results. For instance, 5½ tons of naphtha tar, sp. gr. 0·927, has given after eight days of distillation 45 per cent. of crude vaselin and 25 per cent. of crude kerosin, or generally 35—40 per cent. of pure vaselin, sp. gr. 0·875—0·904, melting point 15°—35° C., and 15—20 per cent. of pure kerosin, sp. gr. 0·800, flashing point 34·3° C.

On the other hand 7½ tons of naphtha residues, sp. gr. 0·912 (at 17·5° C.) have given at the first distillation only 40 per cent. of kerosin, but when the heavier products had been repeatedly poured back into the boiler the whole 70 per cent. of pure kerosin were obtained, the additional 30 per cent. of kerosin being the result of decomposition of the heavier hydrocarbons under the condition of the apparatus. It works very quietly, requiring no special attention, and consumes about 16 *pounds* of liquid fuel for each 100 *pouds* of naphtha residues (the actual amount of the repeatedly distilled material being 300 *pouds*).

Until recently the apparatus of this system was considered unpractical in Baku on account of the very low price of crude naphtha and a comparatively good and constant demand for residues for fuel. But the price of naphtha having begun to rise owing to some apprehension felt in Russia of an approaching decrease of the natural sources of the mineral oil, the former wasteful method of disposing of naphtha appears now to be dangerous, and the use of Alexeev's apparatus is recommended in order to increase the percentage of the most useful and valuable constituent (kerosin) obtained from crude naphtha from 35 per cent. (as hitherto) to 70 per cent., as it ought to be.—N. W. T.

Petroleum Wealth of Russia. J. Soc. Arts, 1891, **39**, 275—277.

M. B. Prilézjaïev, writing in the *Economiste Russe*, says that the development which from year to year is seen in the production of mineral oil in Russia, the increased exports abroad and the competition on foreign markets with American products, and, finally, the fears that have recently been expressed as to the probability of an approaching exhaustion of the sources of petroleum in the Caucasus, invest with a particular interest this important branch of Russian industry. The following is a summary of the progress effected, and the present condition of the petroleum trade. The extraction of naphtha is confined almost exclusively to the Caucasus, in the peninsula of Apchéroo, and principally in the environs of Baku. The existence of petroleum in the Caucasian soil was known at a very early period, and when these districts were still under Persian rule, the Government made concessions to private individuals of the right of working the petroleum beds. After the annexation of Baku to Russia this industry was at first a monopoly, which brought into the treasury, from 1821 to 1872, an annual revenue of 87,000 roubles. After the suppression of this monopoly in 1872 an excise duty was imposed which was removed in 1877, and had yielded a total sum of 1,218,739 roubles. The yield from this source to the Imperial Exchequer in 1888 was nearly 7,000,000 roubles, and in 1889 over 9,000,000. From 1832 to 1862 the production of naphtha in the Caucasus was confined within narrow limits. During this period it varied from 255,500 pouds to 358,300 pouds annually (the poud is equivalent to 36 lbs. avoirdupois). From 1863 to 1868 it rose to between 538,900 and 998,900 pouds, and continued to rise until it amounted to 1,685,229 pouds in 1869, the year from which its enormous development dates. In 1870, the production amounted to 1,701,465 pouds; in 1875, to 6,285,728; in 1880, to 20,736,949; in 1885, to 115,000,000; and, in 1889, to 206,897,100 pouds. The environs of Baku supplied about 99 per cent. of the Caucasian production; in round numbers they yielded 165,000,000 pouds in 1887; 190,000,000 pouds in 1888; and 205,000,000 in 1889. The producing districts are situated at a certain distance from the town, on the plateaux of Balakhani, Sabountchi, and Sourakhani towards the north-east, and in the Bibi-Eibat fields which are to the south-east of Baku. In the Baku basin there were 216 wells in working in 1887, and 239 in 1888. The quantity of naphtha carried from the wells to the distilleries amounted to 186,220,470 pouds in 1889, and from January 1st to August 1st of 1890, it amounted to 138,732,688 pouds (against 99,930,712 pouds for the corresponding period of the preceding year). Professor Mendélejef estimates the daily production of the Baku district as follows:—In 1886, 328,890 pouds; in 1887, 415,000 pouds; and in 1888, 503,120 pouds. The Balakhani and Sabountchi fields are the most important. In the former there were 216 wells, in 1885, and in the latter 128. In 1887, the number of wells in both districts in full working amounted to 201, with a product of 153,246,672 pouds; and in 1888 they amounted to 227, giving a yield of 176,332,226 pouds. The average annual yield for each well was 762,421 pouds in 1887, and 776,794 pouds in 1888, an increase for the latter year of 2 per cent. The principal companies engaged in the extraction of petroleum are the Nobel, Caspian, Baku, Caspian and Black Sea, Schibaïev Mirzoev, Dembo and Cohan, and Zaturov and Arafelov Companies at Balakhani, Sabountchi, Taguiev, and Sarkissov, and the Djakeli Companies, at Bibi-Eibat. The petroleum extracted from the wells is carried by pipes to the large stations or reservoirs, and thence distributed in the same manner to the works. This system was inaugurated in 1877. The quantity of raw petroleum delivered to the works by the Baku Companies amounted to 153,122,049 pouds in 1888, 186,220,476 pouds in 1889; and 192,044,202 pouds during the period comprised between the 1st January and the 1st November 1890. The distilleries are, for the most part, established at Baku, where they form a special district, which is known as the "black town." In this district there were 145 distilleries in 1887, which treated nearly 142,000,000 pouds of naphtha, and produced 38,000,000 pouds of refined petroleum (kerosene), 1,800,000 pouds of lubricating oil, and 40,000,000 pouds of residues, besides a considerable quantity of benzine, vaseline, and products of secondary importance. In 1889 the number of distilleries was 147, and their total product amounted to 181,590,232 pouds, of which 62,000,000 were light oils, 1,000,000 heavy oils, and 113,000,000 residues. Independently of the Baku basin, naphtha wells are found in other regions of the Empire. In the environs of Tiflis naphtha is found in the neighbourhood of Signakh, and at Naftlough. In 1887 there were 85 wells, which yielded 28,660 pouds of naphtha. In 1889 the Signakh wells alone furnished 55,296 pouds, that is more than 17,000 pouds more than the preceding year. In the Government of Elisaetpol the production was only 2,000 pouds in 1888, and 3,000 pouds in 1889; in Daghestan it was 3,350 pouds in 1888, and 3,955 in 1889; in the province of Térek, 161,442 pouds in 1888, and 275,721 pouds in 1889. The wells of the province of

Kouban are of greater importance. The following will show the distribution by districts of the petroleum refineries and their relative production in 1889:—Transcaucasia 148 refineries, with a production of 158,259,869 pouds; St. Petersburg and Moscow, 35, and 1,515,559 pouds; Central regions, 8, and 1,480,208 pouds; Southern, 6, and 944,689 pouds; Western, 2, and 324,215 pouds; Baltic provinces, 1, and 317,127 pouds; Northern, 1, and 15,719 pouds; South-western, 1, and 1,799 pouds; and Poland, 1, with a product of 511 pouds, making in the aggregate 203 refineries, with a yield of 162,859,996 pouds. The working of petroleum at Baku is placed under the direction of a committee of experts, established in 1886. The greater part of the petroleum extracted is consumed in the interior of the Empire. The petroleum is carried from Baku by the Caspian Sea, then by the Volga to Tsaritsyne. From this place a certain quantity goes up the river, but the greater part is carried by rail, in tank-waggons, to all parts of European Russia. The Nobel Company owns the largest amount of material for the transport of petroleum; in 1889 their vessels represented a value of nearly 6,000,000 of roubles, and their tank-waggons 3,000; the waggons belonging to the Caspian and Black Sea Company represented a value of 418,773 roubles. The Naphtha Company owns 2,310 tank-waggons, the Schibaiev 305, and the Caspian Company 200. These companies also own reservoirs in the principal cities of the Empire. Petroleum intended for foreign markets is shipped chiefly from the port of Batoum. The exports keep pace with the development of the petroleum industry. The importance of lighting oils in this export is accentuated from year to year. In 1883 refined petroleum only represented 41 per cent. of the total exports; the following years the proportion amounted respectively to 57 per cent., 67 per cent., 61 per cent., 62 per cent., 78 per cent., to attain the figure of 84 per cent. in 1890. In the year 1889 over 6,000,000 pouds of lighting oils and benzine were exported from Russia to the United Kingdom; 4,000,000 to Austria; 3,000,000 to Germany; 2,000,000 to Italy; 2,000,000 to Belgium; and smaller quantities to Holland, Roumania, Spain, Denmark, Sweden, Norway, Greece, France, &c. Turkey took in the same year 7,000,000 pouds; East Indies, 5,000,000; China over 1,000,000; Persia, 336,000; and Japan 330,000 pouds of lighting oils and benzine. In 1888, 77 per cent. of the total exports were effected *viâ* Batoum, and in 1889, 80 per cent. M. Prilêjaïev concludes by quoting the opinion of Professor Mendélejef to the effect that there is no indication of an approaching failure of the petroleum supply of the Baku basin, leaving out of the question the other districts of Russia which still await the development of their naphtha wealth.

PATENT.

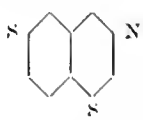
Improvements in Lubricating or Treating Fibrous Materials in Process of Manufacture. R. Hamilton, Trinity, and J. C. Hamilton, Linlithgow. Eng. Pat. 16,111, October 11, 1890. *4d.*

See under V., *page* 251.

IV.—COLOURING MATTERS AND DYES.

Studies on the Constitution of Tri-Derivatives of Naphthalene, No. 9. Andresen's β-Naphthylaminedisulphonic Acid. Henry E. Armstrong and W. P. Wynne. Proc. Chem. Soc. 1891 (93), 27—28.

According to Schultz (this Journal, 1890, 282) naphthalene-1:3′-disulphonic acid on nitration yields a mixture of several nitronaphthalenedisulphonic acids. The chief product on reduction gives the so-called α-naphthylaminedisulphonic acid [$NH_2:SO_3H:SO_3H$ = 1′:1:3′; v. Armstrong and Wynne (this Journal, 1890, 283)] of the Germ. Pat. 45,776. Of the other acids, the production of which has also been noted by Bernthsen (this Journal, 1890, 1121), one yields on reduction, according to Schultz, a β-naphthylaminedisulphonic acid. As this was the first instance in which the formation of a β-nitro-acid by the nitration of a naphthalenesulphonic acid had been observed, the attention of the authors was directed to the determination of its constitution, and a supply of the material remaining after the separation of the greater part of the ε-acid, was obtained for investigation. After separation from the associated acids, and comparison with a specimen of the pure Andresen acid received from Schultz, the amido-acid was analysed by the hydrazine and Sandmeyer methods. When reduced by the hydrazine method, it gave naphthalene-1:3′-disulphonic acid, which was characterised by means of its chloride, $C_{10}H_6(SO_2Cl)_2$, melting at 127°, and the derived 1:3′-dichloronaphthalene melting at 48°. On treatment by the Sandmeyer process, it was converted into a chloronaphthalenedisulphonic acid, the chloride of which, $C_{10}H_5Cl(SO_2Cl)_2$, crystallised from benzene in radiate groups of flat needles melting at 174°, and on distillation with PCl_5 yielded 1:3:3′-trichloronaphthalene melting at 80·5°. This acid, consequently, was identical with that obtained by the authors by sulphonating 2:2′-β-chloronaphthalenesulphonic with 20 per cent. anhydrosulphuric acid (this Journal 1890, 801). As a further proof of the identity of the two compounds, the chloronaphthalenedisulphonic chloride derived from the Andresen acid was hydrolysed by heating with dilute sulphuric acid at 250°—270° for several hours, with the result that β-chloronaphthalene melting at 59·5° was obtained. From these results it follows that the Andresen acid is a β-naphthylaminedisulphonic acid of the constitution—



PATENTS.

Improvements in and relating to the Manufacture of Colouring Matters. H. H. Lake, London. From A. Leonhardt and Co., Mülheim-on-the-Maine, Germany. Eng. Pat. 4387, March 29, 1886. Amended June 4, 1890. *6d.*

A further amendment to the original patent (see this Journal, 1887, 507; 1888, 319; and 1890, 608), relating to the employment of fuming sulphuric acid only for sulphonating and disclaiming the combination of diazotised diamidostilbene with *o*- and *p*-phenylene diamine, *o*- and *p*-tolylene diamine, and also with the following substances: 1. The homologues of aniline, with the exception of tolnidine. 2. The homologues of phenol, with the exception of cresol. 3. The so-called β-naphthylamine-α-sulphonic acid. 4. That disulphonic acid of α-naphthol which, on treatment with nitric acid, yields binitronaphthol. There are, in addition to these corrections, some clerical amendments.—T. A. L.

Production of Brown Dyes or Colouring Matters. T. R. Shillito, London. From J. R. Geigy and Co., Basle, Switzerland. Eng. Pat. 1688, January 31, 1890. *4d.*

A process for obtaining brown colouring matters for cotton by combining diazotised naphthylamine, amidoazobenzene or amidoazotoluene sulphonic acid with *m*-diamines, and further combining these compounds with diazotised primuline (polychromine). The following example shows the method of carrying out the invention. 28 kilos. of sodium naphthionate, dissolved in water and mixed with 30 kilos. of hydrochloric acid, are diazotised by the addition of 8 kilos. of sodium nitrite. This diazo solution is then poured into a solution of 12·5 kilos. of *m*-phenylene diamine, or the corresponding quantity of *m*-tolnylene diamine and 20 kilos. of caustic soda. After standing 24 hours a solution is added, containing 55 kilos. of primu-

line diazotised with 3·5 kilos. of hydrochloric acid and 8 kilos. of sodium nitrite. The reaction is complete in about 24 hours, when the liquor is boiled and the dyestuff precipitated with salt. It forms a brown powder easily soluble in water and dyes unmordanted cotton from a neutral or slightly alkaline bath.—T. A. L.

Improvements in the Manufacture of Fast Dyestuffs for Printing and Dyeing. B. Willcox, London. From the "Farbenfabriken vormals F. Bayer and Co.," Elberfeld, Germany. Eng. Pat. 3303, March 1, 1890. 6*d*.

An exteosion of Eng. Pat. 8299 of 1889 (this Journal, 1890, 608; and 1891, 132), and of Eng. Pat. 1828 of 1890 (this Journal, 1891, 132). The diazo compounds of certain amidocarboxylic acids are combined with α-naphthylamine, or with α-amido-β-naphthol ether, and the resulting amido-azo-compounds are diazotised and combined with the amido-naphthol sulphonic acids G or R (obtained according to Ger. Pat. 3229) in an acetic acid or alkaline solution. The colouring matters obtained dye wool mordanted with chromium salts deep blue-black shades.—T. A. L.

Improvements in the Manufacture of Mordant Dyeing Azo Colouring Matters of the Triphenylmethane Group. B. Willcox, London. From the "Farbenfabriken vormals F. Bayer and Co.," Elberfeld, Germany. Eng. Pat. 3398, March 4, 1890. 6*d*.

The *m*- and *p*-amidotetra-substituted diamidotriphenyl methanes can, according to this invention, be diazotised and, after combination with, preferably, phenol carboxylic acids or certain dihydroxynaphthalenes, yield azo bodies which, on oxidation, form a new group of triphenylmethane derivatives termed azotriphenylmethane dyes. The process can be varied (1) by diazotising the oxidised *m*- or *p*-amido-tetra substituted diamidotriphenyl methanes and combining the diazo-compound with a phenol, naphthol, or their carboxylic acids or with dihydroxynaphthalene; (2) by oxidising the diazotised *m*- or *p*-amido-tetra substituted diamidotriphenyl methanes, and combining the diazo-compounds with the substances enumerated above. The production of a blue mordant colouring matter is described as follows: 34·5 kilos. of *p*-amido-tetra-methyl-diamido-triphenyl methane are dissolved in 200 litres of water and 33 kilos. of 33 per cent. hydrochloric acid, and after cooling to 0° C., added slowly to a solution of 7 kilos. of sodium nitrite. The diazo-solution thus obtained is added to 20 kilos. of hydroxynaphthoic acid dissolved in 120 kilos. of 33 per cent. caustic soda lye. The brown precipitate is filtered off, dried, dissolved in 200 litres of acetic acid, and oxidised with 84 kilos. of peroxide of lead paste (containing 28 per cent.). The whole is then gently heated, and the lead precipitated by 20 kilos. of 50 per cent. sulphuric acid. After filtering, the colouring matter is precipitated on dilution with water, the precipitation being completed by the addition of salt. It is employed as a paste, and dyes wool mordanted with chromium blue.—T. A. L.

Improvements in the Production of Grey Colouring Matters. O. Imray, London. From the "Farbwerke vormals Meister, Lucius und Brüning," Höchst-on-the-Maine, Germany. Eng. Pat. 4577, March 24, 1890. 6*d*.

Nitrosodiethylaniline hydrochloride reacts in an alcoholic or acetic acid solution with β-naphthol sodium sulphonate (Schäffer) at the temperature of the water-bath, forming new colouring matters. The condensation can also take place in an aqueous solution in presence of zinc chloride at 70°—80° C. The colouring matters dye wool grey to black, and the shades are said to be fast to light.—T. A. L.

Production of Grey Basic Colouring Matters by the Action of Hydrochlorate of Nitrosodimethylaniline or Hydrochlorate of Nitrosodiethylaniline upon 1·5 *Dioxynaphthalin and upon* 1·2 *Tetroxydinaphthyl.* O. Imray, London. From the "Farbwerke vormals Meister, Lucius, und Brüning," Höchst-on-the-Maine, Germany. Eng. Pat. 5777, April 16, 1890. 4*d*.

The colouring matters which dye cotton mordanted with tannin grey are obtained by heating to about 50° C. 16 kilos. of (1·4′) dihydroxynaphthalene or (1·2) tetra-hydroxydinaphthyl with 18·6 kilos. of nitrosodimethylaniline hydrochloride, and about 100 kilos. of alcohol, until the nitrosodimethylaniline has completely disappeared. The product is then poured into water, and the colouring matter precipitated by the addition of salt. After filtering and washing, it may be used for dyeing.—T. A. L.

Production of Black Colouring Matters from Amidoflavopurpurine and Amido-anthrapurpurine. O. Imray, London. From the "Farbwerke vormals Meister, Lucius und Brüning," Höchst-on-the-Maine, Germany. Eng. Pat. 5780, April 16, 1890. 6*d*.

Colouring matters of the quinoline series are obtained by applying Skraup's synthesis to amidoflavopurpurine (obtained from β-nitroflavopurpurine) and to amido-anthrapurpurine (from β-nitro-anthrapurpurine). Two kilos. of amidoflavopurpurine, $C_{14}H_7O_3NH_2$, are dissolved in 14 kilos. of sulphuric acid of 66° B., and 1 kilo. of glycerol and 1 kilo. of nitrobenzene are afterwards added. The mixture is then slowly heated to 110° C. and kept at this temperature for eight hours. The melt is then decomposed by water, and the quinoline separated by means of sodium bisulphite, with which it forms a soluble compound. The base is precipitated from this solution by the addition of salt or sulphuric acid, and can be used directly as a colouring matter or mixed with bisulphite in solution for dyeing wool or printing on cotton, giving grey to black shades.—T. A. L.

Improvements in the Manufacture and Production of Substantive Colouring Matters. J. Y. Johnson. From the "Badische Anilin und Soda Fabrik," Ludwigshafen-on-the-Rhine, Germany. Eng. Pat. 6874, May 3, 1890. 6*d*.

Blue colouring matters which dye cotton without a mordant are obtained by combining diazotised benzidine, tolidine, diamidostilbene, or dianisidine with (1·1′) dihydroxy-naphthalene, preferably in an acetic acid solution.—T. A. L.

V.—TEXTILES: COTTON, WOOL, SILK, Etc.

On the Relationship between the Composition of Grey Cloth and its Liability to Mildew. R. Williams.

See pages 227—229.

Note on the Carbonising of Wool in Presence of Silk. E. Knecht.

See page 230.

The Vegetable Fibres of Trinidad. J. Soc. Arts, 1891, 325—327.

The United States Consul in Trinidad has recently forwarded to his Government a report upon the vegetable fibres of that island, and gives a description of some of the most important of them. The *maholtine* is a plant

which grows wild in large quantities. It is easily cultivated, by simply cutting down bushes and burning them, and scattering the seeds of the plant. One acre of good ground will produce about 5,000 lb. of stalk; and this stalk, reduced to fibre, will make about 800 lb. The stalk grows from 8 to 12 ft., the skin or bark of which is stripped off, and steeped in cold water, eight or ten days after which the green watery substance is washed out, leaving a fibre 8 to 10 ft. long. The white *mahoe* (*Sterculia caribæa*), like the *maholtine*, grows wild, and may be cultivated in the same way, producing the same quality of fibre. The fibre is whiter and more silky than that of the *maholtine*, and is believed to be superior to it, although it has never been sent abroad to test its merits. A crop is reaped every seven months. The *gumbo* or *okra* (*Abelmoschus esculentus*) is another stalk fibre, the plant growing 6 to 8 ft. high, and producing a fibre about the same length. Cultivated on good soil, it will produce 4,000 lb. of stalks, yielding as much fibre to the pound as the *maholtine* or the white *mahoe*. The fibre of the *gumbo*, unlike those above mentioned, will not contain water, but throws it off like oil silk. A crop is harvested every seven months. The plantain (*Musa sapientum*) will produce from 5 to 6 lb. of fibre to each stalk. The stalks grow from 8 to 9 ft. high, and 800 of them may be produced on an acre of ground. The fibre is obtained by putting on two wooden rollers, and rolling and squeezing the stalks to crush the watery pores, then steeping it in water eight to ten days, and, finally, putting it under the same rolling process with heavier weights. The banana (*Musa paradisiaca*) grows 4 to 5 ft. high, produces 2 to 3 lb. of fibre to the stalk, and 800 stalks to the acre, and the crop is annual. Ramie or china grass grows very thickly, and when once planted sustains itself against other grass. After the first year it can be cut every six months. The stalk grows about 4 ft. high. It will produce an ounce of fibre to every square foot. The plant was imported into Trinidad from China for experimental purposes about three years ago, and has not yet assumed any commercial importance. The *mahoe bord du mer* (*Paritium tiliaceum*) does not grow inland, but on the sea shore. It is a stalk fibre, but unlike the above it branches, and the branches also produce fibre. It grows 8 to 15 ft. high. Each tree will produce about ½ lb. of fibre, and one acre can support 800 trees. Red *mahoe* (*Sterculia caribæa*) grows wild on any soil of the island, produces about 800 trees to the acre, grows 8 to 10 ft. high, and then branches. The stalk and branches are both used for fibre, which is used by the natives for making rope. The crop is annual. *Rucou*, or annatto, an Indian plant from South America, is a very strong fibre. One acre will support 800 stalks cultivated on fertile soil, and each stalk will produce about ½ lb. of fibre. Black sage (*Cordia eglendros*) is a small shrub about 6 ft. high, and produces a very strong fibre, used by the natives for making ropes. An acre of ground will support 1,600 plants, and they will give ¼ lb. of fibre to each plant. *Bois sang*, or blood wood, grows 25 ft. high, and branches out 8 to 10 ft. from the bottom. When tapped, the tree emits a fluid resembling blood, which produces a red stain. Both stem and branches produce fibre. About 600 trees may be produced to the acre, and each tree will produce 2 to 3 lb. of fibre, which is used for rope-making. The fibre varies from 4 to 6 ft. in length, is very tough, and would, it is said, make a superior twine for bagging. It is cut and planted every three years. *Balizier* (*Helicomea*) is a wild plant, grows on cool soil, and its presence indicates superior land. The blades, which resemble the blades of the plantain, produce the fibre, but the blades grow from the roots of the bush like a pine-apple, and they are 6 to 10 ft. long. One acre will produce about 10,000 blades, and each blade will produce half an ounce of fibre. It is a coarse fibre, not so strong as the others mentioned, but is useful for door mats and similar purposes. Cacao (*Theobroma*) is cultivated for its valuable fruit, but the tree, which grows 15 or 20 ft. high, is trimmed annually in the spring of the year, and the branches of each tree thus trimmed will produce ½ lb. of fibre, which varies from 3 to 5 ft. in length. It is strong, and is used as rope for making hammocks. *Bois l'orme* (*Guazuma ulmifolia*) is a straight tree. At a distance of 8 or 10 ft. up the body of the tree, five or six branches shoot out in a circle round it, and from this point to the top of the tree, encircling branches shoot out at the distance of about one foot apart. The lowest circle of branches are the longest, and they shorten as they ascend the tree, causing the tree to assume the shape of a sugar loaf. Both the body and branches produce fibre. It is a straight brown fibre, and very strong, used generally for rope and twine making. Eight hundred trees may be produced to the acre, and after the third year will produce annually from 1 to 2 lb. of fibre to the tree. The *Agave Mexicana* grows 3 or 4 ft. high, and one acre will support 2,500 plants. After three years, each blade will produce half an ounce, or about half a pound to the plant. The crop may be reaped each succeeding year for from 12 to 16 years without replanting. The plant becomes dry and worthless as soon as it produces a flower, but it rarely produces the flower before 12 years, and usually not before 16 or 20 years. The plant grows wild on the island, but it is understood to have originally been brought from Mexico. The fibre is 3 to 4 ft. long, fine, strong, and it is said, would doubtless be good for textile purposes. The *Agave Americana*, or American aloe, grows higher than the *Agave Mexicana*. It varies in height from 4 to 5 ft., and the fibre is the same length. It grows abundantly, chiefly near the sea shore, and is understood to be a native of the island. The fibre is coarser than the Mexican agave, but about the same quantity can be produced to the acre. Of the pine-apple (*Ananassa sativa*) only the blade, which is about 2 ft. long, produces fibre. The fibre is strong and fine, and is believed to be well suited for textile manufactures. It is of finer texture than either the American or Mexican agave. *Agave rigida*, or sisal hemp, has lately been introduced into Trinidad. The blades alone, which grow about 2½ to 3 ft. long, are used for fibre. Eight blades, it is said, give an ounce and a half of fibre, and the fibre obtained is about 3 ft. long, strong, coarse, and stiff, suitable it is believed for strong ropes and chair-bottoms. An acre will support 2,000 plants of about 16 blades each, and calculated to produce at each reaping 3 oz. of fibre to the plant. After three years a crop is reaped annually. Among the fibre-producing plants of Trinidad may be mentioned the *gemore* (*Malachra*), *bois ceip* (*Oreodaphne cernua*); *gumbo mizse*, the pinquine or wild pine-apple; the Spanish needle (*Yucca*); and the *Sanseviera zeylanica*. Consul Peirce states, in conclusion, that he has been informed that there is no machine now in use in the colony which obtains the fibre without destroying the substance of the fibre ribs. The principal machine, if not the only one, now used in Trinidad and Tobago, is arranged for the operator to hold the blade of the plant in his hand, while the machine scrapes out the green and watery substance. The opinion has been expressed that if a machine could be introduced that would act somewhat on the principle of a cane-mill, in which the cane enters one side and comes out at the other thoroughly crushed and squeezed, a great advantage would be gained over the present practice.

Cultivation of Hemp in Smyrna. J. Soc. Arts, **39**, 1891, 186—187.

In cultivating hemp in Smyrna, the United States Consul there says, that from one and a half to two bushels of seed are sown per acre. The fibre is long and tough, and of good yellow tinge; but, owing to the crude process of shedding, its good qualities are nearly ruined. The price of seed varies between 2*s.* 3*d.* and 2*s.* 7*d.* a bushel; and it generally contains from 12 to 15 per cent. of extraneous matter, chiefly sand. The height that the hemp usually grows is from six to seven feet and a half; in some cases so high, in fact, that Consul Emmet says a man can ride through his fields on horseback without being seen. Hemp is cultivated in almost every village or hamlet of Asia Minor, where an abundance of running water is to be found. The hemp fields are cultivated as near the water as possible, owing to the moisture required while growing, and the use made of the stream after the seed is gathered.

The ground is lightly ploughed, and sown broadcast with from one and a half to two bushels of seed per acre. It is then gone over with a heavily-weighted plank, drawn by oxen, to break the furrows and cover the seed. Nothing more is done to it. If the season be advantageous, and the water supply does not fail, by the receding of the stream, the yield will be good. The crop is cut and put in bundles, when the stalks turn yellow. The seed is gathered, and the sheaves of stalks are immersed in the stream near by, for the purpose of rotting the shell or reed containing the hemp fibre. When the cultivator thinks it sufficiently softened, the bundles are taken from the water, opened, and subjected to a heavy pounding with large mallets. After this, the fibre is extracted by hand, and put in shape for selling. Owing to the process of softening the stalks, or perhaps leaving them too long under water, the fibre darkens and partly rots when exposed to the air, which renders it unfit for foreign markets. It is consumed in the manufacture of coarse bagging and rope, for use in the interior. The hemp seed grown in Smyrna, and exported abroad, is of good quality, and is exported mainly to Germany, Austria, Holland, and the United States, for the extraction of oil. It is also used, to some extent, by the natives as an article of food. The seed is pounded in mortars, and made into a paste, and then fried. The Jews are particularly fond of it, and value it. The principal places in the villayet of Smyrna where hemp and hemp seed are obtained are Odemish, Thyras, Mazli, and Homak Cairch.

PATENT.

Improvements in Lubricating or Treating Fibrous Materials in Process of Manufacture. R. Hamilton, Trinity, and J. C. Hamilton, Linlithgow. Eng. Pat. 16,144, October 11, 1890. 4*d*.

With a view to facilitate the processes of rope-making, spinning, weaving, &c., the fibrous material therein employed is lubricated with substances called by the patentee "tergolene." These are compounds consisting of sulphonic acids or their alkaline salts obtained as by-products in mineral oil refineries or from other sources where olefines are treated with sulphuric acid. The substances are preferably used in a neutral condition either alone or in combination with mineral or fatty oils.—K. E. M.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

Note on the Formation and Direct Fixation of Insoluble Tartrazine on Animal Fibre. E. Knecht.

See pages 230—231.

The Fixing of Substantive Colours on Cotton. W. M. Gardner. Textile Manuf. 1890, 345.

Although but five or six years have elapsed since the introduction of the first Congo colour, now some 70—80 such are known. At first only reds and oranges existed, next came browns, and then the first blue azo colour in the group of benzidine colours. On account of the dulness of the shade new blues came in: benzo-azurin, sulphonazurin, diamine-blue. The present methods of fixing these colours are unsatisfactory; whilst the colours in many cases react quite differently, yet they are dyed in exactly the same manner. According to experiments made in the dyehouse of the Yorkshire College, Leeds, common salt should be added for the deeper shades, or a small quantity of soda or acetic acid may be used. The necessary amount of salt is so variable that each colour has its own peculiar quantity. In the following table these quantities of salt are stated, as well as the action of dilute acids on the colours.

Colour.	Salt for 1 Litre Bath.	Action of	
		Dilute Acetic Acid.	Dilute Sulphuric Acid.
Erika B.	40	Becomes Redder	Becomes Much redder.
Benzopurpurin 10 B.	80	Brown	Blue.
Hessian purple	10	Bluer	Much bluer.
Rosazurin B.	40	Darker	Darker.
Erika G.	20—40	Redder	Much redder.
Hessian purple N.	40	Corinth colour.	Violet.
Brilliant purpurin R.	40	Corinth colour.	Violet.
Deltapurpurin 7 B.	20	Brownish red	Brownish red.
Benzopurpurin 4 B.	20	Reddish brown.	Violet.
Brilliant Congo R.	80	Very little change	Darker.
Diamine scarlet B.	40	Brownish red	Brownish red.
Deltapurpurin 5 B.	80	Reddish brown	Corinth colour.
Congo red	40	Blue	Blue.
Congo 4 R.	40—80	Blue	Blue.
Congo G.	20—40	Blue	Blue.
Brilliant Congo G.	160	Darker	Reddish brown.
Salmon red	20	Brownish red	Corinth colour.
Benzo-orange R.	20	Brownish red	Brick red.
Toluylene orange R.	10	Reddish orange	Reddish orange.
Mikado orange 4 R.	20—40	No action	A little darker.
Mikado orange R.	40	No action	No action.
Toluylene orange G.	20—40	No action	Reddish orange.
Chrysamin R.	10—20	Yellow	Greenish yellow.
Curcumin S. extra	40	No action	Darker.
Curcumin S.	40	Yellowish orange	Orange yellow.
Brilliant yellow	160	No action	No action.
Curcumin W.	160	No action	No action.
Chrysophenin GS.	80	Darker	Brownish yellow.
Hessian yellow	80	No action	No action.
Chrysophenin G.	80	Somewhat darker	Brownish yellow.
Thiazol yellow	80	Orange	Orange.
Congo yellow paste	40	Darker	Darker.
Diamine yellow N.	20	Greenish yellow	Greenish yellow.
Cresol yellow R.	10	Darker	Still darker.
Carbazol yellow	40—80	Greenish yellow	Still greener.
Cotton yellow G.	40	Greenish yellow	Still greener.
Sulphonazurin	10	No action	No action.
Diamine blue B.	10	No action	No action.
Benzo-azurin	20	No action	No action.
Benzo blue-black	10	.. ..	.. ..
Diamine black RO.	10—20	Bluer	Still bluer.
Violet black	20	No action	No action.
Diamine blue 3 R.	10	No action	No action.
Azo blue	20	No action	No action.
Azo violet	20	Somewhat bluer	Bluer.
Congo corinth	10	Somewhat bluer	Bluer.

Colour.	Salt for 1 Litre Bath.	Action of	
		Dilute Acetic Acid.	Dilute Sulphuric Acid.
Hessian violet.....	80	Becomes Somewhat bluer	Becomes Bluer.
Bordeaux, extra.....	40—80	Somewhat bluer	Bluer.
Heliotrope.....	10—20	Somewhat bluer	Bluer.
Benzo brown NB. ..	10—20	No action.....	No action.
Cotton brown N.....	10—20	No action.....	No action.
Benzo brown G.....	40	No action.....	No action.
Mikado brown	40	Somewhat bluer	Somewhat bluer.
Hessian brown MM.	10	Olive brown ...	Olive.
Hessian brown BB.	10	No action.....	No action.
Hessian brown B....	10—20	Bluer	Bluish black.
Alkali brown.....	20	.. ..	.. ..

In the case of all substantive colours, whether they be red, yellow, or blue, it is best to dye in the hot bath, boiling for ½—1 hour.—T. L. B.

Kath or Pale Catechu. H. Warth. J. Soc. Arts, **39**, 1891, 156—157.

The Secretary of State for India has received from the author a memorandum, from which the following particulars are taken:—

"The kath of the North-West Provinces, which is used with pán, and the catechu of Burma, which is exported to Europe as a dyestuff, are both prepared from the wood of *Acacia catechu*. The kath is in its purest state chiefly catechin, a crystallising substance nearly insoluble in cold water. The catechu is chiefly catechu tannin, a substance soluble in cold water, and not crystallising, but some catechin is usually mixed up with it. The difference between kath and catechu is partly due to the methods of manufacture, partly to the difference in the trees.

"The trees in Burma differ from those of the North-West Provinces, and at each place there are two kinds of trees, Nos. 1 and 2, although of exactly the same species. Trees No. 2 have white spots in the wood, caused by a white substance stored up in cylindrical masses half a millimetre thick and 10 millimetres long. Trees No. 1 have no white spots. Trees with spots yield an extract richer in catechin; and both kinds of trees in the North-West Provinces yield more catechin than the corresponding kinds in Burma.

"I found the following proportions of catechin in the total extract:—

	Catechin.
	Per Cent.
Burma, No. 1	14
„ No. 2 (spotted)	30
North-West Provinces, No. 1.....	36
„ „ No. 2 (spotted).	49

"The greatest amount of extract obtained from each kind of wood was as follows:—

	Extract.
	Per Cent.
Burma, No. 1	17
„ No. 2 (spotted)	18
North-West Provinces, No. 1.....	14
„ „ No. 2 (spotted).	21

"The greatest amount of catechin obtainable from these woods is, accordingly, as follows:—

	Catechin.
	Per Cent.
Burma, No. 1	2
„ No. 2 (spotted)	5
North-West Provinces, No. 1.....	5
„ „ No. 2 (spotted)..	9

"Such a great proportion of catechin in the spotted wood of the North-West Provinces explains that kath manufacture is at home there. Moreover, the local kath makers are reported to refuse as unfit all trees as unfit which do not contain white spots, so that the trees No. 1 become wasted in the forests.

"I determined the catechin by direct separation, as follows:—About two ounces of the wood reduced to thin shavings were boiled with 20 times their weight of water for half an hour. The extract was separated from the wood by repeated settlement, and reduced in bulk on the water-bath until it just began to thicken, and contained, by estimate, 6 per cent. of catechin. It was then left in a cool place for five days for the separation of the catechin. Once the catechin had separated, the liquid could again be diluted with cold water for the purpose of filtering. The filtered and roughly-washed catechin was dried at ordinary temperature, and weighed in a thoroughly air-dry condition.

"The high degree of concentration, and the long standing are required because the catechin separates with difficulty out of an extract which contains so much catechu tannin. Once the bulk of the tanning is separated, the catechin may be dissolved in much more water, and it will separate immediately on cooling; but the catechin is at all times a delicate substance, which changes with water slowly into a soluble substance, and is thus lost. The drying of the moist catechin must take place at a low temperature, as heat at once destroys the microscopic crystals.

"The manufacture of kath, or raw catechin, is carried on in the forests with very primitive appliances. The filtering is done through layers of sand, and much sand becomes mixed up with the kath. The drying is performed in the open air.

"Contact with iron must be scrupulously avoided during the extraction of catechin. With catechu or cutch, contact with iron is of no consequence; and the reports mention iron cauldrons in use for the final boiling down of the cutch in Burma."

PATENTS.

Improvements relating to the Treatment of Dyewoods and their Extracts. M. G. Lindemann, Ottensen, Germany. Eng. Pat. 3788, March 10, 1890. 4*d*.

Dyewood extracts are to be treated with the manganates or permanganates of potassium or sodium, or with peroxide of hydrogen which is said to increase the tinctorial power of the solutions.—T. A. L.

Improvements in the Manufacture of Dyestuffs. S. Pitt, Sutton. From L. Casella & Co., Frankfort-on-the-Maine, Germany. Eng. Pat. 4904, March 28, 1890. 4*d*.

By heating together dimethylamine and fluorescein in an alcoholic solution at 140—160° C. a product is obtained which has the properties of a phenol and a weak base. This is known as dimethylrhodaminol and as hydrochloride dyes animal fibres and vegetable fibres mordanted with tannic acid and tartar emetic a fine red. If the temperature be raised to 180° C. another substance is obtained which is identical with tetramethylrhodamine. The same reaction takes place up to 210° C., but at 230° decomposition commences. In place of fluorescein its methyl or ethyl ethers may be used.—T. A. L.

Improvements in Printing or Stamping Inks. C. M. Higgins, Brooklyn, U.S.A. Eng. Pat. 15,857, October 7, 1890. 6*d*.

Oleic acid is claimed as a solvent for coal-tar dyes in the manufacture of inks suitable for type-writing, ticket-printing, &c., where a copyable ink which will not harden or dry on the inking device, is required. Oleic acid, too, may be mixed with such pigments as carbon, ultramarine, and Prussian blue, to furnish inks suitable for the purposes mentioned.

—E. B.

Improvements in Printing or Stamping Inks. C. M. Higgins, Brooklyn, U.S.A. Eng. Pat. 15,858, October 7, 1890. 6*d*.

Inks suitable for hand-stamps, type-writers, and small printing machines, are made by dissolving coal-tar dyes in essential oils or in mixtures of essential oils and oleic acid; thus, a violet ink is prepared by dissolving methyl violet in oil of cinnamon, oil of cloves, or oil of cassia (cinnamon leaf), the last-named oil being preferred for use with rubber stamps in which the inking-pad rests on the rubber, since it does not injure the rubber. A green ink is obtained by dissolving "green crystals" in oil of cloves. Blue inks are produced either by mixing the violet and green inks or by dissolving Chinese blue in oil of cloves. Carbon, carmine, and ultramarine blue may be incorporated with any of these inks.—E. B.

VII.—ACIDS, ALKALIS, AND SALTS.

The Chemical Changes between Nitric Acid and Metals. V. H. Veley.

See pages 204—206.

The Chemical Changes between Lead and Nitric Acid. V. H. Veley.

See pages 206—210.

The Use of Sulphydrate of Calcium in the Manufacture of Alkali and By-products by Haddock and Leith's Process. J. Leith.

See pages 214—219.

PATENTS.

An Improved Process for the Extraction of the Tartrate of Lime contained in Lyes and other Tartarous Matters, and its Transformation into Cream of Tartar or into Tartaric Acid. A. Martignier, Montpellier, France. Eng. Pat. 20,078, December 13, 1889. 6*d*.

When calcium tartrate is treated with a saturated solution of potassium sulphate in excess, neutral potassium tartrate and calcium sulphate are obtained.

This reaction is now applied for the extraction of the calcium tartrate contained in the neutralised lyes (lees), &c. The reaction takes place cold or hot, and after its termination the solution of neutral calcium tartrate is separated from the gypsum, decolourised by animal charcoal, and precipitated with an equivalent of sulphuric acid as potassium bitartrate (cream of tartar), half of the potassium sulphate being hereby regenerated.

This cream, or the original liquor, may be used for the manufacture of tartaric acid by first converting into calcium tartrate. This may be treated with sodium sulphate; the filtered and decolourised liquor containing neutral sodium tartrate and excess of sodium sulphate then treated with an equivalent quantity of sulphuric acid and potassium sulphate, potassium bitartrate being precipitated; or the lyes and tartars may be treated direct with a mixture of the sulphates of potassium and sodium. Neutral potassium tartrate is formed, the sodium sulphate assisting the reaction.—H. A.

Improvements in the Treatment or Preparation of Nitrate of Ammonium. "The Roburite Explosives Company, Limited," London. C. Roth, Charlottenburg, Germany, and W. J. Orsman, Gathurst. Eng. Pat. 20,104, December 13, 1889. 4*d*.

See under XXII., *page* 270.

Improvements in the Manufacture of (Soda) Alum. F. M. Spence and D. D. Spence, Manchester. Eng. Pat. 448, January 10, 1890. 6*d*.

Saltcake (1 part) is dissolved by the aid of live steam in a boiling solution of 5 parts of alumino-ferric cake of 1·3 sp. gr. The solution is run into a leaden tank and allowed to settle for about 20 hours. The clear liquor is then drawn off and concentrated to about 1·45 sp. gr. by means of high-pressure steam. In using aluminium sulphate instead of alumino-ferric cake, the density of the concentrated liquor should not exceed 1·425 sp. gr. The clear liquor is run into shallow coolers, and occasionally agitated with wooden rakes. The cooling of the liquor is thus greatly promoted, and when the temperature is sufficiently low, the whole mass solidifies to a magma. This magma will remain unchanged if left to itself; occasional working up with wooden spades, &c., however, causes it to deposit crystals of soda-alum. These are separated from the mother-liquor, and may be washed with the mother-liquor of the second crystallisation, re-dissolved, and treated in the same way as the original liquor.

In evaporating the mother-liquor from the first crystals to 1·45 sp. gr., a further quantity of soda-alum will be deposited; the mother-liquor may also be utilised for the purification of sewage; or for the production of potash- or ammonium-alum. (See also this Journal, 1890, 1129.)—H. A.

Improvements in the Manufacture or Separation of Ammonium Nitrate and Sulphate or Chloride of Sodium and of Potassium. C. Roth, Charlottenburg, Germany. Eng. Pat. 858, January 16, 1890. 6*d*.

See under XXII., *page* 270.

An Improved Compound for the Generation of Carbon Dioxide, and suitable for use in Gasogenes, Fire-Extinguishers, and similar Apparatus. H. Grimshaw, Manchester. Eng. Pat. 984, January 20, 1890. 4*d*.

The compound consists of an admixture of sodium bicarbonate and sodium bisulphate in molecular proportions, either in the form of a dry powder or slightly damped and granulated by the aid of heat. Any other alkaline or alkaline-earthy carbonate or bicarbonate may be used, along with a suitable soluble bisulphate or biphosphate.—H. A.

Improvements in the Manufacture of Soda and Potash. F. Ellershausen, Hebburn-on-Tyne. Eng. Pat. 1016, January 20 1890. 4*d*.

In the usual way of manufacturing caustic soda, a dilute solution of black-ash is causticised with lime, concentrated and the residue fused to form solid caustic. The object of this invention is the saving of the large quantities of fuel necessary for boiling down such dilute liquors. Accordingly a strong solution of black-ash is mixed with iron peroxide to form a thick paste, the mass calcined, and the sodium ferrate so obtained lixiviated with sufficient warm water to form a strong solution of caustic soda. The iron peroxide is hereby converted into hydrate, which may be used over again either with vat-liquor alone, or in conjunction with the fished salts obtained in evaporating the caustic soda solution, or with sodium sulphide, as described in Eng. Pat. 1015 of 1890.—H. A.

Improvements in the Manufacture of Anhydrous Barium Oxides. H. H. Leigh, London. From T. de Brochocki, Paris, France. Eng. Pat. 1300, January 24, 1890. Amended September 25, 1890. 4*d*.

The patentee now restricts his claim to the use of "carbon," the words ("coal dust") in the claim being deleted. (Compare this Journal, 1890, 510—511.)—H. A.

Improvements in the Method of Vapourising Solutions containing Nitrates of Manganese, and in the Means used for Decomposing the said Nitrates. G. Wischin, St. Petersburgh, Russia. Eng. Pat. 1524, January 28, 1890. *8d.*

In the usual way of manufacturing chlorine from a mixture of nitric acid, manganese peroxide and manganese chloride (or hydrochloric acid), an acid solution of manganese nitrate is formed, from which manganese dioxide and nitric acid are regenerated by evaporating the solution to dryness and heating the residue, the manganese nitrate decomposing about 400°, manganese dioxide being left, while the nitrous fumes given off are condensed. The evaporation of the still-liquors presents great difficulties on account of the action of nitric acid on iron, and also formation of hard crusts of manganese dioxide on the bottom of the vessel.

It is proposed to overcome these difficulties by protecting the bottom of the evaporating vessel with a layer of granulated or powdered manganese dioxide or an equivalent; the vessel is kept hot, to avoid condensation of nitric acid on the sides; the liquor is fed in gradually, whilst the mass is kept in constant movement by means of a mechanical agitator, thus preventing the formation of crusts and also furthering the evaporation.

The apparatus may consist of a cylindrical cast-iron pan with flat bottom and outlet for continuous or intermittent delivery of recovered manganese. The flat top is provided with an outlet for nitric acid vapours, and with small apertures for feeding in the liquor and in connexions by means of branch pipes with a liquor distributor. The wings of the agitator are close to the bottom and the luting of the agitator-shaft is done by a bell moving in a sand lute. The pan is set in a furnace and protected by a perforated arch.

—H. A.

Improvements in or connected with Apparatus for the Manufacture of Sulphuric Acid. E. and T. Deplace, Aubervilliers, France. Eng. Pat. 5058, April 1, 1890. *8d.*

The improvements comprise (1) a modified burner for the better utilisation of the sulphur contained in the pyrites; (2) two Glover towers: A to concentrate the chamber acid and simultaneously to cool the burner-gases, C for the denitrification of the nitrous vitriol. The object of this arrangement is to prevent the decomposition of nitrous gases, owing to an excess of sulphurous acid gas and a high temperature. (3.) A dividing chamber E, allowing of a complete mixture of the gases and separation of the same into two distinct currents, which enter the chamber at F and G. (4.) A chamber H, forming on the inner and outer circumference a circle, or semicircle, an oval, spiral, polygon, &c., to ensure a proper mixing of the gases by the constant changes in the direction of the gases travelling through the chamber. A second circular chamber P, if desired, and a Gay-Lussac tower Q completes the system.

Fig. 3

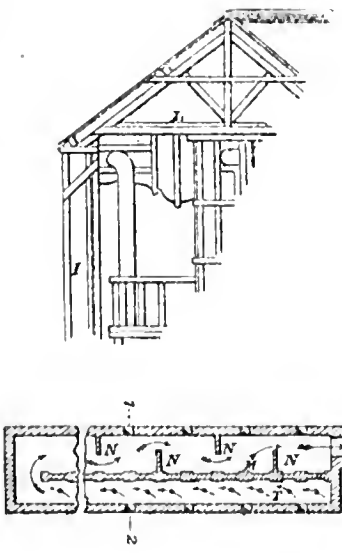


Fig. 1.

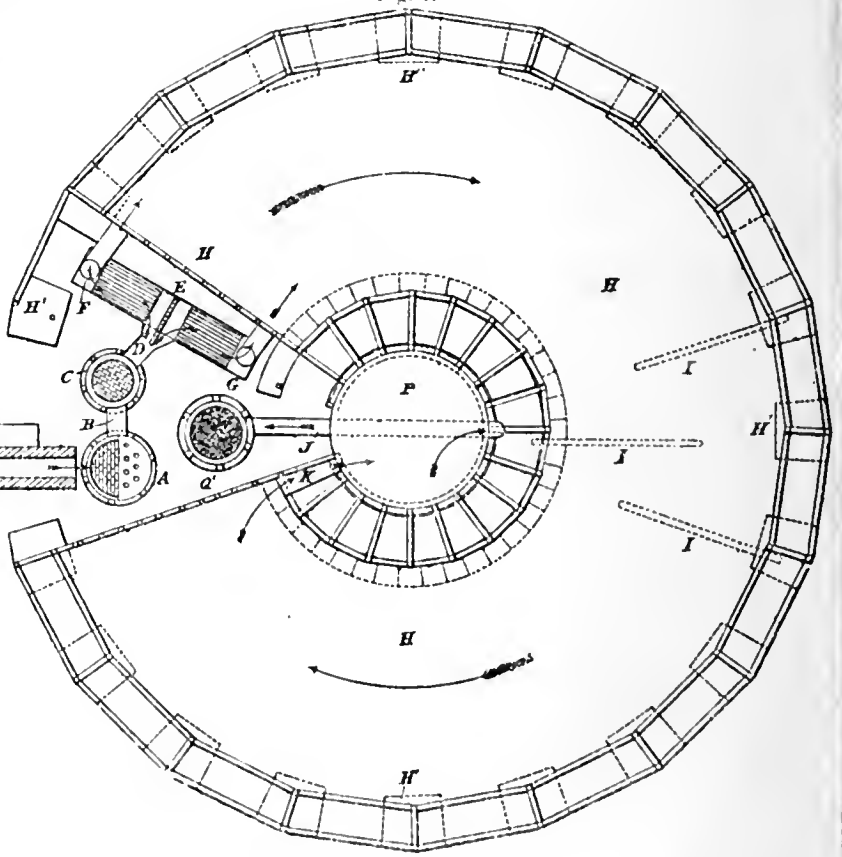
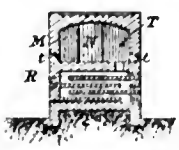


Fig. 2.



Sulphuric Acid Manufacture.

The pyrites burners are placed in a row, each burner being provided with five shelves R (instead of six). The gases from each kiln pass through openings *t* in a mutual collecting chamber T, extending over the whole length of the kilns. Parallel with this and connected to it runs a dust-chamber M, provided with short partitions N, which cause the gas to take a zigzag course.

The towers A and C are packed with natural acid-proof stone; the gases after leaving A pass through B and enter the second tower C on the top, passing from

the bottom into a collector D, containing a central partition; the gases are thus split up into two currents, each having to pass through a chamber E, packed with acid-proof stone or with parallel tubes, for further sub-division. Leaving the two opposite ends of the dividing chamber, the gases enter the lead chamber H. In order to equalise the pressure within the chamber the patentees "connect the roof or upper part of the chamber with the bottom at suitable intervals by means of distributing pipes I, which receive a portion of the high-pressure gases at the top of the chamber and conduct it along the outer or inner circumference down to the bottom." (Fig. 4.)—H. A.

Improvements in Obtaining Oxygen Gas from Atmospheric Air. A. Longsdon, London. From F. Salomon, Essen, Germany. Eng. Pat. 6553, April 29, 1890. 4*d*.

See under XX., *page* 270.

A New or Improved Continuous Method of Generating Carbonic Acid Gas from a Soluble Carbonate in Solution and an Acid in Solution, and in Apparatus connected therewith. J. McEwen, Manchester. Eng. Pat. 6758, May 2, 1890. 8*d*.

The solutions of the carbonate and of vitriol are kept in cisterns provided with taps or valves to regulate the flow of the liquors into the generator. This vessel is fitted with a number of inclined shelves to retard or prolong the movement of the solution in the generator until the mixture is as "near neutralised as found practicable." The carbonic acid gas is delivered into a gas-holder, the height of which may automatically regulate the valves on the liquor-mains, and thus the outflow of the liquor. The spent liquor in the bottom part of the receiver may be kept in constant agitation by means of an Archimedian screw, and syphoned off as desired.

Two sheets of drawings accompany the specification.

—H. A.

Improvements in the Treatment of certain Minerals or Slag containing Phosphate of Lime for the Purpose of Obtaining the Latter in a concentrated Form with or without the Production of Alkali as a By-product, and in Apparatus therefor. J. Simpson, Liverpool. Eng. Pat. 12,670, August 13, 1890. 8*d*.

It is proposed to eliminate the carbonate or oxide of lime from phosphatic rock or slag of low percentage, and so to convert the slag into a richer and marketable article. The rock is first burnt in a furnace to convert the carbonate of lime into caustic lime (in the case of slag the lime is already present as oxide), then suspended in water and treated in a series of vessels with sulphuretted hydrogen under a pressure of at least 20 lb. per sq. in., until sulphuretted hydrogen begins to be evolved at the last vessel of the series. The lime should exist now in solution as sulphydrate, which is drawn off, whilst the remaining concentrated phosphate is washed, run on a filter, and dried.

The calcium sulphydrate liquor is decomposed in another series of vessels by means of carbonic acid, and the sulphuretted hydrogen so liberated used for treating a new quantity of phosphatic rock.

An alternative working consists in treating the calcium sulphydrate liquor with a corresponding quantity of salt-cake, preferably under a pressure of 60—70 lb. of steam.

$$Ca(SH)_2 + Na_2SO_4 = 2\,NaSH + CaSO_4.$$

Hydrated calcium sulphate is precipitated, which, at this temperature, is insoluble in water. The sodium sulphydrate solution so obtained, "is preferably concentrated by evaporation to the extent of about 40 per cent.," then treated with carbonic acid, when sulphuretted hydrogen is given off and sodium bicarbonate precipitated. "Further concentrations are also necessary for the removal of the whole of the alkali as bicarbonate."—H. A.

Improved Process for Purifying Brines. H. J. Allison, London. From M. M. Monsanto, Hoboken, U.S.A. Eng. Pat. 14,544, September 16, 1890. 4*d*.

The invention consists in precipitating lime, magnesia, iron, &c., from brine by adding to the brine tri-sodium phosphate (Na_3PO_4). Even when less tri-sodium phosphate is added than is sufficient to decompose the whole of the calcium sulphate present, it has the "unexplained property" of preventing the calcium sulphate forming a scale upon the evaporating vessel.—H. S. P.

Improvements in the Production of Sulphydrate of Calcium to be used in the Manufacture of Alkali and Sulphuretted Hydrogen, and in Apparatus therefor. J. Leith, St. Helens. Eng. Pat. 15,648, October 3, 1890. 4*d*.

The gases containing sulphuretted hydrogen which are given off under pressure from the carbonating plant of the Parnell and Simpson process (Eng. Pat. 381, 1885; this Journal, 1885, 498) are passed into a series of tanks containing a mixture of Leblanc alkali-waste (or other material containing sulphide of calcium) and water, thereby forming a solution of calcium sulphydrate.

The sulphydrate thus obtained is used in the still for liberating ammonia from the ammonium chloride produced in the carbonating plant, sulphuretted hydrogen and ammonium sulphide being thus evolved. The ammonium sulphide is absorbed by brine which is afterwards treated with carbonic acid in the alkali manufacture, whilst the sulphuretted hydrogen, after passing through a scrubber where any ammonia is removed by brine or by acid, is collected in a gas-holder for use as required.—H. S. P.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

PATENT.

Improvements in Brick and Pottery Kilns. T. Fletcher, R. C. Brown, and W. Ure, Camerton. Eng. Pat. 3343, March 3, 1890. 6*d*.

By an arrangement of flues and dampers the products of combustion from any one of a series of kilns may be led as desired into any other of the kilns. With this arrangement the waste gases of a kiln nearly burnt off can be turned into a freshly lighted kiln, and so aid in consuming the smoke, economise fuel, and at the same time enable a better product to be produced by preventing discolouration.

—D. A. S.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

Hot Tests for Hydraulic Cements. M. Deval. Bull. Soc. d'Encouragement, 1890, 560—583.

H. Le Chatelier has been deputed to examine and report upon a paper by the author on the use of hot water tests for cements and hydraulic limes. In the first place he reviews the causes that have led to the adoption of such tests in the following terms:—

It is at first sight strange that tests of this character should be used for a material which is rarely used under like conditions. In order to understand why this is, it is necessary to remember that cements, when actually incorporated in the work, are in a condition of continual alteration; they suffer gradual change from the moment of setting until they are destroyed. Their destruction under the attack of natural forces may be exceedingly slow, but is in any case inevitable. Such disintegrating agencies need

above all things time for their action to become perceptible, so that no successful attempt to gauge the quality of the cement by imitating the natural conditions to which it is subjected is possible in any reasonable period. Conceding that such imitation is impossible, it is futile to cavil about any one condition such as the temperature of the water. In laying down rules for testing cement, it is only requisite to seek to adopt a method of examination which ranges the cements tested as nearly as possible in their true order of merit, and the plan thus chosen may be wholly arbitrary. Considering that rise of temperature often aids chemical action, it is reasonable to strive to ascertain whether a short test at a high temperature may not give the same results as a long period test at the ordinary temperature. Especially, as has been already shown (this Journal, 1889, 544), is a hot water test useful in detecting latent tendencies to crack or blow owing to the presence of free lime, and it seems likely that further experiments in this direction will lead to useful results.

It should never be forgotten that there is at present only one way of determining whether the judgment passed on a cement by any system of testing is sound, and that consists in waiting half a century to see how the work stands—a method of limited utility. Failing an absolute criterion, the empirical rules based on the observations of the technical worker, which are commonly accepted, must be adopted, and the chemical composition, tensile strength, free from tendency to expand and crack ascertained in the usual way.

Selecting the most generally employed method of testing, Deval has compared the tensile strength of briquettes 5 sq. cm. in section made with a mixture of 1 part of cement to 3 of normal sand gauged with the minimum amount of water, presumably by hand, and broken after the elapse of 7 and 28 days, the hardening being allowed to proceed under water at 15° C. with that of those prepared in the same manner, but exposed to water at 80° C., and broken after 2 and 7 days. The use of the least possible quantity of water for gauging was adopted at the instance of cement makers, but though giving high results for a short time after setting, has the disadvantages of causing large discordances in the results, and of making the precise figures obtained dependent on the conscientiousness of the operator as well on the extent to which he is tired by previous work. Mere experimental errors are usually as high as 10 per cent. and may reach 100 per cent. in certain instances, and this fact must be remembered in considering results such as are given below.

Portland Cement.—The chief proximate constituents of Portland cement are (1), $SiO_2.3\,CaO$, the essentially cementitious ingredient; (2) $Al_2O_3.3\,CaO$, the substance mainly active during setting and contributing to some extent to the subsequent hardening; and (3) a fusible calcium silico-aluminate whose chief function is that of a flux during burning to promote the necessary chemical reactions. (For a fuller account of these bodies see H. Le Chatelier's work; this Journal, 1889, 567.) Besides these and sundry silicates which are tolerably inert, the only other constituent calling for notice is *free lime* which may result from the use of wrong proportions or imperfect mixing or burning, and is dangerous even in quantities less than 1 per cent. The first series of experiments was carried out with six samples of cements which are classified below according to their methods of manufacture.

(1.) Good finely ground cement of modern make. It gave the following results on analysis:—

	Per Cent.			
SiO_2	21·3			
Al_2O_3	7·8			
Fe_2O_3	2·4			
CaO	65·2	CaO	MgO	2·93*
MgO	1·4	SiO_2	Al_2O_3	
SO_3	0·7			
Water and loss	1·2			
	100·0			

It left a residue of 3 per cent. on a sieve with 900 meshes per sq. cm. and 18 per cent. on one of 500 meshes.

(2.) Coarsely ground cement of good quality, but of somewhat ancient date and partly aërated by long storage in the laboratory:—

	Per Cent.		
SiO_2	23·8		
Al_2O_3	8·4		
Fe_2O_3	2·5		
CaO	58·3	$CaO + MgO$	= 2·42*
MgO	1·2	$SiO_2 + Al_2O_3$	
SO_3	1·3		
Water and loss	†4·5		
	100·0		

3 per cent. on 185 mesh sieve; 11 per cent. on 900; 35 per cent. on 5,000.

(3.) Quick-setting cement made by reducing the percentage of lime, and the consumption of fuel in order to compete with the natural Vassy cements.

	Per Cent.		
SiO_2	22·1		
Al_2O_3	8·6		
Fe_2O_3	2·5	$CaO + MgO$	= 2·60*
CaO	63·4	$SiO_2 + Al_2O_3$	
MgO	1·4		
SO_3	1·0		
Water and loss	1·0		
	100·0		

The three cements the composition which has just been given may be considered of good quality for their respective uses.

(4.) Cement made from clinker possessed of the property of disintegrating spontaneously while cooling, indicating the existence of a large proportion of inert material:—

	Per Cent.		
SiO_2	28·2		
Al_2O_3	8·1		
Fe_2O_3	2·6		
CaO	58·4	$CaO + MgO$	= 1·98*
MgO	0·9	$SiO_2 + Al_2O_3$	
SO_3	1·0		
Water and loss	‡0·8		
	100·0		

(5.) Underburnt cement obtained by grinding the underburnt clinker that is always present in larger or smaller quantity. Such cement contains free lime and slakes slowly on exposure to air.

	Per Cent.		
SiO_2	20·1		
Al_2O_3	7·7		
Fe_2O_3	2·2	$CaO + MgO$	= 2·93*
CaO	65·0	$SiO_2 + Al_2O_3$	
MgO	1·0		
SO_3	1·4		
Water and loss	2·6		
	100·0		

This particular sample is not only underburnt but high in lime, so high that it would be difficult to ensure perfect combination even by adequate burning.

(6.) A cement exceedingly high in lime made for experimental purposes. It is quite unfit for use even though properly burnt. Briquettes of neat cement even hardened under cold water expand and crack badly.

	Per Cent.		
SiO_2	20·0		
Al_2O_3	6·3		
Fe_2O_3	1·9		
CaO	66·0	$CaO + MgO$	= 3·1
MgO	0·9	$SiO_2 + Al_2O_3$	
SO_3	1·2		
H_2O	2·5		
Undetermined	§1·2		
	100·0		

* For the explanation of these ratios see Le Chatelier's work, Recherches Expérimentales sur la Constitution des Mortier Hydrauliques, p. 871; the weights are molecular and not in percentages.

† 2·5 in original. ‡ 0·9 in original. § 0·7 in original.

The last three cements are of bad quality.

All these cements were tested in the same way, being made into briquettes composed of 1 part of cement to 3 of normal sand, using 11 per cent. of water for mixing, and immersing them 24 hours after gauging. In the case of those tested cold, they were broken at 7 and 28 days after immersion, while the others were kept in water at 80° C. for periods of 2 and 7 days. The results were as follows:—

	Cold.		Hot.	
	Tensile Strength in Kilos. per Sq. Cm.		Tensile Strength in Kilos. per Sq. Cm.	
	7 Days.	28 Days.	2 Days.	7 Days.
(1.) Good fine-ground cement	15·0	23·2	17·2	24·3
(2.) Coarse-ground cement..	6·7	13·7	7·6	11·0
(3.) Quick-setting cement...	6·2	16·5	7·3	16·2
(4.) Partly inert cement	2·9	3·9	Disintegrated.	
(5.) Underburnt cement	6·1	12·2		
(6.) Over-limed cement	7·6	20·2		

These figures need little comment. It must be noted, however, that there are two causes at work leading to the destruction of cements of bad quality: (i.) incomplete setting at the moment of immersion; (ii.) expansion due to the presence of free lime. The first of these is chiefly the reason of the failure of (4). On allowing it to set for 48 hours before immersion, no disintegration took place. Its tensile strength was then:—

Hot.		Cold.	
2 days	3·2	7 days	2·9
7 days	4·3	28 days	3·9

The similarity of the results obtained at 2 and 7 days hot to those at 7 and 28 days cold is worthy of notice. Overlimed cements disintegrate even if allowed several days to set before immersion in hot water. They can be rendered safe by exposure to moist air, so as to slake the lime previous to gauging, but of course lose enormously in strength when tested cold.

The following deductions may be drawn from these experiments:—

(1.) Tests made cold do not indicate the quality of the cement, inasmuch as cement containing excess of lime, and, in consequence, deplorably bad, may give excellent results.

(2.) Portland cement of good quality mixed with normal sand in the proportion of 1:3 resists water at 80° C. Its strength at 2 and 7 days after setting is about equal to that which it would have at 7 and 28 days in the cold.

(3.) Poor cement containing much inert matter does not resist the action of water at 80° C. unless the setting be allowed to proceed for some days before immersion. With this precaution, the relation between the tests hot and cold is the same as with good cement.

(4.) Cements containing free lime, whether because of the use of too large a proportion of chalk, imperfect mixture, or under-burning, do not withstand the action of water at 80° C. if immersed 24 hours after setting. When the percentage of free lime is tolerably small, whether so originally or after the bulk has been slaked by aëration, the cement will resist the action of hot water if immersed some longer time after setting. But in this case the tensile strength at 2 and 7 days hot is considerably lower than that at 7 and 28 days cold. Comparison of the strength hot and cold will suffice for the detection of even small quantities of free lime.

Further experiments were instituted on several kinds of hydraulic limes and cements. The results may be given briefly *seriatim*:—

(1.) Fifteen Portland cements, both "natural" (*i.e.* made from "cement stone") and artificial (from chalk and clay) were tested hot and cold. The figures obtained showed that the tensile strength at 7 days at 80° C. was approximately equal to that at 28 days cold, as in the former series of experiments. Where divergencies occur, they are always indicative of the greater utility of the hot tests, which favour the complete setting of the pozzuolanic material in certain highly siliceous good-quality cements, which sets with great slowness in the cold, and give low results with cements containing free lime, which cements may appear of high tensile strength when judged by a short-time cold test.

(2.) The results of six samples of slag cement which had been tested by *Prost* instead of Deval, are given in tabular form. In this case, the tests were made in compression, and the temperature used was 90° C. Moreover, the moulds were simply filled with the trowel, instead of the material (cement 1, sand 3) being beaten in. (For an account of the nature and composition of modern slag cements, see this Journal, 1890, 863.) It may be noted that in general slags rich in lime produce the best slag cement, provided that they can be preserved in the vitreous state by sudden cooling—a matter of some difficulty, as they tend to pass into the crystalline condition more easily than those containing less lime.

The general conclusions from these experiments are similar to those given above for Portland cements. The substitution of hot for cold tests would be particularly advantageous in the case of slag cements made with hydraulic as opposed to "fat" lime, as by this means samples made with hydraulic lime imperfectly slaked would be detected.

(3.) Eleven quick-setting cements made by burning argillaceous limestones at a temperature just high enough to drive off their carbon dioxide, and in consequence containing much free lime and but little of the more powerfully cementitious compounds formed at higher temperatures were tested hot and cold. But little agreement between the two series of results could be found, the figures for the hot tests at 7 days being in general higher than those of the cold at 28 days. It is difficult to say which method of testing ranges the samples most nearly in their true order of merit. Sufficient attention has not yet been paid to this class of cements, which has a somewhat limited use. The presence of free lime remaining unslaked, derived from the somewhat harder burnt portions that are liable to be present, would at least be detected by the hot test.

(4.) Experiments on 11 samples of hydraulic limes were also carried out. In order to understand their significance, Le Chatelier's views concerning the nature, composition, and properties of hydraulic lime must be recalled. Hydraulic lime is obtained by burning limestone rich in silica and poor in alumina. It should, after burning, contain sufficient free lime to cause its spontaneous disintegration by slaking. In consequence of the high percentage of lime no vitrification is to be feared, and a continuous system of burning can be used, economising fuel and lowering the price of the product below that of any similar hydraulic material. The active ingredient in hydraulic lime is the same tri-calcium silicate characteristic of Portland cement, viz., $3\,CaO,\,SiO_2$. Less basic silicates of lime may be present which act as puzzolanic materials with the free lime present, and bring about gradual hardening. Such aluminates as are formed become hydrated during the slaking process, and may be regarded as inert. Unless, however, the silica be in a fine state of division (in particles about $\frac{1}{1000}$ mm. in diameter) combination with the lime is difficult to effect in the absence of some alumina, which acts as a flux even as it does in the case of Portland cement. In order to obtain a product containing enough free lime, limestones must be used in which $\frac{CaO}{SiO_2 + Al_2O_3} > 3$. In practice about 4 equivalents of lime would be required. But as complete combination cannot be expected, more siliceous limestones are generally used so as to get highly hydraulic products with a moderate consumption of fuel. Thus the Theil limestones, which may be regarded as a type of what an hydraulic limestone should be, contain 3 equivalents of lime to 1 of silica. The intimate relation between the proportions necessary for

good hydraulic lime and those requisite for good Portland cement is shown by the fact that this limestone yields excellent cement when burnt hard enough.

The proper slaking of the hydraulic lime after burning is at least as important a factor. In works where fuel economy is pushed to an extreme, under-burnt products are turned out, and if these were thoroughly slaked they would be of low tensile strength. In consequence there is a natural tendency to slake them imperfectly, the free lime which they contain causing them to give good results at first, although they become disintegrated eventually. Such materials would escape unnoticed by the cold test, but would be at once detected if tested hot.

Deval's experiments have been made with hydraulic limes of mediocre quality used in the Paris municipal works, and have been conducted on lines essentially different from those hitherto described. In order to test them under conditions similar to those obtaining in practice, the briquettes were ganged with a large percentage of water, so retarding the setting that as much as 6—30 days were allowed to elapse before immersion. The results are, in consequence, not directly comparable with those quoted above. It is at present impossible to draw any exact conclusions from the figures about to be given, but they are worth reproducing if only because of the absence of any previous experiments in this direction.

—	Hot Water Tests.		Cold Water Tests.	
	Length of Time between Ganging and Immersion.	Tensile Strength at Seven Days after Immersion.	Tensile Strength.	
			28 Days.	Six Months.
	Days.	Kilos. per Sq. Cm.	Kilos. per Sq. Cm.	Kilos. per Sq. Cm.
A	10	8·4	3·00	11·60
B	6	8·3	2·15	7·00
C	6	7·8	1·45	5·50
D	26	7·1	1·70	7·05
E	26	6·0	2·20	5·00
F	20	5·4	1·95	7·05
G	18	5·2	2·15	7·90

The briquettes contained two parts of hydraulic lime to five of normal sand, the quantity of water used being about 70 per cent. of the weight of the lime.

Chatelier has supplemented these results by others made on similar materials, only more carefully manufactured. In this case a mixture of one of lime to two of normal sand was used, and the tests made in compression. The briquettes were immersed after 48 hours' setting. A second set of experiments was at the same time made with the same hydraulic limes slaked by being moistened with 10 per cent. of water, and dried for 48 hours at 100° C. and for other 48 hours at 150° C. The following figures were obtained:—

Sample.	Strength in Compression at Seven Days. Kilos. per Sq. Cm.	
	Hot Tests.	Cold Tests.
X In original state	107	28
X After re-slaking	82	14
D In original state	43	14
D After re-slaking	28	12
F In original state	43	12
F After re-slaking	37	12
G In original state	46	14
G After re-slaking	68	14

Samples X and D, seeing that they lose strength by re-slaking, may be considered fully slaked originally. Samples F and G are improved by re-slaking: hence it appears that they were originally badly slaked. Save for the conclusion that the hot tests tend to prevent hydraulic products being ranked as good if they contain free lime, few definite deductions may be drawn.

The extreme value of the method in this respect is yet again demonstrated by a comparison of the results given by some experiments made in 1884 on hydraulic limes from Teil, Saint Astier, and Pavier.

The composition of the raw material used for the first two is nearly identical, but the Teil hydraulic lime is well burnt and thoroughly slaked for 8—15 days, while that of Saint Astier is lightly burnt and the slaking occupies only 48 hours.

Kind of Lime.	Cold Tests.				Hot Tests.	
	7 Days.	28 Days.	42 Days.	Expansion.	7 Days.	Expansion.
Teil	12·5	19·5	39·0	Nil	69·0	Nil
Pavier	3·6	8·5	17·0	Nil	48·0	Nil Per Cent.
Saint Astier (1)	19·5	33·0	51·0	Slight	30·0	15
Saint Astier (2)	16·5	21·0	27·0	Slight	15·0	30
Saint Astier (3)	8·0	13·0	33·0	Slight	7·5	30

The results are in kilos. per cm.

From this it is seen that the hydraulic limes from Saint Astier which contain free lime give higher results for short time cold tests than those from Teil, which are really far better than they. It is only after the elapse of three months that their respective merits can be rightly determined by cold tests, whereas they are correctly classed by the hot test in seven days.

Conclusions.—The conclusions drawn from this lengthy and most important paper are as follows:—Good hydraulic limes and cements are ranked in the same order, whether tested hot or cold. Products containing free lime which may pass the scrutiny of the cold test are condemned by the hot. Products containing puzzuolanic matters, which are practically inert in the cold, rank higher when tested hot, inasmuch as these constituents react and add to their strength. The value of the hot test will be greatest for "natural" Portland cements and similar materials, the composition of which is not so thoroughly under the control of the maker as is that of ordinary Portland cement. It is not to be expected that manufacturers will view with favour the adoption of the hot test in engineers' specifications, as it differentiates good from mediocre cements rather too sharply. Cement users as opposed to makers will probably be prejudiced against it both on account of its novelty and because of the distrust engendered by the erroneous dictum of Michaelis, who first used the hot test, that there was a definite relation between results got by it and those obtained in the cold. This idea is completely exploded, and the fact of no such relation existing is the whole secret of its usefulness, for it permits of the elimination of certain thoroughly bad cements which escape detection by the cold test.

It would be injudicious to endeavour to substitute hot for cold testing all at once; the best plan to adopt is to institute the practice of making hot tests side by side with those ordinarily used, in order to ascertain, not whether any regular relation exists between them, but simply to gain the opportunity of studying the conditions of manufacture and ultimate behaviour in practice of such cements as show noteworthy divergences when tried by the two methods.

It must not be forgotten that the hot test can only replace the corresponding tests in the cold. The usual determinations of speed of setting and hardening must be retained.

To recapitulate the method of testing proposed, it may be said that the cement must be mixed with normal sand in the proportion of 1 to 3, the briquettes immersed at the end of

48 or 72 hours according to the speed of setting, and broken after seven days' exposure at 80° C. The results should be compared with those obtained at 28 days in the cold.—B. B.

PATENTS.

A New or Improved Artificial Asphalt. C. Smith, London. From G. P. V. Nielsen, Frederiksberg, Denmark. Eng. Pat. 20,303, December 17, 1889. 4*d*.

This material is a mixture of resin, 13 parts, chalk, 26 parts, ordinary gravel, 53 parts, and tar, 8 parts; "a little natural asphalt" being added, "according to circumstances."

—E. G. C.

Improvements in Furnaces or Kilns for Burning Bricks, Tiles, and the like. G. Möller, Hohenlimburg, Germany. Eng. Pat. 3985, March 13, 1890. 8*d*.

In this invention the kilns are built so as to avoid having a large number of channels for carrying the gases or any inaccessible valves.

The air is led through a series of chambers, so that after being used for cooling bricks, the heated gas passes on, and subsequently passes out with the products of combustion and over unkilned bricks or tiles to preliminarily dry them. The orifices of the channels through which the air and gases pass are covered by means of lids with sand joints which can be attended to at any time if required.

There is also an improved arrangement for regulating the draught.—D. A. S.

Improvements in Kilns for Burning Bricks, Tiles, and other Clay Goods. E. P. Lee, Cardiff. Eng. Pat. 4504, March 22, 1890. 8*d*.

This is an improvement on kilns for burning bricks, &c., flues being built with dampers so that the communication between the kilns can be controlled in such a way that the surplus heated air and fumes, instead of being discharged into the atmosphere, are directed from any kiln in use into a fresh one, for the purpose of "steaming" or drying off, and heating the goods before being finally burnt.—D. A. S.

Improved Article of Manufacture for use as a Substitute for Wall Papers, Flooring, and other Ornamental Coverings. G. Baker, Birmingham. From H. Silver and S. S. Ritchie, Lindsay, Canada. Eng. Pat. 17,782, November 5, 1890. 6*d*.

"The object of the invention is to produce a useful article of manufacture to be used as a substitute for wall paper, flooring, and other ornamental coverings, and it consists essentially of two or more strips of thin wood veneer cemented upon a backing of paper, cloth, or other flexible fabric."—E. J. B.

Improvements in and relating to Furnaces for Burning Bricks and the Like. L. Trevisan, Villaverla, Italy. Eng. Pat. 20,251, December 11, 1890. 6*d*.

The burning of bricks is hereby continuously affected by means of combustion of gas generated by the distillation of coal in retorts placed in the interior of the furnace, coke being obtained as a by-product. The material to be burned is placed in the furnace, and some vertical retorts are built in proportion to the size of the compartment with bricks to be burnt preferably firebricks, a free space being left between the walls of neighbouring retorts to enable the flames to surround them. As soon as the temperature has been raised to a suitable point, coal is introduced gradually to the interior of the retorts. Thus the coal is only introduced when the retort is sufficiently hot for distillation.

—D. A. S.

X.—METALLURGY.

PATENTS.

Manufacture of Nickel and of Cobalt, and of Alloys of either of these Metals with Iron. A. M. Clark, London. From C. Combier, La Société Anon, "Fonderie de Nickel et Metaux blancs," Paris, France. Eng. Pat. 2243, May 2, 1883. (Second Edition.) 6*d*.

Malleable and ductile nickel, cobalt, ferro-nickel, and ferro-cobalt are obtained by melting metallic nickel or cobalt with cyanide or ferro-cyanide of potash and oxide of manganese, soft iron being also added in the case of the alloys.

The mixture, when fused, forms a mass which is thoroughly stirred by the constant ebullition due to the disengagement of gases; when this ceases the temperature is raised and the metal poured into moulds.

"Given a peroxide of manganese containing a mean of 74 per cent. of metallic manganese, the best proportions are 12 parts of cyanide or ferro-cyanide of potassium to 100 parts of matters to be melted."

In the manufacture of ferro-nickel and ferro-cobalt, soft iron of the best quality should be used for alloying; the addition of a very small quantity of aluminium to the crucible ensures the homogeneity of the metal and facilitates the subsequent working.—S. B. A. A.

Improvements in the Manufacture of Metallic Alloys or Compounds. G. E. Vaughan, Middlesex. From L. Weiller, Angoléme, France. Eng. Pat. 18,211, December 13, 1888. (Second Edition.) 6*d*.

This improvement consists in the addition of a small quantity of zinc or spelter to copper or bronze containing silicon or sodium, or both silicon and sodium, for the purpose of improving the tenacity and ductility of the above alloys. If the resulting metal is to be of the nature of brass, the quantity of spelter added may amount to 40 per cent., but if bronze is required it must not exceed 5 per cent.

—H. K. T.

Improvements in Obtaining Alloys of Aluminium with Other Metals. J. Clark, Birmingham. Eng. Pat. 12,648, August 10, 1889. (Second Edition.) 6*d*.

Waste materials containing aluminium silicate, also bauxite or cryolite, are mixed with quicklime, fluorspar, carbon, and sometimes common salt. The mixture is then ground up with water, dried and heated in a furnace in contact with fuel, until fusion takes place. The fused material is ground to powder and mixed with metal in small pieces, charged into crucibles and heated, when an alloy of the metal with aluminium is produced. The fused silicate may also be mixed with iron or steel in small pieces and charged into a blast or cupola furnace for the production of ferro-aluminium, or it may be used as a lining for a Bessemer converter or for the bed of a reverboratory furnace.

—H. K. T.

Improvements in and Connected with Steel-making and other Water-Gas Furnaces. W. Deighton, Leeds. Eng. Pat. 13,301, August 23, 1889. 8*d*.

This invention is designed to simplify the construction and arrangement of steel-making and other furnaces using "water-gas" as fuel, and for the elimination of non-metallic substances from the molten metallic bath in the form of vapour or gases.

The body of the furnace may be stationary, rotating, or otherwise, and a special feature is that it dispenses with all the usual arrangements for reversing the current or flow of the air and gas. The flow of air and gas is always in one direction through the furnace, and an extra jet of air or gas may be introduced at any desirable point. The waste gases are led through a second furnace in order to melt the metal so that it will flow freely into the first furnace to be finished.—D. A. S.

Improvements in Furnaces such as Cupola and Blast Furnaces. F. E. Ross, Croydon. Eng. Pat. 16,338, October 16, 1889. 8*d.*

THE hot gases and products of combustion that escape from the upper part of cupolas and blast furnaces are utilised by being drawn down and caused to re-enter the furnace at a lower part and to be completely burnt, thus effecting economy in the working. The jets of air usually blown in at the bottom may be used to induce the hot gases to flow and re-enter the lower portion of the furnace. A pump may, however, be used for the same purpose.

For melting metal in cupolas as ordinarily constructed and worked, it is necessary to use coke as fuel, but by re-constructing and working cupolas in the special way described it is claimed that coal can be used, as the coal will be converted into coke before it reaches the melting and combustion chamber. The combustible vapours driven off during the coking operation are drawn off with the hot gases withdrawn from the combustion chamber, and introduced with these gases into the combustion chamber by the inducing action of the air tuyere and are thus utilised.

There are two sheets of drawings completely illustrating this specification.—D. A. S.

Improvements in Treating Ores to Obtain Precious Metals, and in Apparatus therefor. T. Young, Glasgow. Eng. Pat. 20,181, December 16, 1889. 8*d.*

THIS invention consists of a new form of precipitating vessel for the lixiviation products of chlorinised ores, which is also adapted for use in other operations involving precipitation and filtration.

The vessel consists of a central cylindrical part bolted by flanges to a curved top and curved bottom, it is air-tight and completely lined with rubber. The top piece is connected with the space beneath the false bottom of the tank in which the chlorinised ores are lixiviated, and is fitted with pipes for the introduction of steam and liquid reagents. A vulcanite or protected metal discharge pipe communicating with a filter press passes through the top piece and dips down to the bottom of the vessel, a little above which there is a perforated vulcanite diaphragm on which crystals of ferrous sulphate or other reagents are placed. Before treating a charge, the air in the vessel is expelled by injecting steam, the latter on condensing dissolves the reagents on the diaphragm and causes a partial vacuum in virtue of which the solution in the tank is drawn over on opening a valve in the connecting pipe. When the precipitation is complete steam is again admitted, and the mixture forced through the discharge pipe into the filter press.—S. B. A. A.

Improvements in the Manufacture of Steel and Iron. J. Mackintire, Sheffield. Eng. Pat. 213, January 6, 1890. 6*d.*

THESE improvements are in the compounding of certain mixtures, the use of which in any modern steel-making process is alleged to ensure the production, from various grades of iron, of high-class metal of all kinds, and to render possible the manufacture of steel combining very high tensile strength, well defined elongation, and perfect soundness. The mixtures may also be used with good results in the puddling furnace. One composition consists of (1), 7 oz. of a mixture of 98½ per cent. calcium carbonate with 1½ per cent. of calcium phosphate; (2), about 5 oz. of black oxide of manganese; (3), ½ oz. of tannin; (4), 6 oz. of vegetable soot well mixed with 2 oz. of bone black; (5), 2 oz. of tar well mixed with from 2 to 3 oz. of water. To the last ingredient first (4) is added, then an intimate mixture of (1), (2), and (3), and the whole is triturated into a compact cake. This is introduced into the crucible either with the charge of cold metal or into the molten mass. The above ingredients may with some advantage be used in the form of an iron alloy, especially in the Bessemer converter. 1¾ lb. of the mixture of calcium carbonate and phosphate, 1¾ lb. of manganese dioxide, 1¼ oz. of tannin, ½ lb. of soot, ¼ lb. of animal black, and 1 oz. of tar made into a paste with water and formed into a cake, is added to 40 lb. of hæmatite pig melted to a pasty condition, covered with 26 lb. of cold pig, and the whole run down and cast into moulds. When required for use the alloy is re-melted in a cupola, and run into the converter at the termination of the blow, no spiegel or lime being added, a further blow of about one-half minute is given and the metal tilted into the ladle and cast. The proportion of the alloy added may be varied up to 16 per cent. of the iron, but when a steel containing more carbon is required the alloy is melted with a sufficient quantity of pig iron for the Bessemer and open-hearth processes, and the carbon is directly added as wood charcoal in the crucible process. Improved iron castings may be made from equal parts of the alloy, scrap iron, and pig iron, also with a smaller proportion of the alloy according to requirements. In the puddling furnace the alloy or mixture should be added before the molten iron comes to nature.—S. B. A. A.

Improvements in the Extraction of Metals from Ore or other Material containing them, and Apparatus therefor. J. E. Chaster, Shawlands. Eng. Pat. 316, January 8, 1890. 8*d.*

THIS invention relates to a new form of amalgamating pan in which the mercury is kept from sickening by the passage of a current of electricity. It consists of an oblong trough containing mercury and closed at one end by a perforated iron plate or wire gauze for the discharge of water and tailings. Resting upon the mercury and nearly filling the trough there is a rectangular framework with a perforated base of which the upper or under surface is covered by a metal plate separated from the mercury by a diaphragm of some porous material such as canvas or raw hide. This plate forms the anode of the circuit, the mercury forming the cathode. One side of the framework is depressed below the surface of the mercury, and has attached to it a high vertical shoot or feed pipe opening below the framework and containing a head of water and ore sufficient to overcome the pressure of the mercury. The whole framework is oscillated by suitable machinery from side to side of the trough. In the treatment refractory ores the trough may be heated by means of a steam chamber placed below.

—S. B. A. A.

Improvements in the Manufacture of Copper. T. Twynam, Bedford Park. Eng. Pat. 560, January 11, 1890. 4*d.*

ACCORDING to this invention copper mattes, coarse metal, cupola metal, and other cupriferous products containing a large percentage of iron may be converted into blister or refined copper in a single operation. The matte or coarse metal, or a mixture of these substances with copper precipitate, is mixed with the necessary quantity of siliceous material, preferably siliceous copper ore or slags, and charged into a Siemens or reverberatory furnace provided with a lining of chrome iron ore made coherent by either of the methods previously described in Eng. Pat. 8358 or 8359 of 1886 (see this Journal, 1886, 494). When a reverberatory furnace is employed an air blast may be used to promote the oxidation of the iron. The slag formed is skimmed off at intervals, siliceous material being added if it be not readily fusible. When the iron is removed or nearly so the copper remains as white or purple metal, which after complete removal of the slag is treated at intervals with small quantities of lime, and the operation continued until the metal is converted into blister or refined copper. Chrome iron lined furnaces may be advantageously employed in melting copper precipitate as the lining is not attacked. Cupriferous materials containing much arsenic and not less than 50 per cent. of copper may be bessemerised in chrome iron lined converters with special advantage. In this case when the iron and the sulphur have been oxidised and removed in the slag, a suitable basic addition such as a mixture of lime and soda ash is made, and the blowing continued until the arsenic passes into the slag formed.—S. B. A. A.

Improved Construction or Arrangement of Apparatus for Coating Hoop Iron with Tin or Terne Metal. T. H. Johns, London. Eng. Pat. 1522, January 28, 1890. 6*d*.

This apparatus consists of a flat perforated tube immersed in a bath of molten tin or terne metal, through which the hoop iron is caused to travel. On issuing the edges of the hoop iron are caught by rolls set vertically, and the hoop iron is forced between adjustable scrapers. It afterwards meets a current of cold air for the purpose of causing the metallic coating to set.—H. K. T.

An Improved Process for Treating Iron and other Ores, and Apparatus therefor. M. R. Conley, Brooklyn, and J. H. Lancaster, New York, U.S.A. Eng. Pat. 1806, February 3, 1890. 11*d*.

This is a direct reduction process and consists in the deoxidisation and also desulphurisation and dephosphorisation of iron or other ore by heating it in a closed retort with hydrocarbon gases. A metal or fireclay retort partially surrounded with firebricks, provided with a swinging door at one end and supported within a brick setting, is heated externally by gaseous or solid fuel to 1,500° F. The granulated ore is charged from a hopper car through a deep shoot, the mouth of which is immediately secured; producer-gas is then injected and the mass kept in agitation by a series of stirrers carried on a central shaft revolving in bearings at either end of the retort. Intermittent rabbling may be substituted for the mechanical stirrers, but in this case precautions must be taken to minimise the access of air. The waste gas passes off through a narrow exit pipe, and may be utilised as fuel. The reduction is complete in 3 to 6 hours, and is indicated by the appearance of the ore or of the issuing gases. The door is then raised and the mass rapidly emptied through a shoot immediately beneath the door into a closed moveable car in which it is conveyed to the roof of an open-hearth furnace, and charged through a suitable aperture by opening a valve in the base of the car. The contrivances described have for their principal object to prevent access of air to the retort, and to the granular or spongy iron during transit to the melting furnace.

—S. B. A. A.

Improvements in the Method of Precipitating Gold or Silver in the Process of its Extraction. J. Buchanan, Glasgow. Eng. Pat. 2390, February 14, 1890. 4*d*.

The solutions of gold and silver obtained in the chlorination processes are allowed to percolate through iron or steel borings, or some other finely-divided metal or alloy capable of precipitating the above metals. When the solution contains copper it is first allowed to percolate through copper turnings, whereby the bulk of the gold and silver is thrown down. It is then treated with iron, when the copper with the rest of the gold and silver is precipitated. The precipitated metals are removed by riddling and washing the turnings and filtering out the suspended metal; or the precipitating metal may be kept in agitation whilst the precipitation is going on, the gold and silver being afterwards obtained from the liquor by filtration, or by allowing the precipitated metals to settle.—H. K. T.

A Process for Extraction of Tin from the Slag or Débris of Tin Smelting. T. Teague, Devoran. Eng. Pat. 5638, April 14, 1890. 4*d*.

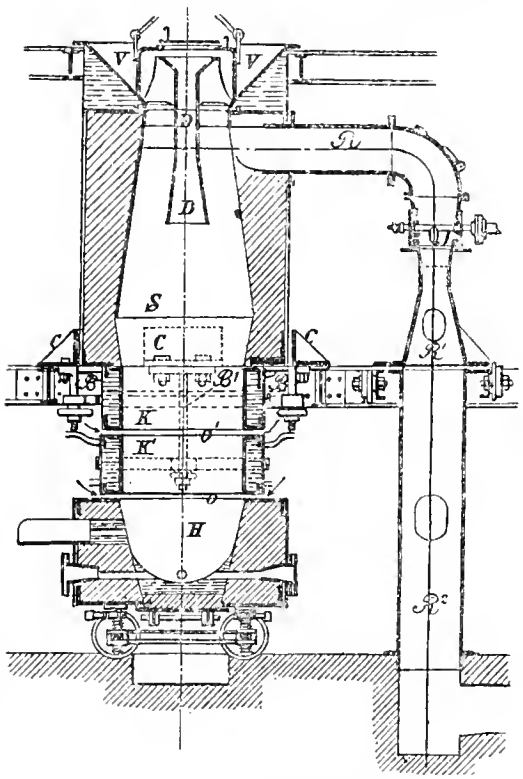
Tin slags or débris in fragments are mixed usually with about 10 per cent., but if necessary with 10—25 per cent. of smaller fragments of fluor or other spar, elvan blue or mixtures of these, preferably along with a little lime, and, in cases where there is little or no reducing material in the slag, coal-dust or other powdered carbonaceous matter is added. The whole is well mixed in a pot, run down, and teemed into a sand mould of sugar-loaf form. After cooling the cast is removed and the tin is found collected in a button at the bottom.—S. B. A. A.

Improvements in or relating to the Art or Process of Galvanising Metal Tubes and Bars, and in Means or Appliances for use therein or relating thereto. T. L. Thomas and J. B. Hillman, Tipton. Eng. Pat. 8572, June 3, 1890. 8*d*.

In the usual method of galvanising, the articles to be coated, after immersion in the molten bath, are withdrawn slowly from the metal through a special flux, and are placed on fine edges and rotated until the coating has set. The patentees, however, remove the article rapidly and draw it through asbestos dies, whereby a more even coating is effected, and less waste of metal is occasioned. The article is then immersed in a water-bath.—H. K. T.

Improvements in Smelting Furnaces. F. A. Herbertz, Cologne, Germany. Eng. Pat. 14,053, September 6, 1890. 6*d*.

In this furnace the draught is caused by means of suction produced by a steam jet, the air entering the furnace by means of circular adjustable apertures. The furnace consists of a fixed stack S, below which are suspended by



Improved Smelting Furnace.

means of the hanging bolts B, B_1, two water-jacketed annular chambers K, K_1, an annular space O being left between them for the entrance of air, which also enters through the space O left between the lower annular chamber and the moveable hearth H. The draught is caused by a steam jet J, which draws the products of combustion through the flues R_1 R_2. In order to prevent the choking of the flues by mechanically suspended particles the upper of these, R_1, is removable and can be replaced by a similar flue so as to allow of its being cleaned without interrupting the process. Finely-divided ore is introduced through the shoot D into the body of the furnace, coke and coarser material being added through the shoot V.—H. K. T.

Improvements in Apparatus for Decomposing Metallic Salts and Desulphurising Ores. H. H. Lake, London. From O. B. Peck, Chicago, U.S.A. Eng. Pat. 16,545, October 17, 1890. 8*d*.

THIS apparatus consists of a receiving vessel in which the metallic salts or ores are treated in a molten condition and which may be rotated at a high speed upon a central vertical shaft. This vessel is provided with one or more cast-iron linings, slightly incomplete to allow for expansion, the open slits being provided with cover-pieces. The lining for the neck and mouth of the receiving vessel is made with vertical recesses into which are dovetailed blocks with channels in their faces, and around the upper part of the vessel is an annular tub into which the molten substances under treatment forced up the channels by centrifugal force finally subside. A device is also shown for cooling the vessel by the circulation of water. (Compare Eng. Pats. 17,069 of 1888 and 10,288 of 1889; this Journal, 1889, 400 and 868.)—S. B. A. A.

Improvements in the Manufacture of Steel and Ingot Iron. P. M. Justice, London. From J. Meyer, Dudelange, Germany. Eng. Pat. 17,613, November 3, 1890. 4*d*.

THIS is a process for the direct introduction of carbon into iron which has been decarbonised and dephosphorised in acid or basic converters or in Siemens-Martin furnaces. A mixture is made of 95 parts of powdered charcoal or anthracite coal and 5 to 8 parts of quicklime, the whole being made into a paste with water and left for 12 to 30 hours. The mixture is then made into briquettes and dried.

In order to effect recarbonisation, one-third of the total weight of briquettes to be used is placed in the casting ladle, and the molten metal, previously freed from slag, is poured upon it, the remainder of the briquettes being added to the metal whilst it is being poured into the ladle. A portion of the carbon is oxidised furnishing a large amount of heat, so that there is no danger of the metal setting whilst being poured. The lime which the briquettes contain combines with the silica of the ash and rises to the surface as a fusible slag. It is advisable to break this crust during the recarburisation so as to allow free escape for the gases produced by the combustion of the carbon.

The following are the quantities of briquettes required for the recarburisation of a metric ton of pig iron:—

Pig Iron.				Per Cent. of Carbon.
2·5 to 2·8 kilos.	of briquettes	for steel	with	0·10 to 0·15
3·0 to 3·2	„	„	„	0·15 to 0·20
4·0 to 4·5	„	„	„	0·25 to 0·30
5·0 to 5·3	„	„	„	0·30 to 0·35
6·7 to 7·0	„	„	„	0·40 to 0·45
7·0 to 7·5	„	„	„	0·45 to 0·50

—H. K. T.

Improvements in or Appertaining to the Manufacture and Tempering of Steel. W. P. Thompson, Liverpool. From M. F. Coomes and A. W. Hyde, Louisville, U.S.A. Eng. Pat. 18,171, November 11, 1890. 4*d*.

ACCORDING to this invention malleable cast iron or soft steel is carburised by placing the white-hot metal in a bath composed of water, sugar, common salt, and ammonium chloride, and allowing it to remain there whilst cooling. To prepare the bath, sugar is added to a saturated aqueous solution of common salt until no more is dissolved; the compound solution is then saturated with ammonium chloride. This solution may also be used as a tempering bath in the ordinary way.—S. B. A. A.

Improvements in the Manufacture of Coated Aluminium Plates or Surfaces and in the Application of the Same for Coating or Soldering to Other Metals. W. P. Thompson, Liverpool. From C. H. Land, Detroit, U.S.A. Eng. Pat. 18,915, November 21, 1890. 6*d*.

THE inventor finds that pure tin will unite with aluminium at a temperature above the melting point of tin provided the heated metal is burnished over the surface of the aluminium. Aluminium plates are in practice coated with tin by immersing them in a bath of the molten metal and burnishing them whilst immersed; such plates may then be soldered with pure tin or common solder, or may be united with tin-plated metals by heating both plates and pressing them together. The method is useful for attaching aluminium facings to metallic surfaces, and in the manufacture of aluminium cylinders for compressed air. The latter may consist of a tin-coated aluminium plate folded over into a cylinder of as many thicknesses as desired and sweated together, a tin-coated aluminium wire may then be likewise wound around the cylinder and sweated on.—S. B. A. A.

XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

The Elmore Copper-Depositing Process. Engineering, 1891, **51**, 141—142; and Engineer, 1891, **71**, 178—179.

THE copper is brought into the works in its rough state as Chili bars. These contain about 97 per cent. of pure copper, and in the remaining 3 per cent. are present about about ½ oz. of gold and 3 oz. of silver per ton. The Chili bars are first melted in a furnace, and the molten metal is poured into a crucible which holds about a ton. The crucible is carried on a small truck, which runs over a light track, and the metal is poured into a large tank of water in order to granulate it, so that it may be in a suitable condition for use in the tanks.

The depositing tanks are made of wood, coated inside with a bituminous composition. At the bottom of each tank is fixed a perforated copper plate, which is covered with the granulated copper. The tanks contain a solution of sulphate of copper in water, with a small quantity of sulphuric acid. When it is desired to make a tube, an iron mandrel, the size of the bore of the tube, is placed horizontally in the tank, being held at each end in bearings. Before being placed in the bath the mandrel receives a thin coat or film of copper, by means of the ordinary cyanide process. The mandrel is caused to revolve in the bath by means of chain gearing run by suitable mechanism. The mandrel thus forms a cathode, whilst the anode consists of the granulated copper which is spread on the perforated tray at the bottom of the bath. The average density of the electrolyte is 16·5 B.

Although it would appear that there ought not to be much difficulty in manufacturing a cast iron tube 10 ft. or 12 ft. long, and of even thickness throughout its length, and without sponginess, yet it appears to be extremely difficult. When the mandrel is thicker at one part than the other, it causes uneven rotation, and it is very liable to break the driving chain, and if it be at all spongy the holes in the surface become filled with the copper deposit, and it is impossible to release the tube from the mandrel. The method now in use is to fill up any small flaws in the surface with lead, and then to deposit a thin coating of copper upon the mandrel by the ordinary cyanide process. The copper which is afterwards deposited on it does not adhere to the thin copper layer with which the mandrel is coated, it being found that an exposure to the air for even a short period produces a coating of oxide which effectually prevents adherence, so that if a mandrel were not in stock of the size required, a tube could be deposited over another tube.

The burnishing, which is the great distinctive feature of the Elmore process, is accomplished by means of an agate, held in a suitable holder and pressed against the work—which is of course beneath the surface of the bath—by means of elastic bands, which allow of an adjustment of pressure sufficiently accurate for the purpose. This agate burnisher is caused to traverse the whole length of the tank at such a speed that the advance made whilst the mandrel completes one revolution is equal to the longitudinal dimension of the agate. The action is similar to

that of screw-cutting in a lathe, and it will be evident that every part of the tube being formed is gone over by the agate once in each traverse.

The loss of pressure in each tank is generally about 0·9 volt. The current density is about 16 ampères per square foot of cathode surface as an average for ordinary work, but it may fall to 12, or rise as high as 20 ampères. It might be objected that, working at such high current density, hydrogen would be evolved and occluded in the copper deposited, but such is not found to be the case. In this process all the conditions are very favourable to working with high current density. In the first place the density of the liquor throughout the tank is kept uniform by means of the circulation due to the rotation of the horizontal mandrel, the conditions being very different from those which are present when the deposition takes place with a vertically-placed and stationary cathode. In the next place the deposited surface is kept quite smooth by means of the burnisher, and there are thus no points to induce an extra discharge of current in one place. Thirdly, by the rotation of the mandrel fresh particles of liquor, always strong in sulphate of copper, are constantly being brought in contact with any given area of surface. Further, the electro-motive force is below one volt per tank, and the electrolyte being uniform, the evolution of hydrogen is not to be anticipated.

The deposit is at the rate of about $\frac{1}{8}$ in. thickness of metal per week; therefore a 12 ft. by 2 ft. tank would turn out one 18 in. tube in a week of 168 hours, for it is practically a necessity of the system that it should be continuous so long as work is being carried on. Such a tank would therefore produce 275 lb. to 280 lb. of copper tube in one week. A tank of approximately the same size would produce two 9-in. tubes or three 6-in. tubes of the same total weight.

After the deposition has been completed, the mandrel is removed from the bath, for the purpose of withdrawing the tube. The copper is, of course, a tight fit on the mandrel, and in order to loosen it, the whole is placed in a machine by which three rollers are pressed on the tube, and traversed along the length of the pipe. The pipe and mandrel are caused to revolve at the same time, the motions being similar to those of screw-cutting in a lathe. The squeezing of the copper between the rollers and the mandrel causes a slight extension of surface, and therefore an increase of diameter. The pressure is regulated so that the tube is only expanded enough to make it a sufficiently easy fit to be stripped off the mandrel. Another machine, with circular cutters, removes the rough unburnished ends. In one machine the expansion and parting of ends is carried on at one time.

The sludge which gradually settles at the bottom of the tanks is run off with the spent electrolyte into large settling tanks, and when a sufficient quantity is obtained it is then smelted.

The copper is produced of different qualities, according to the use to which it is to be put, and the quality is varied by a difference in the solution and by the difference in the pressure of the burnisher upon the tube.

The following are the results of some mechanical tests made by Unwin on strips cut from tubes. The results are the same, whether the sample be cut longitudinally or circumferentially from the tube:—

Strip 1·226 × 0·049 in. section.
Area, 0·060074 square inch.
Broke with 2·36 tons = 39·29 tons per square inch.
Ultimate elongation, 5·1 per cent. in 10 in.

Strip 1·221 × 050 in. section.
Area, 0·06105 square inch.
Broke with 2·52 tons = 41·28 tons per square inch.
Elongation, 7·0 per cent. in 10 in.

Kennedy found the tensile strength of some specimens to vary between 25·92 and 26·83 tons, with an elongation of 17 per cent. in 4 in.

The copper produced by this process seems to be particularly suitable for wire drawing. Wire has been drawn down to a diameter of $\frac{1}{1000}$ in. in diameter without annealing. Some tests with wire produced by this process showed that the practical limit of hardness had been reached. Wire 18 B.W.G. (0·113 in. diameter) was drawn through 13 holes until the diameter reached 0·057 in., when the breaking strain was 29 tons per sq. in., with an elongation of $\frac{3}{4}$ per cent. In spite of the hardness it was found to have an electrical conductivity about $2\frac{1}{2}$ per cent. higher than that of soft annealed wire of the best quality to be procured commercially. Wire subjected to torsion gave the following, the length of the wire being 3 in. between jaws of machine:—0·113 in. diam. (205 lb. per mile); breaking strain 27·4 tons with elongation of 2 per cent.; number of twists 31 in the 3 in. Wire 0·050 in. diam. (40·8 lb. per mile); breaking strain 28·4 tons; elongation $\frac{3}{8}$ to 1 per cent.; number of twists 47.—O. H.

PATENT.

Improvements in the Manufacture of Manilla Paper. J. B. Atherton, Huyton. From L. B. Beck, New York, U.S.A. Eng. Pat. 11,021, July 15, 1890. 8*d*.

See under XIX., *page* 268.

XII.—FATS, OILS, AND SOAP MANUFACTURE.

PATENTS.

Improvements in or Connected with the Manufacture of Oil Cake. F. C. Calthorp, Liverpool. Eng. Pat. 1471, January 28, 1890. 8*d*.

See under XVIII. A., *page* 266.

Improvements in or Appertaining to the Manufacture or Shaping of Soap. R. C. Scott, Lancaster. Eng. Pat. 3601, March 6, 1890. 8*d*.

Bars of soap are shaped with two or more sides deeply corrugated or with semi-spherical indentations, so that they may be firmly grasped, and also that they may drain and dry quickly when taken out of water, thereby lessening waste.—K. E. M.

Improvements in Decolourising Vegetable Oils in the Manufacture of Pale Drying Oils and Varnishes, and Apparatus therefor. W. N. Hartley, Dublin, and W. E. B. Blenkinsop, London. Eng. Pat. 11,629, July 24, 1890. 8*d*.

A MANGANESE soap or other suitable organic compound of manganese is dissolved either direct in the oil under treatment, or in any suitable solvent (such as turpentine), and this solution added to the oil. Preferably the insoluble impurities are now removed. The clear oil is treated with a current of air or oxygen at a suitable temperature, generally at 190° F. In the manufacture of pale drying oils or varnishes, such as "boiled oil," manganese linoleate is preferably employed, 1 part of the latter to 800 parts of the oil. Oils containing much mucilage and water are mixed with about 1 per cent. of dilute sulphuric acid of 1·29 sp. gr. at 60° F. Should the acid used be too strong a colouring matter is produced which is not easily removed from the oil. Mucilage may also be removed by adding 1 part of a strong solution of manganese sulphate to 100 parts of the oil, and agitating. Drawings of an arrangement of apparatus adapted for carrying out the process accompanies the specification.—K. E. M.

Improvements in Cleansing and Polishing Compositions. E. Bietski, Cardiff. Eng. Pat. 16,979, October 24, 1890. 6*d*.

SPECIFIED proportions of dry soap (Hudson's dry soap) and yellow soap (Primrose soap) dissolved in water are boiled with whiting, whereby a paste is obtained for polishing and cleaning metals and glass.—K. E. M.

XIII.—PAINTS, PIGMENTS, VARNISHES, AND RESINS.

PATENTS.

A New or Improved White Pigment. H. Grimshaw, Manchester. Eng. Pat. 985, January 20, 1890. 4*d.*

The white pigment in question is a basic chloride of zinc, prepared either by dissolving metallic zinc in a solution of chloride of zinc, and precipitated by cooling, with or without the addition of an alkali, or by mixing zinc oxide with a solution of zinc chloride, and grinding the mass, when set, to a fine powder.—E. G. C.

Improvements in Imitation Whalebone. H. M. Knight, London. Eng. Pat. 1765, February 1, 1890. 6*d.*

The inventor coats metal strips or cores with vulcanised india-rubber. The resulting imitation whalebone is stated to be not liable to crack or break.—E. G. C.

An Improved Glue Compound. T. O. Butler, Chicago, U.S.A. Eng. Pat. 17,853, November 6, 1890. 6*d.*

A mixture of common glue, Paris white and sulphur. —E. G. C.

Improvements in Vulcanisers. J. H. Gartell, Penzance, and F. Knoerfell, London. Eng. Pat. 20,005, December 8, 1890. 6*d.*

See under I., *page* 241.

XV.—MANURES, Etc.

PATENT.

An Improved Method of Nitrogenising Substances in the Manufacture of Manures and for other Purposes. H. Fewson, Buckingham. Eng. Pat. 20,076, December 13, 1889. 8*d.*

A "vegetable preparation" is made by grinding any refuse matter containing suitable vegetable acids (malic, malaic, citric, tartaric, tannic, oxalic, benzoic, acetic, or gallic) and boiling it with water containing a suitable alkali, "one bushel of vegetable matter to ten gallons of water and one quarter of an ounce of sulphate of soda," being good proportions. This preparation is added to the sewage in the proportion of half a cubic inch per gallon of sewage, either in the sewer or at the outfall. Two to four grains of lime or other alkali are then added and the sewage subjected to the action of high potential electric currents by being caused to pass through a box or sewer containing an iron electrode, so disposed that the liquid shall flow over it and a "platinum or other suitable electrode," which is maintained at a height of about one inch above the surface of the sewage. Filtration completes the process.

It is claimed that this treatment precipitates the solid matters and at the same time enriches them in nitrogen, the effluent being clear and odourless. The electricity is said to cause the absorption of nitrogen. A. G. B.

XVI.—SUGAR, STARCH, GUM, Etc.

The Juice of the Berries of the Mountain Ash, and the Formation of Sorbose. A. Freund. Monatsh. **11**, 560—578.

All attempts to isolate sorbose from the fresh juice were unsuccessful, so that it must be concluded that this sugar is not present in the ripe berries. When the expressed juice, which has a specific gravity of 1·125, is kept for 13 months, sorbose is not formed, but if the juice is diluted with water until it has a specific gravity of 1·09, and then kept for six months, a considerable quantity of the sugar is produced. A specific gravity of 1·09 to 1·06 seems to be most favourable to the formation of sorbose.

The best way of preparing pure sorbose from the juice of the berries of the mountain ash is the following:—The expressed juice is diluted with water until it has a specific gravity of 1·09 to 1·06, and after 10 to 12 months a portion is evaporated to a thick syrup to ascertain whether a sufficient quantity of sorbose has been produced; under favourable conditions a crop of crystals, equal in volume to about half that of the syrup, is deposited in the course of a few days. The crystals are separated from the mother-liquors, placed in linen bags, and submitted to a pressure gradually increasing up to 300 atmospheres; the cake is then rubbed to a thick paste with a little water, pressed again, dissolved in water, a little albumen added, the solution boiled and filtered; on evaporating the filtrate, decolourised with animal charcoal if necessary, to a thin syrup, the sorbose is deposited in large crystals, and can then be further purified by recrystallisation from boiling 80 per cent. alcohol.—F. S. K.

Corrections to be made in the Abstract of Fischer's and Piloty's Paper on Sugars richer in Carbon from Rhamnose. Ber. **23**, 3827.

Abstract on pp. 1140—1142, this Journal 1890.

Page 1141, col. 2, line 25—
For $[\alpha]_D = -61{\cdot}1$, read $[\alpha]_D = -61{\cdot}4°$.

Page 1141, col. 2, line 31—
For $[\alpha]_D = +11{\cdot}6°$, read $[\alpha]_D = +14{\cdot}0°$.

Page 1141, col. 2, line 4 from bottom—
For $[\alpha]_D = -51{\cdot}2$, read $[\alpha]_D = -50{\cdot}8$.—A. L. S.

PATENTS.

Improvements in Centrifugal Machines. J. Imray, London. From "La Société Nouvelle des Raffineries de Sucre de Saint Louis," Marseilles, France. Eng. Pat. 2774, February 20, 1890. 8*d.*

See under I., *page* 240.

Apparatus for Drying Sugar or like Substances. R. Pzillas, Brieg, Germany. Eng. Pat. 10,893, July 12, 1890. 6*d.*

Several waggons, open only at their ends, and provided with shelves to carry the material, are locked firmly together, thus forming a closed channel and tube, running on rails. At one end is a fixed chamber and at the other a moveable one connected with a hot-air apparatus, both being very slightly larger than one of the waggons, and provided with doors for the entrance and removal of the waggons, and having also suitable air flaps. Above the fixed chamber is placed an exhauster by which air is drawn from the heater through the entire length of the channel (or waggons). The waggons being made continuous with the two chambers, are propelled by rackwork, from the fixed to the heating chamber, where each is removed with the material dried, and being again loaded is transferred to the fixed chamber, and so on. The object of one chamber being made moveable is to allow of alteration in the number of waggons employed.—E. S.

XVII.—BREWING, WINES, SPIRITS, Etc.

On the Examination of Beer. A. Bertschinger. Zeits. f. angew. Chem. 1890, 665—671.

See under XXIII., *pages* 674—675.

PATENTS.

Improvements in the Manufacture of German or Dried Yeast, part of which Improvements is applicable to the Production of Vinegar. J. Fordred, London. Eng. Pat. 5891, December 28, 1883. (Second Edition.) 6*d*.

A WATER containing a large amount of calcium sulphate is employed for mashing a grist in which rye-meal preponderates, as, for instance, 50 parts of rye, 20 parts of maize, 5 parts of oats, 25 parts of barley malt. A wort is produced of a "gravity ranging from 1·015 to 1·095 degrees"; if this be deficient in yeast-food a little spent wash is added to it. The wort is cooled to 70° F., and pitched with 8—10 lb. of fresh yeast to 100 gallons of wort. The yeast should be carefully selected, the cells should be plump and translucent with thin cell walls and few empty or shrivelled cells. The wort should be aërated by a rouser. As the yeast is formed it is removed in the ordinary way, strained through fine sieves and pressed in a filter-press. In some cases the yeast may be washed in the press by pumping through cold water containing a little phosphate. The fermentation is stopped when the attenuation has reached about 8°, and the fermented liquor converted into vinegar by the German quick method, or by stoving as practised in England.—A. L. S.

Manufacture of Amylöins applicable for the Treatment of Beer. H. T. Brown and G. H. Morris, Burton-on-Trent, and E. R. Moritz, London. Eng. Pat. 1809, February 3, 1889. 4*d*.

THIS material is manufactured by boiling together 100 parts of starch, 300 parts of water, and 3 parts of sulphuric acid, in a strong vessel provided with an agitator. If the boiling be carried on under pressure, not more than one-fifth of the above quantity of acid must be used. Samples are taken from time to time, and when the product has an optical activity of $[\alpha]j = 193°$, and a cupric oxide reducing power of 21, and the solution gives a full red colour with iodine solution, the reaction is stopped. The product obtained is suitable for addition to beer, on which it is said to have considerable effect in improving its qualities in respect of body, flavour and briskness.—A. L. S.

Improvements in Rousing Beer and Mixing or Blending Wort or Gyle, and in Apparatus employed therein. J. F. Littleton, Kingston-on-Thames. Eng. Pat. 1996, February 6, 1890. 8*d*.

THE apparatus consists of a vessel which may be lowered into or raised out of the fermenting liquor. The vessel is furnished with a lifting valve at the bottom, so that as it is lowered it quickly fills with liquor and is perforated with fine holes, so that when raised above the surface of the liquor this flows through the perforations, washing in the head of yeast, and effectually rousing the whole. The inventor also proposes to use a pump for the same purpose, the liquor being drawn from the lowest part of the fermenting vessel, and delivered in a fine spray on to the surface.—A. L. S.

An Improved Apparatus for the Aëration of Beers, Wines, Mineral Waters, and other like Liquors. B. J. Sharp, London. Eng. Pat. 2471, February 15, 1890. 8*d*.

THIS consists of a chamber to contain the liquid to be aërated, with a perforated false bottom, through which carbonic acid gas is forced from a reservoir of compressed gas. The apparatus may be used in connexion with an ordinary bottling machine. A drawing of the apparatus accompanies the specification.—A. L. S.

Improvements in Apparatus for Generating and Supplying Carbonic Acid Gas to Vessels containing Fermented Liquor. H. S. G. Stephenson, Lympsham Manor. Eng. Pat. 2990, February 25, 1890. 8*d*.

A SIMPLE apparatus for the constant evolution of carbonic acid, similar to those in common use in chemical laboratories, is connected with a cask of beer, so as to keep up a small but constant pressure of carbonic acid within the cask as the beer is drawn off.—A. L. S.

A New or Improved Process for the Recovery and Utilisation of Yeast. J. Campbell, Glasgow. Eng. Pat. 7195, May 8, 1890. 6*d*.

THE worts of a specific gravity of about 38° —48° are set to ferment at 73°—76° F. "When about 8°—12° of gravity remain unattenuated" the yeast is collected by skimming, tapping or other means into a vessel provided with an attemperator by which the temperature of the yeast is reduced down to 55° – 45° F. The yeast is allowed to stand in the back until it settles, when the liquid between the top and bottom layers is drawn off and the yeast is collected as for re-use as "ordinary brewers' yeast."—A. L. S.

A Composition for Refining and Heading Malt Liquors. G. Roskilly, London. Eng. Pat. 14,118, September 8, 1890. 4*d*.

To make six gallons of the composition, 3 lb. of quillaia are steeped in 12 gallons of water for 30 hours, 5 lb. of nettles added, and the whole boiled down to 6 gallons; when cooled to 60° F. add 1 lb. of golden hop and raise to 210° F., then strain and when cool add 3 lb. of Russian isinglass; after standing 12 hours it is fit for use in the proportion of one pint to one barrel of malt liquor.—A. L. S.

Improvements in the Treatment of Alcoholic Liquids. E. J. Mills and R. Barr, Glasgow. Eng. Pat. 18,212, November 12, 1890. 4*d*.

THE spirit is placed in a vat and air blown through it, at first rapidly and afterwards more slowly. During the aëration a small quantity of sherry or other similar wine is added (about one pint to 80 gallons of spirit). If the spirit is very coarse a small quantity of potassium hydrogen sulphate or sulphuric acid is added at the same time. This treatment may continue for a few minutes or several days, but six hours is an average time.

The spirit is finally transferred to casks, when in about three months it will have acquired about three years' age. —A. L. S.

Apparatus for Detaching and Removing Acrospires and Shoots from Malt. S. Hirschler, Worms-on-the-Rhine, Germany. Eng. Pat. 19,198, November 25, 1890. 6*d*.

THIS consists of a hollow cylinder arranged horizontally, having radial bolts projecting into and fixed to the sides of the cylinder. Through the centre passes a rotating shaft provided with radial beaters. The bottom of the cylinder is perforated with holes of a convenient size to allow of the passage of the acrospire, &c., but not of the malt. The malt is fed into the cylinder at one end and passes out at the other, through an opening in the end cover, which can be adjusted to different heights by turning the cover on the axis of the cylinder.—A. L. S.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

(A.)—CHEMISTRY OF FOOD.

On Aldepalmitic Acid. J. A. Wanklyn.

See page 212—213.

Investigation of China Teas. P. Dvorkovitz. Journ. Russ. Chem. Soc. 22, 558—568.

See under XVIII., *pages* 276—277.

Notes on Vegetable Butter. F. Jean. Monit. Scient. 1890. 36, 1116—1119.

See under XVIII., *pages* 275—276.

PATENTS.

An Improved Process for the Production of Dry Extract of Coffee. H. Barotte, Paris, France. Eng. Pat. 19,882, December 10, 1889. 8*d.*

The roasted and finely ground coffee is introduced into a jacketed cylinder connected with a copper condensing sphere; the cylinder is rotated during the process, and is heated by passing superheated steam into the jacket. A vacuum is maintained in the sphere and cylinder until the temperature of the latter reaches 160°, after which the pressure is allowed to increase rapidly, and when there is only 10 cm. of vacuum the steam is shut off and the apparatus left for five or ten minutes until the temperature rises to 210° C.; at this point cold water is at once injected into the jacket.

The distillate is filtered and immediately added in suitable proportion to a pulverised extract of the residual coffee in the cylinder, prepared by throwing the residual coffee into hot distilled water and evaporating the infusion thus obtained in *vacuo*. The mixture is finally dried in *vacuo* either by heat or over absorbents, and the resulting powder is called "Express Café."—A. G. B.

Improvements in or Connected with the Manufacture of Oil-Cake. F. C. Calthorp, Liverpool. Eng. Pat. 1471, January 28, 1890. 8*d.*

The object of this invention is the improvement of hard-pressed oil-cake as a cattle food. The cake is either steamed or soaked in some vapour or liquid and subsequently dried; or it may be first broken up by a dry or wet method, and then again pressed into a cake with or without the addition of substances to moisten and render it adhesive.—A. G. B.

Improvements in the Treatment or Regeneration of Yeast to be used in the Process of Bread-making, and in the Preparation of Paste and Dough for Pastry-Cooks and Biscuit-Makers. E. Leconte, Estaires, France. Eng. Pat. 3856, March 11, 1890. 6*d.*

In order to render the yeast as supplied to bakers more active, the crude yeast is made into a thin cream with water at about 70°—100° F., and a syrup made from malted barley or other malted cereal is added. This is allowed to stand for about one hour, and it is then mixed with paste or dough, as is usual in the ordinary process employed by bakers, &c.

The inventor claims that by this method of working the yeast works quicker and a bread is produced which will remain fresh and sweet for a longer period than bread made in the ordinary way.—A. L. S.

An Improved Preparation of Food for Animals, Game, and Poultry. E. Wylam, London. Eng. Pat. 14,417, September 12, 1890. 4*d.*

The claim in this patent is for incorporating the nuts the product of *Arachis hypogæa L.* (Nat. ord. Leguminosæ) with any other ingredients which are usually used in making food for dogs, &c. One part of the nuts by weight to 16 parts of the other ingredients as a whole by weight, is recommended.—A. G. B.

Improvements Relating to the Preservation of Bread and similar Substances, and to Apparatus therefor. G. F. Redfern, London. From E. Schramm, Charlottenburg, and A. Cheehong, Berlin, Germany. Eng. Pat. 16,362, October 14, 1890. 6*d.*

The bread is packed whilst hot in tins, which are afterwards hermetically sealed. The packing is preferably performed in an air tight chamber continuous with the oven, in which case the tins are first sterilised by drawing the hot air from the oven through them. Otherwise the loaves are placed in the tins whilst hot, the air is pumped out of the tins and sterilised air, or air saturated with moisture, allowed to enter before the opening is sealed.—A. G. B.

Improvements in Baking Powders and like Preparations. B. Willcox, London. From "The Rumford Chemical Works," U.S.A. Eng. Pat. 17,245, October 28, 1890. 6*d.*

It is customary in the preparation of baking powders to dilute the bicarbonate of soda and dry acid or acid salt used with some inert substance such as starch, flour, or other dry powder. Corn-starch is the substance usually used as a diluent. Baking powders mixed with corn-starch deteriorate when exposed to the air, owing to the absorption of moisture which causes a reaction between the alkaline carbonate and the acid. The invention is for the purpose of obviating this deterioration by the use of a diluent consisting of a salt of a fatty acid with an inorganic base. Among such salts calcium stearate is the preparation instanced as one of those suitable for a diluent.—H. S. P.

New or Improved Corn Products, and Process for Manufacturing the same. B. G. Hudnut, Indiana, U.S.A. Eng. Pat. 17,427, October 31, 1890. (Internat. Conv. April 5, 1890.) 6*d.*

The corn is made into hominy and separated from offal. The hominy is dried, cleaned, and partially cooked with steam. One of two processes is then followed; the partly cooked hominy is either passed through rolls and afterwards dried, in which case the product is in flakes, or first dried and then passed through the rolls, the product being granular. The products are used for food or brewing.

—A. G. B.

New or Improved Corn or Grain Products and Method for Manufacturing the same. W. P. Thompson, Liverpool. From F. Lankoff, Detroit, U.S.A. Eng. Pat. 19,457, November 29, 1890. 4*d.*

The cereal in its dry, raw, or normal condition is crushed into coarse meal, the hulls and other impurities removed, and the meal subjected to a "drawing compression," without heat, between smooth rollers, one of which travels faster than the other. The resulting product is a light, thin, curled film with a large surface. It has heretofore been necessary to steam, soak, or soften the cereal meal, whereby some of the strength thereof has been lost; moreover, when the rollers are hot the surface of the crushed cereal is so cooked and glazed as to be less soluble. By this new method the maximum solubility is ensured.—A. G. B.

(*B.*)—SANITARY CHEMISTRY.

The Treatment of Sewage. G. E. Davis.

See pages 221—227.

The Analysis of the Air of Large Cities. Industries, **10**, 1891, 91.

The question of air pollution is being taken up in earnest in Manchester. Certainly the smoky condition of the atmosphere of our large cities has, in conjunction with fogs, been brought prominently forward during the long frost, and any movement which has for its object the minimising of the evil has our hearty support. The late Dr. Angus Smith, in his book on "Air and Rain," gave a *résumé* of the large amount of work he had done in connexion with air analysis, but not much attention seems to have been given to the subject in recent years. Much remains to be cleared up as to the origin of fogs, although a good deal of attention has been paid to the matter by Aitken, whose papers have appeared in the *Philosophical Magazine*. It was thought, therefore, that a systematic series of analyses, carried out at different points of a large city at the same time, would give valuable information as to the chief causes of pollution, and to this end a chemical sub-committee has been appointed by the Town Gardening Section of the Manchester Field Naturalists' Society. The committee consists of Dr. Bailey, Dr. Cohen, and Mr. P. J. Hartog, B.Sc., of the Owens College Chemical Staff, and Dr. Tatham, Medical Officer of Health for Manchester. A subscription list was opened to defray the cost of apparatus, &c., and about 200*l.*, the sum required, has been raised.

The analytical scheme is a very comprehensive one. The observations, which are to be made at seven different stations in Manchester and Salford, are intended to afford definite information on the following points:—

1. The composition of the air in densely populated as compared with thinly populated districts.

2. The relation between atmospheric impurities and prevalent sickness and mortality.

3. Amount and distribution of noxious ingredients specially injurious to plant life, *e.g.*, sulphurous acid.

4. The extent to which smoke and noxious gases are due to (*a*) dwellings; (*b*) factories.

5. Nature of fog, and the chemical character of the air during the prevalence of fogs.

At a meeting of the Society on the 7th instant Dr. Bailey reported that their investigations had been commenced. They had found, he said, that the snow carried to the ground large quantities of sulphuric and hydrochloric acids, and also some of the elements of sewage. The depositions on leaves collected at the various observing stations were in amount directly as the population, and the greatest injury to plant life was found to be due to the emanations from dwelling-houses. They estimated that, in one day, two tons of "blacks" and 3 cwt. of sulphuric acid were deposited per square mile of the city area. The above figures are sufficient to show that much interesting and valuable information may be looked for when the final report of the committee is issued. On similar lines, a committee, with which the names of Professor Oliver, of University College, London, and Mr. Scott, the botanists, are associated, has been appointed in London, the initiative being due to the Royal Horticultural Society.

PATENTS.

An Improved Method of Nitrogenising Substances in the Manufacture of Manures and for other Purposes. H. Fewson, Buckingham. Eng. Pat. 20,076, December 13, 1889. 8*d.*

See under XV., *page* 264.

Improvements in Furnaces for Burning Tan and other Refuse Material. C. A. Brown, Exeter. Eng. Pat. 1170, January 22, 1890. 6*d.*

See under I., *page* 239.

Improvements in the Treatment of Night-Soil and such like Noxious Matters, and in Apparatus therefor. E. W. Cracknell, Sydney, New South Wales. Eng. Pat. 17,687, November 4, 1890. 8*d.*

The mixture of rubbish and night-soil is screened, disintegrated, dried and converted into poudrette. The larger substances and such as resist disintegration are burnt. All the machinery or chambers containing the same are connected by pipes to a central exhaust fan which passes the vapours and gases to the ash-pit of the furnace where they are consumed. The claims are for the arrangement and construction of machinery, and the method of collecting and burning noxious vapours; these are severally set forth in the drawings accompanying the specification, which must be consulted for details.—A. G. B.

(*C.*)—DISINFECTANTS.

Paris Green as an Insecticide. Standard Agricultural Report, Mar. 10, 1891.

One of the most important sections of Miss Ormerod's Annual Report is that which describes the results of experiments with insecticides carried out by a committee appointed among fruit-growers in the Evesham district. The most effectual agent for the destruction of caterpillars was Paris green, a double salt of arsenite and acetate of copper, containing about 28½ per cent. of arsenic and over 32 per cent. of copper, and, therefore, a strong poison which should be used with great caution in proper dilution. This insecticide has long been a favourite in America, but has not been tried extensively in this country. The Evesham fruit-growers who used it last year are almost unanimous in favour of it, and although it is a pity that some less dangerous preparation has not proved equally effectual in killing caterpillars, the need of destroying these rapacious creatures is so urgent that fruit-growers cannot afford to be very particular as to the means adopted for getting rid of them. Provided the Paris green is used in the form of paste, and not in that of powder (which is likely to be inhaled by the person using it), and properly diluted, it may be applied without danger. One ounce of the paste should be diluted with 10 gallons of water for plum trees, and with 20 gallons for apples or pears, and applied before or after the blossoming period. This solution, sprayed over the trees, is fatal to caterpillars, and does not hurt the foliage, though it might injure the blossoms. Live stock should be kept out of orchards for a few days after the trees have been sprayed.

XIX.—PAPER, PASTEBOARD, Etc.

PATENTS.

An Improved Arrangement of Roasting Apparatus for the Incinerating of Black Liquor and Spent Soda Lyes used in the Boiling of Esparto Grass or other Fibrous Matter. T. Goodall, Sunderland. Eng. Pat. 1087, January 21, 1890. 8*d.*

The apparatus consists of two or more superimposed roasting beds or hearths upon which the black liquor or spent soda lye is roasted. At one end of the hearths are placed independent fuel grates also superimposed. These grates have independent flues communicating with one common main flue leading to the chimney, and these flues

are fitted with dampers in such a way that the flame and heated products of combustion may be led from any of the grates over the roasting hearths, finding their exit finally over one or more of the grates not placed in connexion with the roasting beds, before passing to the chimney. In this way the organic volatile matters evolved from the roasting hearths are completely burnt before entering the chimney flue. At the end of the roasting hearths farthest from the grates is built a burning off chamber. The partially roasted ash from the hearths is transferred to this chamber where it remains until completely burnt, the gases from this chamber passing away along with the gases from the hearths. Tanks containing the liquor may be placed over the top hearth or over the burning off chamber, in which tanks the liquor becomes heated and concentrated by the heat from the chamber and hearth, and from which by suitable pipes it may be led into the roasting hearths. Or, by another modification, an additional flue may be placed at the end of the burning-off chamber farthest from the roasting beds, and fitted with a damper so that the operation may be varied by leading all the gases from the beds over the material in the burning-off chamber, whence they pass away by the end flue.—H. S. P.

An Improvement in Boilers used in the Manufacture of Paper Pulp. C. D. Davies, Manchester. From C. Kellner, Vienna, Austria. Eng. Pat. 2964, February 8, 1890. *4d.*

Instead of coating the inside of boilers used in the acid processes of manufacturing wood pulp with sections or segments of lead, the present inventor lines the boiler with an acid-resisting cement such as a mixture of Portland cement and sand.—E. J. B.

Improvements relating to the Treatment of Straw, Esparto Grass, and other Fibrous Materials for the Manufacture of Paper and other Purposes, and to Compounds therefor. E. Applegarth, London. Eng. Pat. 2832, February 21, 1890. *6d.*

The inventor prepares a compound by boiling together "caustic soda, boracic acid water, kerosene oil, or any other unctuous or spirituous product of petroleum, and animal fat or oil or vegetable oil." A suitable quantity of this compound is added to the caustic lye or other alkaline solution in which the straw or other fibrous material is boiled.—E. J. B.

Improvements in the Manufacture of Manilla Paper. J. B. Atherton, Huyton. From L. B. Beck, New York, U.S.A. Eng. Pat. 11,021, July 15, 1890. *8d.*

This invention relates to a method of preparing Manilla paper which may be used for insulating electric wires.

The fibre is first cut into lengths of not more than 2½ in. It is then opened out by a suitable machine, such as an "oakum devil," and packed tightly into an open wooden vessel fitted with a perforated bottom and steam pipe for heating. Here it is macerated with a solution of caustic soda for 20 hours or longer if necessary until the fibres are easily separated by slight pressure. It is then gently "beaten" for five to seven hours, and the alkaline liquor removed by washing. The pulp is then made into paper without sizing, preferably on a cylinder machine.—E. J. B.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES AND EXTRACTS.

Veratrine. S. Stransky. Monatsh. **11**, 482—485.

Some years ago the author commenced an investigation of the alkaloid veratrine, which, since it was studied by Bosetti (Arch. für Pharm. 1883, 81), has received but little attention; the results of his unfinished experiments are now published on account of the recent appearance of a paper by Ahrens (Ber. **23**, 2700—2707; this Journal, 1890, 1060) on this subject.

Veratrine, obtained from Merck and purified by Schmidt and Köppen's method (Annalen, **185**, 221) is very readily soluble in warm xylene and glycerin, and in cold aniline carbon bisulphide, ethyl acetate, acetone, chloroform, and amyl alcohol, but it is only sparingly soluble in hot light petroleum.

According to Bosetti, the commercial alkaloid is a mixture of crystalline veratrine with veratridine; the former is insoluble in water and is decomposed by alkalis into ceridine and angelic acid, whereas the latter is soluble in water and is decomposed by alkalis into veratroïn and veratrum acid (melting point 179·5°). The author's experiments gave results completely in accordance with those obtained by Bosetti.

When the mixture of bases (veratroïn and ceridine) obtained by boiling the alkaloid with alcoholic potash is fused with potash, methylamine and pyridine bases are produced. When veratrine is distilled with zinc dust, it yields a brown oil which seems to be a mixture of pyridine bases with a neutral compound which has an odour of, but does not show the reactions of, veratrol.—F. S. K.

Communication from the Pharmaceutical Laboratory of the Botanical Garden of Buitenzorg (Java).* M. Greshoff. Ber. **23, 3537—3550.

Carpaini, an alkaloid found in the leaves of *Carica papaya L.*, may be obtained by extraction with alcohol, chloroform, or ether. In the latter solvent it appears to be more readily dissolved from the leaves than after it has been separated in the crystalline state. It occurs in largest quantity in the young leaves, from which 0·25 per cent. of the alkaloid may be obtained. From the solutions of its salts the alkaloid is completely precipitated by sodium carbonate; it is also insoluble in potash solution. It is precipitated by the following reagents:—Mayer's reagent and iodine solution (1 in 300,000); phosphomolybdic acid (1 in 75,000); picric acid (1 in 30,000); gold chloride (1 in 25,000); tannin and potassium sulphocyanide. No colorations are produced by strong mineral acids. It melts at 115°, and volatilises partly undecomposed.

It is a vegetable poison, which acts upon the heart. The fatal dose for *Bufo melanosticus schw.* (which is used in the place of a frog for physiological investigations) is 0·012 grm., that for a fowl 0·200 grm. With acids it forms well-crystallisable salts. The hydrochloride is soluble in water, and crystallises in beautiful shining needles. The base dissolves in 100,000 parts of water, and has a bitter taste.

Derrid, a tarry substance obtained from the bark of the root of *Derris (Pongamia) elliptica Benth*, is the active principle of the decoction used in Java for killing fish. It contains no nitrogen, and is not a glucoside. It dissolves readily in alcohol, ether, chloroform, amyl alcohol, &c., but very sparingly in water. It commences to melt at 61°, and decomposes at 160°. Fused with potash, salicylic and protocatechuic acids are formed. It has not been obtained in the crystalline condition, and its preparation in the pure state is very difficult. The roots contain about 2·5 to 3 per cent. of the tar. The alcoholic solution has a slightly acid

* For a more lengthy description of these researches, see "Eerste Verslag van het onderzoek naar de plantenstoffen van Nederlandsch-Indie. Batavia Land's Drukkery, 1890.

reaction, has an aromatic taste, and destroys the sensitiveness of the tongue for some hours. One part in 5,000,000 of water acts instantly on large fish.

Pachyrhizid, a substance closely analogous with *Derrid*, is obtained from the seeds of *Pachyrhizus angulatus Rich.* A decoction of this substance in 125,000 parts of water caused death in the case of *ophiocephalus javanicus* very quickly. It is unaccompanied by any tarry substance, and may be obtained in the pure state. Its solubility and melting point correspond with those of derrid.

Erythrina (*Stenotropis*) *Broteroï Hassk* contains an alkaloid in the bark, which is soluble in ether. The sulphate crystallises from the concentrated aqueous solution. With mercuric chloride, gold chloride, platinum chloride, potassium sulphocyanide, potassium dichromate, picric acid, iodine, and tannin, it forms precipitates. From the seeds of *Erythrina* (*Hypaphorus*) *subumbrans Hassk* another poisonous alkaloid has been separated.

Cassia glauca Lam contains a glucoside in its leaves.

The seeds of *Crotolaria retusa L.*, and the seeds and leaves of *Crotolaria striata L.*, contain an alkaloid, and the leaves of the first named contain a large quantity of indican.

The seeds of *Millettia atropurpurea Benth* contain a glucoside, the properties of which are somewhat similar to those of saponin.

The bark of *Acacia tenerrima Jungh* contain an amorphous alkaloid of bitter taste soluble in ether and chloroform.

From the leaves of *Albizzia saponaria Bl.*, cathartinic acid has been separated; the seeds and bark contain saponin.

Several members of the natural order *Pithecolobium Endl.* contain alkaloids.

The bark of *P. bigeminum Mart* contains 0·8 per cent. of an amorphous non-volatile alkaloid, which forms crystalline salts. It is readily soluble in chloroform and ether, and is precipitated by alkalis from the solutions of its salts as a heavy yellow oil. Shaken up with water, it forms a milky liquid, which possesses a burning taste, and reacts with the usual reagents for alkaloids. Mayer's reagent gives a definite reaction with a proportion of 1 in 200,000, and picric acid gives a definite reaction with 1 : 100,000. Subcutaneously injected to fowls, it rapidly stops the heart's action, and fish are destroyed in a solution of 1 : 400,000. It also acts strongly on the mucous membrane.

The bark of *P. saman Benth* contains a body very similar to sapotoxine.

The *seeds*, *bark*, and *leaves* of *Melodinus laevigatus Bl.* contain an alkaloid, which occurs, however, principally in the seeds. It reacts readily and in minute quantity with the usual alkaloid reagents, and with Erdmann's and Fröhde's reagents, potassium dichromate, chlorous acid, &c.; it dissolves, forming a beautiful green solution, which changes to deep blue, and finally an orange colouration. The alkaloid is decomposed by warm dilute mineral acids, and is poisonous.

From the bark of *Leuconotis eugenifolia Dec.* a crystalline alkaloid may be separated, which is soluble in ether, is a fairly strong poison, and reacts with the usual alkaloid reagents.

From the bark of *Rauwolfia canescens* W. 0·4 per cent. of an alkaloid has been separated with ether. A blue-fluorescing substance has also been obtained from the same source. The alkaloid gives a blood-red colouration with nitric acid, which is a beautiful and delicate reaction.

Other members of the family *Rauwolfia* family *R. serpentina*, *R. trifoliata*, *R. spectabilis* and *R. madurensis*, also contain the same alkaloid.

In the bark of *Hunteria Corymbosa Roxb.* a crystalline alkaloid is present, which forms crystallisable salts, reacts delicately with the usual alkaloid reagents, and is specially characterised by giving a blue colouration with Ermann's and Fröhde's reagents. It has a strong paralysing action, and a solution 1 : 10,000 has a sharp burning taste.

A crystalline alkaloid is present in the bark of *Pseudochrosia glomerata Bl.* It is soluble in ether, and possesses poisonous properties. There is also a blue fluorescing substance present.

From the bark of several varieties of the (Javan) *Ochrosia*, *O. Lactaria acuminata*, *Ackeringæ* and *Coccinea*, three alkaloids have been separated. (1.) Soluble in ether, colourless and crystalline, and acts on the heart. (2.) Insoluble in ether, soluble in amyl alcohol, and which may be separated by means of its mercuric chloride salt. (3.) The alkaloid which is also found in the varieties of *Rauwolfia*, *Pseudochrosia*, *Kopsia Bl.*, *Alstonia*, and *Voacanga* (*Orchipeda*) *Fœtida*, and which crystallises in brownish yellow plates. It dissolves in dilute acid, forming an intense brown coloured solution. It is readily soluble in chloroform, less soluble in ether, which solution has a beautiful blue fluorescence, and reacts very delicately with metallic salts and other alkaloid reagents. This alkaloid is present in the *seeds* of *Kopsia flavida Bl.*

The bark of *Voacanga* (*Orchipeda*) *Fœtida* contains, besides the alkaloid just named, a second alkaloid, soluble in ether.

The kernel of the seeds of *Cerbera Odollam Hamilt* contains an active principle, *Cerberin*, which is neither nitrogenous, nor is it a glucoside. It crystallises well, is insoluble in water, soluble in alcohol, chloroform, glacial acetic acid, and in "80 per cent." ether. It melts at 165°. With sulphuric acid it gradually forms a beautiful violet colour; has a burning but only slightly bitter taste, and is very poisonous.

From several members of the natural order *Lauraceæ* an alkaloid, *Laurotetanine*, has been separated. It is readily soluble in chloroform, less so in ether; sodium carbonate precipitates it, whilst excess of sodium or potassium hydroxide redissolves it. It is precipitated by the usual alkaloid reagents. The freshly prepared alkaloid commences, after a few days, to crystallise out in stellate groups of needles. Very small quantities of the base form a dark indigo blue solution with Erdmann's reagent. With sulphuric acid it forms a weak rose-coloured solution, with nitric acid a red-brown coloured one. Its toxicological action is very similar to that of strychnine.

Hydrogen cyanide has been found either free or combined in *Gynmema latifolium Wall.*, in *Pygium parviflorum T. et B.*, and *P. latifolium Miq.*, in the fruit of *Lasia zolliugeri Schott*, in the leaves of *Cyrtosperma Merkurii Hassk*, in the leaves, seeds, and fruit of *Pangium edule Reinw.*, and in several varities of *Hydnocarpus*.—J. W. L.

German and Turkish Rose-Oils. Poleck. Ber. **23**, 3554—3555. (Compare this Journal, 1891, 63.)

On fractional distillation German rose-oil yields at first about 5 per cent. of ethyl alcohol, but no trace of terpenes. When free from stearoptene the bulk of the oil distils over between 110° and 120° C. under a pressure of 14 mm. The elæoptene thus obtained boils at 215° C. Turkish rose-oil behaves similarly. Both elæoptenes are slightly levo-rotatory and have the following specific gravities: that from German rose-oil, 0·8837 at 11° C.; from Turkish, 0·8813 at 12° C. Their composition is expressed by the formula $C_{10}H_{18}O$; no body of the formula $C_{10}H_{20}O$ could be detected. The substance $C_{10}H_{18}O$ is a primary alcohol possessing two ethylene linkings. By oxidation the corresponding aldehyde, $C_{10}H_{16}O$, and acid, $C_{10}H_{16}O_2$, are obtained. Phosphorous pentoxide and zinc chloride abstract water from the elæoptene and convert it into a mixture of two terpenes, of which the higher boiling point one exhibits strong dichroism when the temperature of dehydration is allowed to exceed 0° C. Strong oxidising agents convert the elæoptene into acetic, formic, carbonic, and oxalic acids, and a trace of some higher carbon acid. Chemically speaking, the volatile portion of rose-oil closely resembles geraniol, which Semmler obtained from Indian geranium-oil (this Journal, 1890, 889, 1145).—H. T. P.

Indian Geranium-Oil; Geranaldehyde and Geranic Acid. F. W. Semmler. Ber. **23**, 3556—3557.

By oxidation with bichromate mixture geraniol is converted into geranaldehyde, and from the latter geranic acid is best prepared as follows: 13·5 grms. of silver nitrate are precipitated with baryta water, the precipitate is well washed and treated with ammonia until only very little

is left undissolved. The ammoniacal solution, measuring about 500 cc., is gradually added to an emulsion of 6 grms. of geranaldehyde in 500 cc. of water, about two hours being taken for the operation. The mixture is then slightly acidified with phosphoric acid and steam-distilled. The distillate is mixed with an excess of soda and evaporated to dryness. The residue is extracted with boiling absolute alcohol, the alcoholic solution is filtered and evaporated to dryness. Finally the residue is redissolved in water and treated with silver nitrate, which precipitates the insoluble silver salt of geranic acid, $C_{10}H_{15}O_2.Ag$. The free acid forms a thin oil, the properties of which will be described in a later paper. (Also see this Journal, 1890, 889, 1145.)

—H. T. P.

A Phenol-Sulphonic Acid derived from Camphor. P. Cazeneuve. Compt. Rend. **111**, 743—745.

The author has recently described a neutral compound of the composition $C_9H_{12}O(OH)_2.SO_2$, obtained by treating monochlorocamphor with sulphuric acid (Compt. Rend. **110**, 719 and 961; this Journal, 1890, 647 and 853), and named amethylcamphophenolsulphone, because in its formation from camphor one methyl group is eliminated.

An acid, which the author calls *Amethylcamphophenolsulphonic Acid*, $C_9H_{12}O(OH).SO_3H$, and which is isomeric with the sulphone, has now been obtained.

Amethylcamphophenolsulphonic acid is a colourless acid syrup and behaves in some respects like tannic acid; it precipitates gelatin, quinine, cinchonine, brucine, and strychnine (but not morphine) from their solutions, and it reduces boiling solutions of the chlorides of gold and platinum, and also ammoniacal solutions of silver nitrate.

—F. S. K.

PATENTS.

Improved Means and Appliances for the Production of Pure Carbonic Oxide Gas. T. Williams, London. Eng. Pat. 19,096, November 27, 1889. 8*d*.

This is an improved arrangement of tanks, pipes, and machinery with an improved vacuum pump so as to enable pure carbon monoxide to be produced automatically and continuously from coal, coke, or other fuels; and if desired also the separation of hydrogen from carbon monoxide. Cuprous chloride is used to absorb the gas, the solution being re-utilised after expelling the carbon monoxide. The flow of the liquid solution is controlled by the pressure of the gas.

The gases from certain fuels require the use of salts of iron to ensure the efficient operation of the cuprous solution.

The specification is accompanied by drawings.—D. A. S.

Improvements in Obtaining Oxygen Gas from Atmospheric Air. A. Longsdon, London. From F. Salomon, Essen, Germany. Eng. Pat. 6553, April 29, 1890. 4*d*.

The process consists "in heating a mixture of lead monoxide and alkaline earth, lime, for example," to a red heat in a retort, whilst air is passed over it. Oxygen is absorbed, and lead peroxide and plumbate of lime are formed. On passing carbonic acid gas over this, after the temperature has been allowed to fall to a certain point, oxygen is given off and the carbonic acid is absorbed. At first the oxygen given off is nearly pure. Afterwards some carbonic acid passes off with it, and this is removed by absorbing it with lime or carbonate of soda. The mixture of calcium carbonate and lead monoxide remaining in the retort is then reheated and treated with air, when the carbonic acid is expelled and oxygen again absorbed. Or the carbonic acid can be expelled with a mixture of air and steam. The greater part of the carbonic acid can be recovered for use again. Other metallic oxides, as, for instance, the oxides of manganese, may be used instead of lead monoxide, but the expulsion of the oxygen is not so easy as in the case of the lead combination.—H. S. P.

XXII.—EXPLOSIVES, MATCHES, Etc.

Siliceous Earths in Barbadoes. Board of Trade Journal.

In the middle portion of the Oceanic series beds of white Radiolarian earth occur, which are of exceedingly light specific gravity, and are almost purely siliceous. Such beds occur at Springfield, on Joses River estate, on Melvin's Hill at Mount Hillaby, and below the Spring estate. This earth is now in use as a boiler covering or felting through the British West Indies and in the most important works of British Guiana. The writers are aware of the existence of extensive deposits of similar material elsewhere in the West Indies.

Another use for these siliceous earths is as a substitute for kieselguhr in the manufacture of dynamite, and the characters of some of the Barbadian samples appear to be admirably suited for this purpose. A third use to which these light siliceous earths can be put is the preparation of polishing powders, and their freedom from all gritty matter makes them peculiarly suitable for this purpose.

They might also be used in the manufacture of sodium silicate on account of the easy solubility of the silica they contain. Lastly, they have been used with considerable advantage for accelerating the filtration of saccharine liquids in filter presses.

PATENTS.

An Improved Machine for Compressing Gunpowder into Cartridge Form. W. E. Flint, Wandsworth, and H. J. Michell, Chiswick. Eng. Pat. November 15, 1889. 1*s*. 1*d*.

The machinery or apparatus constructed according to this invention acts throughout in all its operations in an automatic and continuous manner. "The powder passes from a hopper to a measure, the measure at the proper time delivers the powder through passages into a pressing chamber, the bottom of which has been closed by the rising of an underneath plunger; an upper plunger then descends a set distance and subjects the powder to a slight vertical pressure and regulates the length of the form to be produced; the pressing chamber (the sides of which are formed of moveable jaws), then closes in and subjects the contained powder to great lateral pressure; the jaws then begin to open and the lower plunger descends carrying the formed pellet on top, from whence it is swept into a suitable receptacle."

The specification is copiously illustrated by drawings.

—W. M.

Improvements in the Treatment or Preparation of Nitrate of Ammonium. "The Roburite Explosives Company, Limited," London; C. Roth, Charlottenburg, Germany; and W. J. Orsman, Gathurst. Eng. Pat. 20,101, December 13, 1889. 4*d*.

To prevent the absorption of hygroscopic moisture by ammonium nitrate, the crystals of that salt are dried by heating to 80° C., and a solution of nitrocellulose "in the various nitro- and chloro-nitro compounds of benzene or of the benzene series of hydrocarbons and their derivatives" is then poured over them, the mixture thoroughly stirred and allowed to cool. This treatment is especially advantageous when the ammonium nitrate is used in the manufacture of explosives.—H. S. P.

Improvements in the Manufacture or Separation of Ammonium Nitrate and Sulphate or Chloride of Sodium and of Potassium. C. Roth, Charlottenburg, Germany. Eng. Pat. 858, January 16, 1890. 6*d*.

Ammonium nitrate is prepared from equivalent quantities of ammonium sulphate and potassium or sodium nitrate, either by heating the aqueous solution of these salts or by melting them at a temperature below that at which ammonium nitrate dissociates. If the aqueous solution be heated to a temperature above 110° C. until practically all the water is driven off (110° C. being the temperature at which a solution of ammonium nitrate in an equal weight of water boils), or when the salts are heated in the absence of water and the melt maintained at a temperature between 160° and 200° C.,

sulphate of potassium or sodium, as the case may be, separates out in the solid form and settles to the bottom of the melt, whilst a liquid layer of ammonium nitrate remains above, which can easily be siphoned off, or otherwise removed. A solution of ammonium nitrate in an equal weight of water, at a temperature of 110° C., is only capable of holding in solution 15 per cent. of sodium sulphate and 10 per cent. of potassium sulphate, and the solubility of these substances in ammonium nitrate decreases as the temperature is raised, until at 200° C. (at about which temperature ammonium nitrate decomposes) only traces are held in solution. Ammonium chloride may be similarly used instead of ammonium sulphate, but its greater cost makes it less advantageous.—H. S. P.

Improvements relating to the Manufacture of Nitrocellulose or Pyroxylin. H. H. Lake, London. From G. M. Mowbray, North Adams, Mass., U.S.A. Eng. Pat. 20,978, December 23, 1890. 4*d*.

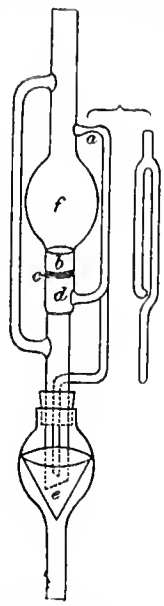
The inventor uses, as raw material, cotton rags, cotton lint from cotton seed hulls, and other materials, instead of fine pure unsized cotton tissue paper, and first steeps it in a bath of a salt, preferably a nitrate, and then passes it between rollers and slowly dries it. The salt crystallises in the cells of the fibre, and this action opens up the cells so that when the material is subsequently immersed in the acid bath nitration takes place more rapidly, and is effected at less cost than by the present process. It is pointed out that, although a nitrate is preferred "any salt crystallised, or even water crystallised by freezing, in the cells of the fibrous cellulose, facilitates nitration by rendering the inner walls of the cellular tissue more readily accessible to the acids of the immersion bath."—W. M.

XXIII.—ANALYTICAL CHEMISTRY.

APPARATUS.

Extraction Apparatus. O. Henzold. Zeits. Anal. Chem. **30**, 1891, 15—16.

After noting the difficulty of getting suitable corks for the ordinary Soxhlet extraction apparatus wholly free from



Modified Soxhlet Extractor.

matter soluble in ether, and taking into account the inconvenient tendency of the syphon in some cases to run unintermittently, the author describes the apparatus shown in the figure.

The substance to be extracted is placed in the upper bulb without an enclosing paper cartridge, and rests on the plug of wadding *b*; *d* is another plug of wadding, and between them is a layer of animal charcoal *c*. The ethereal extract is thus compelled to pass through an efficient filtering medium before reaching the syphon. This latter is of the form commonly used with the Soxhlet apparatus, but has its upper bend connected with the main tube by a piece of tubing *a* constricted to a diameter of about 1 mm. This is designed to prevent the continuous syphoning mentioned above as a frequent failing of apparatus of this kind.

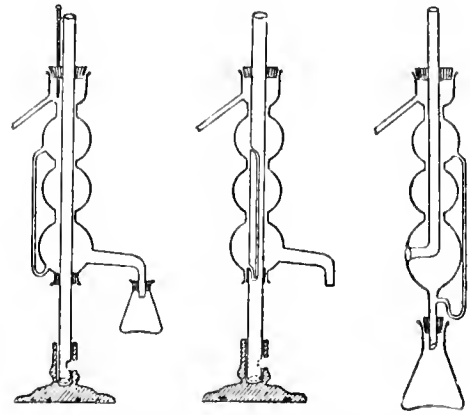
The lower end of the syphon discharges on to a folded filter *e* to ensure the removal of particles that may have escaped the upper filtering arrangement.

The apparatus is well adapted for such purposes as the extraction of fat in milk.—B. B.

Apparatus for Fractional Distillation. Greiner and Friedrichs. Zeits. Anal. Chem. **30**, 1891, 17.

The apparatus (three forms of which are illustrated) is designed to provide a means of regulating the cooling of

Fig. 1. Fig. 2. Fig. 3.



Apparatus for Fractional Distillation.

the vapour of a liquid to be fractionated. To this end in all three forms a wide tube is carried through the bulbs of the deplegmator so that a current of air is induced in and flows along it, cooling the contents of the bulbs. The cooling effect can be controlled by regulating the draught. The forms are functionally identical, as far as their fractionating action is concerned, but those shown in Figs. 1 and 2 can also serve as supports for the fractionating flask, if fitted with heavy stands as illustrated.—B. B.

On a Rapid Method of Solution in the Cold. J. B. Coleman.

See pages 231—232.

INORGANIC CHEMISTRY.—QUALITATIVE.

The Chemical Changes between Nitric Acid and Metals. V. H. Veley.

See pages 204—206.

The Chemical Changes between Lead and Nitric Acid. V. H. Veley.

See pages 206—210.

A New Method of Distinguishing between Arsenical and Antimony Mirrors. G. Denigès. Compt. Rend. **111**, 824—825.

The author draws attention to the use which may be made of the arsenic molybdate reaction as a confirmatory test of the presence of arsenic in the mirrors formed in Marsh's test. A pure antimony mirror will give no reaction, whilst phosphorus cannot be present in such a mirror. The author directs that the metallic mirror be treated with a few drops of pure nitric acid, which should be warmed to complete the oxidation to arsenic acid. Four or five drops of an acid solution of ammonium molybdate are then to be added, when the formation of the characteristic yellow crystals will follow if arsenic be present even to the extent of $\frac{1}{1000}$ of a milligramme. The crystals may be further identified by examination under a microscope with polarised light.

—G. H. B.

INORGANIC CHEMISTRY,— QUANTITATIVE.

On Standard Sperm Candles. W. C. Young.

See pages 185—191.

The Volumetric Estimation of Alumina. C. F. Cross and E. J. Bevan.

See page 202.

Estimation of Glycerin by Alkaline Permanganate. W. Johnstone.

See pages 203—204.

Estimation of Oxygen in Gas Mixtures. L. L. de Koninck. Zeits. angew. Chem. 1890, 727—728.

As an absorbent of oxygen the author uses a solution of iron protoxide prepared in the following way :—

Three aqueous solutions are first made, as follows :—

A. 40 grms. of crystallised ferrous sulphate.

B. 30 grms. of Seignette salt (sodium potassium tartrate).

C. 60 grms. of potassium hydrate.

Each of these solutions is made up to 100 cc. 1 vol. of A. is then added to 5 vols. B.; a white precipitate of hydrated ferrous tartrate forms, which immediately dissolves on the further addition of 1 vol. of C. If the Seignette salt and potassium hydrate are first mixed together and then added to the ferrous sulphate a clear solution is not obtained.

The clear solution prepared as above is yellowish, in contact with the air it turns green owing to the formation of iron protosesquioxide salt, and on complete oxidation it again becomes clear.—H. S. P.

Analysis of Commercial Barium Hydrate. E. Hintz and H. Weber. Zeits. Anal. Chem. **30**, 1891, 21—29.

The sample examined was found to contain as impurities barium carbonate, sulphate and thiosulphate, as well as traces of barium sulphide and sulphite. The last named was detected as follows :—On extracting the sample with water a residue consisting of barium sulphate, sulphite, carbonate and a portion of the thiosulphate present was obtained. This residue was boiled with sodium carbonate and a sulphite looked for in the filtrate by neutralising with acetic acid, and adding it to a solution of zinc sulphate containing very little sodium nitroprusside. The production of a red colour directly or on the addition of a solution of potassium ferrocyanide indicates the presence of sulphurous acid in small quantity.

The complete insolubility of barium sulphite was proved by precipitating the aqueous extract of the original sample with an alkaline lead solution (to remove the trace of sulphide present), and testing the filtrate for sulphite in the manner described above. This insolubility is turned to good account in the scheme for the quantitative analysis of the sample which was afterwards drawn up. The presence of a thiosulphate was also recognised in an aqueous extract freed from sulphide by an alkaline lead solution, by means of silver nitrate. Armed with a knowledge of these facts the authors devise the following plan :—

I. *Determination of Barium Sulphide and Hydrate.*—About 20 grms. of the substance were dissolved in hot water freed from air by boiling in a weighed 500 cc. flask. After cooling, the flask was filled to the mark with cold water, weighed, the contents well mixed and allowed to settle for some time.

(1.) 50 cc. of the clear solution were withdrawn and weighed, acidulated with hydrochloric acid, precipitated with dilute sulphuric acid, and the resulting barium sulphate filtered off and weighed in the usual manner, giving the total amount of barium in a form soluble in water.

(2.) Similarly, 250 cc. were poured into a solution of pure potassium hydrate, to which a few drops of lead acetate had been added. Lead sulphide mixed with barium carbonate (from absorption of CO_2) separated out. It was filtered off, treated with a few drops of hydrochloric acid containing bromine, and the barium sulphate (formed by the reaction between the sulphuric acid produced by the oxidation of the lead sulphide and the barium chloride from the barium carbonate), collected and weighed, giving the quantity of barium sulphide present in the original substance. In such a determination the following precautions must be observed :—

(*a.*) As barium thiosulphate is present in the original aqueous solution, enough caustic potash must be used to prevent the formation of a precipitate of lead thiosulphate.

(*b.*) The barium sulphate finally weighed, may contain lead sulphate, particularly if there be much barium sulphide in the original substance. In such a case the precipitate must be fused with sodium carbonate and the total sulphuric acid determined in the aqueous extract of the melt after the removal of lead by means of carbon dioxide.

(3.) The filtrate from the mixed precipitate of lead sulphide and barium carbonate obtained in process (2) contains the portion of the total barium thiosulphate which has gone into solution. It is decomposed with hydrochloric acid containing bromine, barium sulphate equivalent to the barium thiosulphate present being precipitated; it may need purification from lead sulphate in the manner described in (2) (*b*).

The barium found as sulphide and thiosulphate deducted from the total quantity in the aqueous extract gives that present as hydrate.

II. *Determination of Barium Sulphate.*—Five grms. of the original substance were heated with dilute hydrochloric acid in a stream of carbon dioxide to expel all the sulphur dioxide. The whole contents of the flask were then transferred to a dish, evaporated to dryness, the residue taken up in water with a few drops of hydrochloric acid, the undissolved impure barium sulphate collected, washed, ignited, fused with sodium carbonate, and the sulphuric acid determined in the aqueous extract of the melt in the customary way.

III. *Determination of Barium Thiosulphate and Sulphite.*—Ten grms. were treated with water, the insoluble matter separated and washed. The aqueous extract was treated with alkaline lead solution as in I. (2) to remove sulphide (this precipitate can be obviously used instead of the portion taken in I. (2) to determine the barium sulphide), and the quantity of thiosulphate present determined in the filtrate as in I. (3). In the residue insoluble in water are only barium sulphate, sulphite, and carbonate, and that part of the barium thiosulphate that did not dissolve in water. It is placed in a flask fitted with a cork perforated by two holes, by one of which the flask is connected with an upright condenser at the upper end of which are two Peligot's tubes filled with hydrochloric acid containing bromine; a tube in the other hole of the cork connects the flask with a second flask containing dilute hydrochloric acid; this second flask is con-

nected in its turn with an apparatus for generating carbon dioxide. The tube connecting the two flasks can be shifted up and down in the cork of the second one so that it can either dip into the hydrochloric acid which it contains, or not. At first this tube is placed so that it is clear of the acid, and carbon dioxide is passed through the whole apparatus; when the air is all expelled the tube is dipped into the acid and a portion of the latter driven over into the flask containing the insoluble matter. Sulphur dioxide is liberated and is absorbed in the bromine hydrochloric acid in the Peligot's tubes; to complete its expulsion the contents of the flask are afterwards boiled, a stream of carbon dioxide being maintained throughout the operation. The liquid in the Peligot's tubes (containing sulphuric acid formed from the sulphur dioxide) is evaporated on the water-bath, the residue dissolved in water, precipitated with barium chloride, and the resulting barium sulphate collected and weighed. The sulphur dioxide which is thereby estimated has been derived from barium sulphite only in part, the larger portion of it coming from the barium thiosulphate also present in the insoluble residue. The production of this portion, however, is accompanied by the liberation of a corresponding quantity of sulphur which remains in the flask with the insoluble matter. Accordingly hydrochloric acid containing bromine is added to the contents of the flask to oxidise this sulphur, the whole evaporated to dryness, taken up with dilute hydrochloric acid, the residue of impure barium sulphate filtered off, ignited, and purified by fusion with sodium carbonate as previously described. The resulting pure barium sulphate represents not only the extra atom of sulphur of the thiosulphate, but the barium sulphate present in the sample as such which has been already determined (II.). The difference between these two quantities gives the data for calculating the thiosulphate, whence the amount of sulphur dioxide that must be deducted from the total quantity liberated may be reckoned, and the true percentage of barium sulphite obtained.

IV. *Determination of Barium Carbonate.*—The operation was made in the usual apparatus; on account of the presence of sulphide and thiosulphate the decomposition was effected by a mixture of strong potassium permanganate solution and dilute nitric acid. A further precaution was observed by placing an absorption tube filled with pumice moistened with strong permanganate solution next the generating flask.

The particular sample examined according to this method gave the following results:—

Barium hydrate ($Ba(OH)_2 + 8\ H_2O$), 94·3; barium sulphate, 0·52; barium sulphite, 0·07; barium thiosulphate, 0·70; barium carbonate, 1·75; and barium sulphide, 0·04.

Apart from the determination of barium sulphate and carbonate, the whole analysis might be performed on one portion could an arrangement for filtering and washing with complete exclusion of atmospheric carbon dioxide be devised.

For the determination of the barium hydrate only, it suffices to treat 250 cc. of the solution taken as in I. (2) directly with hydrochloric acid containing bromine, filtering from the barium sulphate produced from the barium sulphide and thiosulphate, and estimating the barium present in the filtrate.

If the alternative method of determining the barium sulphide be adopted (as given under III.) the weight of barium sulphate corresponding to it can be deducted from the total amount of barium sulphate resulting from this oxidation of barium sulphide and soluble thiosulphate, giving thereby the quantity of dissolved thiosulphate.

The only cause of difference between the determination of the barium hydrate gravimetrically, and by titration, is due to the presence of barium sulphide—a negligible error in the case of the sample quoted above.—B. B.

The Analysis of Commercial Sodium Fluoride. E. Hintz and H. Weber. Zeits. Anal. Chem. **30**, 1891, 30–33.

The sample examined had a strong alkaline reaction and was proved to contain sodium carbonate, silica, sulphuric acid, chlorine, potassium, lime, magnesia, alumina, and ferric oxide as impurities. Apparently it had been prepared by evaporating a solution containing excess of sodium carbonate, whence it was concluded that no fluosilicate could be present as it would have suffered decomposition under such conditions.

The following is the process of analysis approved by the authors after many trials:—

I. *Determination of Silica and Fluorine.*—

(*a.*) 2–3 grms. of the substance are weighed and dissolved in water, in a capacious platinum dish, with the aid of heat. Ammonium carbonate is added and the liquid heated, more of the reagent being added as it evaporates. The resulting precipitate is filtered and washed with ammonium carbonate solution; it consists of impure silica and is set aside.

Sodium carbonate and a solution of zinc oxide in ammonia are then added to the filtrate, which is evaporated in a platinum dish until all the ammonia has been driven off, when the mixed precipitate of zinc silicate and hydrate is filtered off. The filtrate is preserved for the determination of fluorine. The silica is separated from the precipitate by evaporating to dryness with nitric acid, collected, ignited together with the impure silica previously precipitated with ammonium carbonate, and weighed. It may be volatilised with hydrofluoric and sulphuric acids and the non-volatile residue deducted, but on account of the probable presence of lime which would be converted into sulphate, and thus cause too large a correction to be made, it is preferably fused with sodium carbonate, and determined in the aqueous extract of the melt by evaporation with hydrochloric acid.

(*b.*) In the filtrate from the precipitation of the silica with an ammoniacal solution of zinc oxide, the fluorine is determined by precipitating hot with calcium chloride, filtering the mixed precipitate of calcium fluoride and carbonate, washing, igniting in a platinum crucible, evaporating to dryness in a platinum dish with a slight excess of acetic acid, taking up in hot water, and filtering and weighing the undissolved calcium fluoride. The purity of the calcium fluoride can be ascertained by converting a portion into sulphate by evaporation with sulphuric acid; sulphuric acid as an impurity can be looked for in another portion.

II. *Determination of Sulphuric Acid and Chlorine.*—About 20 grms. are heated with water, cooled and made up to 1 litre (without previous filtration).

(*a.*) After proper time for settlement has elapsed, a measured quantity of the clear liquid is drawn off, acidified with hydrochloric acid in a platinum dish, and the sulphuric acid present precipitated by barium chloride. The precipitate is filtered and washed in a platinum funnel, fused with sodium carbonate, and sulphuric acid determined in the aqueous extract of the melt in the usual way. This operation is, if necessary, repeated. The purity of the barium sulphate finally attained is verified by its weight remaining constant on evaporation with sulphuric acid.

(*b.*) A second portion of the clear liquid is acidified with nitric acid in a platinum dish, and precipitated with silver nitrate for the chlorine.

III. The carbon dioxide is determined as usual, save that decomposition is effected by a strong solution of tartaric acid.

IV. The bases are determined in the usual way, after decomposition of the fluorides by evaporation with sulphuric acid.

V. The water is determined by heating the sample in a stream of dry air, and absorbing the water given off in a drying tube.

VI. A portion of the silica of the sample examined was present as sand. It was determined by treatment with water, and extraction of the insoluble matter thus left with a solution of sodium carbonate and caustic potash, followed by treatment with dilute hydrochloric acid.

The result of the analysis is shown below:—

Sodium fluoride, 65·65 per cent.; sodium chloride, 0·74; sodium carbonate, 13·89; sodium sulphate, 1·96; potassium sulphate, 0·74; soda (as silicate), 1·50; silica (partly as sodium silicate), 10·11; calcium carbonate, 0·25; magnesium carbonate, 0·32; ferric oxide, 0·48; alumina, 0·17; and water, 3·97. Total, 99·78.—B. B.

On a New Volumetric Method of Analysis for Sulphurous Chloride. G. A. Le Roy. Monit. Scient. 1890, **36**, 1115—1116.

NORMAL sulphurous chloride (sulphur monochloride), S_2Cl_2, contains 47·41 per cent. of sulphur and 52·59 per cent. of chlorine. It is, however, able to absorb considerable quantities of sulphur or chlorine. It is largely employed in the manufacture of artificial and of vulcanised caoutchouc, and as no doubt the employment of a substance of constant composition is of importance to the manufacturer, a method of determining the percentage of sulphur and chlorine easily and rapidly would be useful.

Rose, in his *Traité de chimie analytique* (Vol. II., 790), gives the following method of analysis:—The sulphur monochloride is first oxidised with fuming nitric acid, and the sulphur is then determined as barium sulphate. Secondly, the chlorine is obtained by difference. The direct estimation of the chlorine in compounds of sulphur and chlorine is difficult and unsatisfactory.

Le Roy therefore proposes the following method.—The sulphurous chloride is weighed out in a tared flask or measured with an accurate pipette, and run into a dilute solution of pure soda (containing 19·37 grms. of Na_2O per litre—10 grms. of sulphur per litre) of which a known volume has been taken. The sulphurous chloride is decomposed; sodium chloride, hyposulphite, sulphite, sulphate, and sulphide being formed, and free sulphur separating out. On heating, the latter disappears rapidly. When the sulphur has disappeared and the solution has been cooled, hydrogen peroxide is added, and the mixture gently warmed to convert all the sulphur into sulphate. The excess of hydrogen peroxide is then driven off by ebullition. The excess of soda is then titrated with pure nitric acid (39·35 grms. of HNO_3 per litre) in presence of an indicator (litmus, methyl-orange), and after adding to the quantity of soda thus obtained, the quantity obtained in combination with the chlorine (calculated from a second experiment) and deducting the sum from the total soda used, the amount combined with the sulphur is obtained by difference, and the latter can thus be determined *n* cc. of soda sol. = *n* and 0·01 grm. of sulphur.

The neutral solution, which is free from sulphides and sulphites, is then titrated for chlorine with standard silver nitrate and potassium chromate, or with ammonium sulphocyanide and ammoniacal iron persulphate.

—F. W. T. K.

ORGANIC CHEMISTRY.—QUANTITATIVE.

On the Examination of Beer. A. Bertschinger. Zeits. f. angew. Chem. 1890, 665—671.

THE author was instructed by the Swiss Society of Analytical Chemists to draw up a report embodying a standard method for the examination of beer. This has been adopted by the Society with some modifications. The leading features are here given.

Definition. Beer is a beverage made from barley malt, hops, yeast, and water by mashing and alcoholic fermentation. If any malt or hop substitute has been used, this must be particularly stated.

Appearance.—Beer must be clear, or at most but slightly opalescent.

Composition.—Beer should contain more extract than alcohol. The amount of fermentation should be at least 48 per cent., beer which contains more than 3 per cent. maltose should not be sold.

The mineral constituents must not exceed 0·3 grm. in 100 grms. beer. A larger amount of mineral matter would indicate the addition of salts for neutralising or some other purpose.

The acidity of a normal beer calculated as lactic acid should be between 0·9 and 2·7 grms. per 1,000 grms. beer; that is, should require between 1 and 3 cc. normal soda solution for neutralisation. A beer with higher acidity is to be considered acid, and one with less has probably been neutralised.

The nitrogen should be at least 0·3 per cent. on the original wort solids, and the *phosphoric acid* about the same. A less amount points to the use of some malt substitutes like sugar or starch.

The acetic acid should not exceed 0·6 grm. per 1,000 grms. beer, *i.e.*, should not require more than 1 cc. normal soda solution for neutralisation.

The glycerol should not exceed 0·4 per cent.

Preservatives.—Neither salicylic acid, nor boric acid, nor any compounds of these should be used, and not more than 11 mgrms. per 1,000 grms. beer of sulphurous acid should be present.

Colouring.—None should be used. Dark-coloured beers should derive their colour from the malt used.

Beer pressure apparatus.—Only apparatus using compressed carbonic acid should be employed.

The following tables give the results of a large number of analyses of Swiss and German beers.

SWISS BEER.

	Number of Analyses.	Maximum.	Minimum.	Mean.
Alcohol	312	5·87	2·61	4·12
Extract	312	9·85	4·48	6·65
Mineral matters	197	0·330	0·121	0·210
Acidity	189	0·313	0·072	0·162
Maltose	53	3·07	0·72	1·75
Nitrogen	33	0·095	0·045	0·073
Phosphoric acid	150	0·106	0·025	0·071
Glycerol	22	0·32	0·12	0·22
Solid matter before fermentation.	312	13·87	11·29	11·89
Degrees of fermentation	312	66·52	41·6	55·31
Alcohol : extract as 1 :	312	2·92	1·01	1·61
Per cent. of nitrogen in original wort.	33	0·65	0·12	0·50
Per cent. of phosphoric acid in original wort.	150	0·68	0·17	0·47

GERMAN BEER (VIENNA AND PILSEN BEERS).

	Number of Analyses.	Maximum.	Minimum.	Mean.
Alcohol	88	4·89	3·08	3·74
Extract	88	9·18	4·72	7·04
Mineral matters	11	0·270	0·176	0·218
Acidity	43	0·365	0·097	0·191
Maltose	12	3·71	0·62	2·78
Nitrogen	5	0·102	0·049	0·067
Phosphoric acid	27	0·095	0·065	0·076
Glycerol	4	0·32	0·11	0·17
Total solids before fermentation.	88	16·48	11·70	14·52
Degrees of fermentation	88	64·30	38·98	51·52
Alcohol : extract as 1 :	88	2·97	1·18	1·88
Per cent. of nitrogen in total solids before fermentation.	5	0·62	0·41	0·45
Per cent. of phosphoric acid in total solids.	27	0·61	0·48	0·55

Appendix.—Method adopted by the Swiss Society of Analytical Chemists for the examination of beer.

The amount of alcohol and extract present is to be determined. The acids remaining in the beer after removal of the carbonic acid is to be expressed as lactic acid in parts per 1,000. The other constituents are to be expressed in percentages

First, the smell, taste, colour, transparency, and microscopic appearance of sediment or turbidity should be noted. Next, the specific gravity, alcohol, extract and mineral constituents should be determined. Finally the nitrogen, phosphoric acid, maltose, dextrin, glycerol, acetic acid, sulphates, chlorides, carbonic acid, sulphurous acid, salicylic acid, boric acid and foreign bitters should be determined.

In determining the carbonic acid, this may all be removed from the beer by continued shaking and gentle warming to 35° C.

The specific gravity is determined at 15° C.

The alcohol is determined by distillation and calculated by Holzner's tables.

The extract is determined from the specific gravity of the beer freed from alcohol, by evaporation to one quarter its bulk. The determination may be controlled by evaporating to dryness 10—20 cc. beer mixed with a known weight of sand and drying in the water-bath 5—6 hours.

The mineral constituents are estimated by ashing 10—20 cc. beer.

The acidity is determined by titration with $\frac{1}{10}$ normal alkali after removal of the carbonic acid.

The original extract is obtained with a fair approximation by adding together the weight of extract and twice the weight of alcohol.

The degrees of fermentation are calculated from the formula $100\left(1-\frac{\text{extract}}{\text{original extract}}\right)$.

The nitrogen is determined by Kjeldahl's process, in 50 cc. beer evaporated to 5 cc.

The phosphoric acid is determined in the ash by ammonium molybdate, or directly in the beer, after treatment with charcoal, by titration with uranium solution.

The maltose is determined by Fehling's solution.

The dextrin is determined in the same way after saccharification.

The acetic acid is determined by Landmann's method.

The carbonic acid is determined by the loss when heated, loss of water being prevented by a calcium chloride tube. Or by passing the gases evolved on boiling into baryta water and weighing the carbonate precipitated.

Boric acid is detected in the concentrated beer by its flame reaction.

Foreign bitters are detected by Dragendorff's method.

—A. L. S.

On the Revision of Constants employed in the Analysis of Fats and Oils. R. T. Thomson and H. Ballantyne.

See pages 233—237.

Notes on Vegetable Butter. F. Jean. Monit. Scient. 1890 **36**, 1116—1119.

The manufacture of a vegetable butter from the oils obtained from cocoa-nuts is commencing to be a pretty large business on the Continent, both in France and Germany. The manufacture of the vegetable butter according to Dr. Schlink's method depends on the treatment of the cocoa-nut oils with alcohol and animal charcoal, which removes the volatile and fragrant fatty acids of the aromatic oils and makes the oils perfectly white. The product thus obtained is a perfectly white mass, of the consistency of butter, and of a sweet, neutral, agreeable flavour, melting at 25° and remarkably free from any tendency to turn rancid. It contains 0·357 per cent. of water, 0·011 per cent. of mineral matter, and 99·632 per cent. of fatty matter.

Ordinary butter from cow's milk contains about 7 per cent. of butyric, caproic, capric, caprilic acids, &c., and these soluble acids only exist in traces in vegetable and in animal fats such as margarin; whereas vegetable butter resembles milk in containing about the same amount of soluble acids.

Experiments on its digestibility by various experimenters go to show that it exercises no harmful influence on the digestion. An experiment of the author seems to show that vegetable butter is not quite so digestible as butter, though more digestible than margarin and similar butters.

Though vegetable butter does not easily mix with butter, it will no doubt be employed as an adulterant. However, it seems as if there will be no great difficulty in detecting such fraud.

On saponifying a suspected butter and then liberating the acids by means of alcohol and sulphuric acid, the very characteristic odour of cocinic ether will be obtained if vegetable butter be present. The fatty acids obtained from a mixture of even 10 per cent. of it with butter have an acrid flavour and taste disagreeably of rancid cocoa-nut.

Since the percentage of soluble fatty acids in butter and vegetable butter are practically alike, their determination would practically lead to no result. Thus, 5 grms. of vegetable butter require from 29—30 cc. of decinormal alkali, whereas butter requires about 32 cc.

The determination, however, of the volatile acids by the Reichert-Meissel-Wollny method will serve to detect fraud, *i.e.* if pretty considerable quantities of vegetable butter have been added. Butter requires 27 cc. of decinormal soda, vegetable butter requires 7—8 cc. The fraudulent addition of margarin is more easy to detect, as this only requires 0·8—0·9 cc. of tenth-normal alkali.

A lowering of the melting-point, too, of the butter acids may help to indicate the presence of vegetable butter, as it melts at 27°, whereas butter melts at about 38°.

Fatty Substance.	Deviation in the Oleo-refractometer.	Solubility of Acetic Acid.	Melting Point of the Fatty Acids.	Cc. of Decinormal Soda per 5 grms. of Fatty Substance.		
				Soluble Acids.	Volatile Acids.	Fixed Fatty Acids.
	Degrees.	Per Cent.	Degrees.	Cc.	Cc.	Per Cent.
Butter from cow	− 30	63·33	38	37—22	29—26	87—88
Butter from cocoa-nut	− 59	+ 100	27	29—30	7—8	88·75
(Animal) oleomargarin	− 17	26·66	36—37	2	0·8—0·9	95
Pure Isigny butter	− 30	63·33	37·8	34·29	30·26	87·3
„ „ +10 per cent. of vegetable butter.	− 33	66·66	37	..	2·8	..
„ „ +15 „ „	− 34 good	90	..	..	..	..
„ „ +20 „ „	− 36	96	..	..	24·13	..
Pure Rennes butter	− 29	63·33	..	..	27·50	88·3
„ „ suspected	− 25	60	..	..	23·98	..
Suspected Privalaye butter	− 25	60	..	..	22·99	..
Pure Indre-et-Loire butter	− 29	63·33	..	..	25·5	..
„ „ suspected	− 26	56·66	..	..	25·1	..
Suspected Ardennes butter	− 27	58·33	..	..	..	..
Isigny butter and margarin	− 24	58	..	..	..	..

In the oleo-refractometer vegetable butter gives − 59°, whereas butter gives − 30°, so that this is a good test.

Further, the author finds that fats and oils, according to their kind, possess the property of absorbing a definite volume of acetic acid (of special density). Thus, butters absorb about 63·33 per cent., margarin about 26·66 per cent., and vegetable butter above 100 per cent., so that the presence of the latter in butter will raise the acetic acid absorbing power of a butter.

The results obtained are tabulated on page 275.

—F. W. T. K.

The Determination of Rosin Oil in Lubricating Oil. L. Storch. Ber. d. österr. Gesellsch. z. Forder. d. Chem. Ind. **9**, 93.

Ten to fifteen grms. of the lubricating oil is gently warmed with about five times its weight of 96 per cent. alcohol, in a small flask on the water-bath, shaken and then cooled. The alcohol is then decanted into a tared Erlenmeyer flask, 7 cm. high; the residue in the first flask is carefully washed with a little 90 per cent. alcohol, and the washing added to that already in the Erlenmeyer flask. The whole is then gently boiled on a water-bath, the flask being surrounded by a broken beaker to prevent condensation. When no more alcohol is evolved, the residue is cooled and weighed (A). This is then treated with ten times its weight of 96 per cent. alcohol. The solution is treated in exactly the same way as the first solution, and the weight of the residue is (B).

The difference between the amounts of alcohol used in the two cases was evidently necessary in order to dissolve the remaining mineral oil in the second experiment. The amount of alcohol used in the second solution is thus a guide to the amount of mineral oil, which, together with the rosin oil is again dissolved. By subtracting the amount from the weight of the residue B, a weight is obtained which is a little less than the amount of rosin oil actually present; the true weight lies between the weight of residue B and the weight when corrected as above.—A. L. S.

Investigation of China Teas. P. Dvorkovitz. Jour. Russ. Chem. Soc. **22**, 558—568.

The author undertook to find out how far the price of tea depends on the percentage of theine and tannin in it. The results of his numerous analyses are shown in the following table:—

Analysis of China Teas of the First Crop of 1890.

Nos. of Tea.	Water.	Constituents of the Tea Dried at 100° C.					Ratios.		
		Theine.	Tannin.	Products of Fermentation.	Extractive Matters.	Total Amount of Theine, Tannin, and Products of Fermentation.	Per Cent. of Theine.	Per Cent. of Tannin.	Per Cent. of Products of Fermentation.
1	7·44	2·44	9·44	1·80	33·43	13·38	16·00	70·55	13·45
2	7·79	2·50	9·87	1·61	33·34	13·98	17·80	70·60	11·51
3	8·20	2·53	9·27	1·68	32·11	13·48	18·78	68·76	12·46
4	..	2·68	10·05	1·44	37·26	14·17	18·92	70·92	10·16
5	7·97	2·66	9·77	1·75	34·55	13·98	19·03	69·89	11·08
6	8·16	2·65	9·76	1·45	31·20	13·86	19·13	70·41	10·46
7	7·66	2·72	9·79	1·78	36·70	14·09	19·31	69·46	12·63
8	7·90	2·73	..	..	..	..	..	..	..
9	7·91	2·86	..	..	..	..	..	..	..
10	..	2·91	10·38	1·52	34·88	14·81	19·65	70·09	10·26
11	7·60	3·01	10·55	1·67	34·60	15·22	19·79	69·31	10·90
12	..	2·87	10·05	1·74	33·90	14·66	19·82	68·56	11·68
13	..	2·83	10·07	1·35	31·15	14·25	19·87	70·66	9·47
14	8·07	2·88	9·65	1·67	30·92	14·17	21·31	68·10	11·57
15	..	2·82	9·36	1·59	33·00	13·77	20·55	67·90	11·55
16	..	3·14	10·03	1·70	32·21	14·84	20·96	67·59	11·45
17	8·10	3·01	9·35	1·88	34·12	14·24	21·02	65·73	13·25
18	..	3·10	10·00	1·50	34·10	14·60	21·23	68·50	10·27
19	..	3·16	9·80	1·75	33·05	14·71	21·48	66·62	11·90
20	..	3·02	9·37	1·50	32·40	13·89	21·74	67·46	10·80
21	9·08	3·03	9·45	1·18	33·80	13·63	22·02	69·38	8·63
22	7·84	3·10	8·84	1·18	32·20	13·02	23·05	67·89	9·06
23	8·85	3·02	9·05	0·80	33·00	12·97	23·20	69·77	6·94
24	8·20	3·27	9·21	1·44	31·05	13·92	23·50	66·16	10·34
25	8·24	3·25	9·14	1·27	32·05	13·64	23·84	67·00	9·16
26	9·13	3·41	9·32	1·44	33·26	14·17	24·07	65·77	10·16
27	9·78	3·33	9·22	1·27	32·00	13·82	24·11	66·71	9·18
28	8·42	3·45	9·42	1·38	34·80	14·25	24·22	66·10	9·68
29	7·83	3·21	9·00	1·17	33·46	13·38	24·52	67·26	8·22

The higher numbers of tea in it are better ones and more expensive. The author's conclusion from this table is that "it is not on the absolute amount of theine in tea that the price of different sorts depends, but on the relative percentage of theine to the total amount of tannin and products of fermentation, and the greater this ratio the higher is the price of the tea, and the more regular the fermentation the better the tea.

The methods used in estimating theine and tannin are as follows:—

Determination of Theine.—Ten grms. of tea leaves are ground, and scalded three times with 200 cc. of boiling water for five minutes each time, after which the tea is boiled twice with 200 cc. of water until no colouring is observed; then the solution is washed with petroleum ether for removing the fat and brown colouring matter of tea. 600 grms. of the liquid (containing the extract from 6 grms. of tea) are acted upon by 100 cc. of caustic baryta (4 cc. $Ba(HO)_2$ + 100 cc. H_2O); the sediment being immediately filtered off, 583 grms. of the filtrate (corresponding to 5 grms. of tea) are mixed with 100 cc. of 20 per cent. solution of common salt and subsequently gradually treated with 400 cc. of chloroform in three parts. On evaporating and drying the remainder at 100° C., white needles of theine are obtained.

Determination of Tannin. — Löwenthal's method, viz., oxidising tannin with potassium permanganate (see also this Journal, 1890, 1157—1159) in presence of excess of indigo carmine until a yellow tint appears, proved to be unreliable for two reasons:—

(1.) The result of the analysis greatly depends on the way of adding the permanganate; the slower it is added the less of it is required; and

(2.) The difficulty of establishing the strength of permanganate solution by tannin.

To avoid the second difficulty the author has found 31·3 grms. of tannin (not 41·20 grms. found by Neubauer) to correspond to 63 grms. of oxalic acid. Thus, having prepared the permanganate solution, of which 130 grms. would answer to 100 grms. of pure 10 per cent. oxalic acid, and 20 cc. of the same to oxidise 25 cc. of indigo carmine solution (about 50 grms. of indigo carmine dissolved in a litre of water, treated with 50 grms. of sulphuric acid, and filtered), the author mixes 40 cc. of extract of tea (as above) with 500 cc. of water, 25 cc. of indigo carmine solution, and 25 cc. of 20 per cent. sulphuric acid, and added potassium permanganate as follows: 32 cc. at once, then 2—3 drops per second, and finally 1 drop per second, until the yellow tint appears. "The total amount of the permanganate added, which ought not to exceed 38 cc., reduced by that required for the oxidation of indigo carmine points to the amount of the products of decomposition of tannin in tea, or rather to the stage of fermentation of the tea."—N. W. T.

The Analysis of Soap. J. F. Schmaible. J. Anal. Chem.; Chem. Trade J. 1890, **7**, 403, **8**, 39—40.

In soap which has not been carefully made, there may exist more or less unsaponified fat or free alkali, as the case may be. Besides these variations the commercial soap often contains varying amounts of rosin, alkaline carbonates and silicates, borax, Glauber's salt, pearl ash, starch, flint, talc, sand, &c., complicating the analysis to a corresponding degree. In toilet soap there may be found glycerin, alcohol, sugar, colouring matter, &c., while medicated soap often contains phenol, sulphur, potassium iodide, and other medical substances. (See this Journal, 1887, 681.)

After a careful comparison of the many analytical methods proposed, the author has found the following to give good results:

Water.—For the determination of water the method of Loewe (Fresenius, Zeits. Anal. Chem. **19**, 112) was employed with good results. From 80 to 100 grms. of the soap (which has been reduced to very fine shavings, and represents an average sample) is weighed out between watch glasses and heated in the air bath, at first from 60° to 70° C., to avoid melting, then at 100 to 105° C., till it possesses a constant weight.

In selecting the sample in this, as well as in all subsequent determinations, it is essential that an average specimen be obtained, since the content of water in the different parts of the bar varies considerably. This is best effected by cutting away about one-third from the end, and evenly scraping the cut surface of the remainder until a sufficient amount is obtained for the analysis. (See this Journal, 1884, 307.)

Unsaponified Matter.—For the determination of unsaponified matter (Allen's Com. Org. Analysis, Vol. II.), the soap which has been dried in the manner indicated, is extracted in a Soxhlet extraction-apparatus with petroleum ether, which for this purpose should boil below 80° C. and should leave no residue on evaporation. After the extraction is complete, the "petroleum ether" is distilled off, the residue dried at 100° C. and weighed.

In a boiled, well-made laundry soap, there should be no unsaponified matter unless the same had been subsequently added. In addition to unsaponified fats, foreign matters are sometimes found in the petroleum ether extract, such as soft paraffin (so-called "Mineral Soap Stock"), waxes, hydrocarbon oils, phenol, &c. If waxes be present the dried soap should be extracted with boiling toluene, which dissolves them better than petroleum ether.

Total Alkali and Fatty Acids.—The dried soap thus freed from unsaponified matter is next dissolved in hot water, preparatory to determining the total alkali and fatty acids. A pure soap dissolves completely in hot water, and no ordinary product should leave more than a slight residue.

If the article examined be "scouring soap," the insolable residue will be found to contain large quantities of fine sand, and sometimes talc. The residue, if appreciable, should be washed by decantation and eventually brought upon a filter with hot water, dried at 100° C., and weighed, after which, if desired, it can be subjected to further examination.

To the aqueous solution is added an excess of semi-normal sulphuric acid, setting free the fatty acids which rise to the surface. The beaker or vessel in which the precipitation was effected is next cooled with ice-water. When the fatty acids (U.S. Dept. Agric. Chem. Div. Bull. **13** [4], 456) have solidified, it is best to decant the liquid, remelt with hot water two or three times to remove any enclosed mineral acid, again cool, filter and wash with cold water until the washings are no longer acid, as shown by litmus.

The filtrate from the insoluble fatty acids contains the total alkali now present as sulphate, the excess of sulphuric acid and any glycerin which may have been present in the soap, if saponification were effected in the cold. The acid liquid may further contain a small amount of soluble fatty acids. It is first titrated with semi-normal potash, using methyl orange as indicator (Allen's Com. Org. Analysis, Vol. II., p. 260). From the original amount of sulphuric acid added and the number of cc. of semi-normal potash required to neutralise the excess of the same, can be determined the total alkali of the sample. It is calculated as Na_2O.

After the liquid has been rendered neutral to methyl orange (which indicates the mineral acid), phenolphthalein is added and more potash is run in. The number of cc. of potash required for neutralising corresponds to soluble fatty acids and is calculated to caprylic anhydride—

$$\left\{\begin{matrix} C_7H_{15}CO \\ C_7H_{15}CO \end{matrix}\right\} O$$

in the absence of more definite knowledge as to their nature.

The solution is now concentrated and tested for glycerin, which may be determined by evaporating to dryness and extracting with ether-alcohol mixture (Chem. Zeit. **8**, 1667), oxidising to oxalic acid by means of permanganate (Chem. Zeit. **9**, 975; also this Journal, 1886, 392) (not always applicable). (Allen's Com. Org. Analysis, Vol. II., p. 290.) In soaps containing silicates of the alkalis (a not unusual constituent), the gelatinous silicic acid which separates on the addition of sulphuric acid, remains with the fatty acids on filtration. To separate the fatty acids from this, as well as all other impurities which may be present, the author found the following method effective:—

The funnel containing the filter with the fatty acids is placed in a small beaker and heated in an air-bath (Allen's method). As the filter dries, the fatty acids pass through it and collect in the beaker below, while all the impurities

(silicic acid, traces of silica, talc, &c.) remain behind on the filter. Of course it is necessary to wash the filter, which remains saturated with the fatty acids, with hot re-distilled alcohol or petroleum ether, or else exhaust in an extraction apparatus. The alcohol or petroleum ether is distilled off, and the residue treated in the same way as the main quantity of fatty acids.

In determining the fatty acids in a soap, it is frequently convenient to extract with ether in a separating funnel (Chem. News, **43**, 218).

To do this the soap solution is placed in the funnel and shaken with sulphuric acid and ether. The separated acids are at once dissolved in the ether. The aqueous solution may be drawn off below, the ethereal solution washed with water, the ether evaporated, and the residue dried at 100° C. and weighed.

Some analysts recommend (Chem. News, **48**, 67) melting the fatty acids (if soft) with a weighed amount of paraffin or stearic acid, as by this means a firm coherent cake is obtained, which can be easily handled. The cake is washed, dried and weighed, and the weight of paraffin deducted.

This method, however, is not applicable when it is desired to make a further examination of the fatty acids, to determine their origin; in this case it is better to extract with ether, as given. Since the fatty acids exist in the soap as anhydrides, and are weighed as hydrates, it is necessary to multiply the weight found by the factor 0·9, which gives the weight of fatty anhydrides.

The fatty acids, after having been weighed, may be titrated with semi-normal potash, and from these data may be ascertained what portion of the total alkali exists in combination with the acid as soap. (See also this Journal, 1885, 369, 1887, 389, and 1890, 1072.)

Free Alkali.—To determine the per cent. of free alkali (Allen's Com. Org. Analysis, Vol. II., p. 251) in soap, a separate portion is weighed out and extracted with neutral alcohol in an extraction apparatus. The caustic alkali is determined in the alcoholic solution by titrating with semi-normal hydrochloric acid, using phenolphthalein as indicator.

When, however, the soap contains unsaponified fat, as is frequently the case if made by the so-called "cold process," this method cannot be used, since in alcoholic solution unsaponified fat would be readily saponified by the free caustic alkali present.

In such a case the soap must first be dried in an atmosphere free from carbon dioxide at 100° C., the unsaponified matter extracted with petroleum ether, and finally the soap dissolved in alcohol and the free alkali determined in the alcoholic solution as before.

The carbonate of soda, silicate of soda, borax, and everything insoluble in alcohol, remains behind in the extraction tube, and may be dried at 100° C. and weighed. If considerable, it may be further treated as follows:—

First, it should be exhausted with boiling water. One half of the solution is then titrated with semi-normal hydrochloric acid, using methyl orange as indicator. The amount of acid required corresponds to carbonate, silicate, and borate. In this solution sulphates may also be determined, and starch and gelatin tested for. The other half of the solution is examined qualitatively for carbonate, silicate and borate. If there remain considerable residue insoluble in water, it may be dried at 100° C., weighed, and further examined. (See also this Journal, 1889, 123.)

Resin.—Resin is a very common constituent of soaps, the resinates of alkalis having a similar action to soaps, and the cheapness of the material often suggesting a partial substitution of it for the natural fats and oils.

As a qualitative test for resin, Gottlieb's (Benedikt, Analyse der Fette u. Wachsarten, p. 121) method is reliable and easily made.

The soap is dissolved in water and heated to boiling. A strong solution of magnesium sulphate is added until the fatty acids are completely precipitated. The magnesium resinates remain in solution. After boiling two or three minutes, the solution is filtered and the hot filtrate acidified with sulphuric acid. In the presence of resin the liquid becomes turbid, due to the separated resin acids. The boiling should be continued for half an hour, to make sure that the turbidity is due to the resin acids and not to volatile fatty acids.

Badford (Benedikt, Analyse der Fette u. Wachsarten, p. 121) recommends as a qualitative test for resin the solution of the soap or mixed fatty and resin acids in 80 per cent. alcohol, and the addition of an excess of a solution of calcium chloride with ammonia to alkaline reaction. After cooling, the precipitate is washed and filtered. The filtrate contains the calcium salt of the resin acids, together with a slight amount of calcium oleate. It is now acidified with hydrochloric acid, the resin separates as a soft, gummy and viscous mass.

For the quantitative determination of resin, several processes have been recommended.

Gladding's method (this Journal, 1882, 205, and 1883, 480), which is based on the solubility of the silver resinates in ether, is open to objection on account of the inaccuracy arising from the repeated transfer of the ethereal solution and the numerous readings to be taken, and also on account of the evaporation of the ether which takes place. Furthermore, Wright and Thompson have shown the correction for oleic acid, which Gladding introduces, to be not at all constant.

A very convenient method, and one which the author found to give good results, is that devised by V. Hubl and Stadler (Benedikt, Analyse der Fette u. Wachsarten, p. 125).

0·5 to 1 grm. of the fatty acids is heated in a closed flask on the water-bath with about 20 cc. alcohol to complete solution. The acids are neutralised with alkali, using phenolphthalein as indicator. The alcoholic soap solution is then poured into a beaker, the flask rinsed with water, the solution diluted to 200 cc., and silver nitrate added to complete precipitation. The precipitate (consisting of the silver salts of the resin and fatty acids) must be protected from the sunlight. It is filtered, washed with water, dried at 100° C., and then extracted in a Soxhlet extractor with ether. The silver resinates dissolve in the ether, while the silver salts of the fatty acids remain behind. The ethereal solution, as it leaves the extraction tube, should be yellow or light brown in colour, but not dark brown. It is filtered, if necessary, and the filtrate shaken with hydrochloric acid in a separating funnel. The resulting ethereal solution of the resin acids is filtered from silver chloride, washed with water, and the filter and the separator rinsed with ether, the ether distilled off, and the residue dried at 100° C. As the resin is weighed in the hydrated form, its weight must first be multiplied by the factor ·9732 to obtain the weight of the anhydride. (See also this Journal, 1886, 392.)

It is frequently of interest to know the origin of the fatty acids of a soap which is, however, in many cases a problem not easily solved. The only clues are to be sought in the specific gravity, combining weight, melting and solidifying points, and iodine number of fatty acids.

Occasionally, fats, before being used in soap making, are bleached by various chemical agents, the most common of which are, perhaps, potassium bichromate and hydrochloric acid or sulphuric acid. When such a mixture is heated in bleaching, as is frequently the case, the bichromate, acting on the hydrochloric acid, liberates chlorine, and, under favourable conditions, the chlorine combines with the unsaturated acids present in the fats as glycerides, thus utterly destroying the value of the iodine number—the most definite index as to the origin of the fats.

Again, it frequently occurs that mixtures of two or more fats may be used, the combining weights, iodine number, and other properties of which closely approximate those of an individual fat, and so an erroneous conclusion may be drawn from an examination of such mixed fatty acids.

When, however, a mixture of two fats, in their natural state, without having undergone any bleaching or refining process, has been used, it is generally possible to ascertain, with considerable accuracy, the nature of the fatty acids by means of the iodine number, it having been found by actual experiment that the iodine number of a mixture of two fats corresponds within the limits of analytical error with theoretical numbers calculated for the pure fats. (See also this Journal, 1883, 479—480.)—O. H.

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THIS, the second volume of Mr. Groves' translation of Fresenius, commences on page 193, in the subject of "*Acidimetry.*" On page 205 the subject of Alkalimetry is taken up, followed by the description of methods for the valuation and analysis of Chloride of Potassium, Sulphate of Potash, Nitrate of Potash, and Gunpowder. On page 228 commences a description of methods for analysing Tartar. Later on, pp. 230—240, are found methods for analysing Black Ash, Common Salt, and Salt Cake, pp. 241—248 being devoted to the subject of the analysis of Bleaching Powder or Chloride of Lime. Then follow methods for analysing Acetate of Lime, Limestones, Dolomites, and Cements, Clays and Native and Mixed Silicates. After these, Chromium Compounds and Zinc Compounds follow, and here the volume ends uncompleted.

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PART I. is now issued, in paper cover, large 8vo size, with Introduction and extending from A to ALO. Price 1*s.* 6*d.*

THE METALLURGY OF STEEL. By HENRY MARION HOWE, A.M. (Havard), S.B. Volume I., Second Edition, Revised and Enlarged. The Scientific Publishing Company, 27, Park Place, New York. 1891.

THIS is a quarto volume, handsomely bound in brown cloth and gilt. The work is dedicated to Sir Lowthian Bell, Bart., F.R.S., as a token of the author's admiration. It contains Prefaces to the First and Second Editions, List of Errata, Tables of Contents, List of Illustrations and of Tables, and Subject-Matter extending over 385 pages, closing with an Alphabetical Index and Advertisers' Index. There are 232 excellent wood engravings and numerous tables. The matter is classified as follows:—Chap. I. Classification and Constitution of Steel. II. Carbon and Iron. Hardening, Tempering, and Annealing. Evidence that there are two conditions of Combination of Carbon with Iron. Effect of Carbon on the Physical Properties of Iron. Hardening, Tempering, and Annealing. Rationale of Hardening and Annealing. III. Iron and Silicon. IV. Iron and Manganese. V. Iron and Sulphur. VI. Iron and Phosphorus. Effect of Phosphorus on the Physical Properties of Iron. VII. Chromium, Tungsten, Copper. VIII. The Metals occurring but sparingly in Iron. IX. Iron and Oxygen. X. Nitrogen, Hydrogen, Carbonic Oxide. XI. The Absorption and Escape of Gas from Iron. XII. The Prevention of Blowholes and Pipes. XIII. Structure and Related Subjects. XIV. Cold-working, Hot-working, Welding. XV. Direct Processes. XVI. Charcoal-Hearth Processes. XVII. The Crucible Steel Process. XVIII. Apparatus for the Bessemer Process.

Appendix I. Special Steels. II. Anti-rust Coatings. III. Lead Quenching. IV. Direct Processes.

Trade Report.

TARIFF CHANGES AND CUSTOMS REGULATIONS.

ITALY.

Recent Customs Decisions.

Note.—Quintal = 220·4 lb. avoirdupois. Lira = 9$\frac{6}{10}$*d.*

The following decisions affecting the classification of articles in the Italian Customs tariff have been given by the Italian Customs authorities:—

Oxidised enamel colour.—Category 73*b.* Duty, 50 lire per quintal.

Aristol (chemical preparation).—Category 61. Duty, 10 lire per quintal.

Betha naphthaline.—Category 51*b.* Duty, 4 lire per quintal.

CANADA.

Grease for Soap Manufacture.

The *Canada Gazette* for the 31st January publishes an order of the Governor-General of Canada in Council, providing that under authority of section No. 248 of the Customs Act, the item No. 277, chapter 20, 53 Victoria, intituled "An Act to amend the Act respecting the Duties of Customs" is to be interpreted and to read as follows:—

Grease, rough, the refuse of animal fat, such as is fit only for use in the manufacture of soap, although the same is passed through a process of deodorisation. Provided that the same shall not be admitted free of duty except when imported by soap manufacturers for the manufacture of soap only, in their own factories, and in all cases of importation, on entry of such grease, the importer, when he claims the exemption from duty, shall swear to and subscribe the following affidavit:—

"I, , the undersigned importer of the grease mentioned in this entry, do solemnly swear that such grease is fit only for the manufacture of soap, that it is imported by me for that purpose, and will be, and all products thereof will be wholly used for that purpose only, and will be so used in my factory situate at in the province of ."

Customs Decision.

The following decision affecting the classification of copper in the Customs tariff of Canada has, according to the *Canada Gazette*, been recently given by the Canadian Board of Customs under the approval of the Governor-General in Council:—

Metallic copper, the exclusive product of Canadian ore smelted abroad and returned to Canada by the producers of the ores from which smelted, may, for one year from the 1st February 1891, be admitted into Canada under such regulations as the Minister of Customs may prescribe, and on payment of duty on the cost of smelting thereof.

MAURITIUS.

Customs Tariff.

Note.—Kilog. = 2·204 lb. avoirdupois; Hectolitre = 22 Imp. gallons; Metre = 1·094 yds.; Rupee = 2*s.* (nominal value).

The following is a statement of the rates of Customs duty now levied on merchandise imported into the island of Mauritius:—

Note.—Under Ordinance No. 20 of 24th December 1890, a surcharge of 10 per cent. has been levied on import duties, except those on rice, salt fish or dried fish, wheat and wheat flour, dholl, lentils, wine in casks, salt beef and salt pork (salt pork does not include hams and bacon). The same to remain in force up to 31st December next inclusively.

CUSTOMS TARIFF OF MAURITIUS—*continued.*

Description of Goods.	Rates of Duty.	
		Rs. C.
Asphaltum or bitumen	Per 1,000 kilos.	1·25
Brimstone or sulphur, common	Per 100 kilos.	0·60
„ „ refined	„	1·20
Camphor, crude	„	8·00
„ refined, and in powder	„	11·25
Candles (except wax)	„	2·75
„ wax	„	9·00
Cautchouc and india-rubber (manufactured)	„	16·00
Cement	„	0·25
Charcoal	„	0·10
Clay, pipe and fire	„	1·50
Copper, old	„	2·60
„ bar, bolt, sheet, &c. (red)	„	8·00
„ „ „ (yellow metal)	„	4·00
Detonators	Per 1,000	4·00
Dynamite	Per 100 kilos.	12·00
Gambier or cutch	„	2·00
Glass, window	Per 100 metres	2·00
„ bottles, empty	„ bottles	0·10
Glue	Per 100 kilos.	3·00
Gum, arabic	„	2·00
„ copal	„	8·00
Gunpowder, sporting	„	5·00
„ blasting	„	1·00
Hides, raw and salted	„	3·00
„ tanned	„	4·50
Indigo	„	2·25
Lead, sheets, shot, and pipes	„	1·25
Leather, sole	„	7·50
Lime	„	0·20
Lime and lemon juice	Per hect olitre	3·00
Manure of all sorts; and the following substances when imported for the purpose of being used in the preparation of manures or other colonial produce, or as disinfectants, viz :—		
1. Ammoniacal liquor		
2. Bones, bone dust, bone oil, and dissolved bones.		
3. Carbolic acid		
4. Chloride of lime		
5. Chloride of manganese		
6. Chloride of soda, solution of soda		
7. Chloride of zinc	Per 1,000 kilos.	0·25
8. Coal and wood soot		
9. Dried muscular flesh and dried blood		
10. Ether		
11. Fish and other substances damaged and condemned by the Customs sanitary officers as fit for manure only.		
12. Lime, carbonate of lime, sulphate of lime or gypsum, phosphate and superphosphate of lime,		
13. Nitrates, silicates, and carbonates of potash and soda.		
14. Perchloride of iron		
15. Permanganate of potash	Per 1,000 kilos.	0·25
16. Phosphate of soda		
17. Sulphate of iron		
18. Sulphate and muriate of ammonia and other ammoniacal salts.		
19. Sulphate of potash		
20. Sulphate of zinc	Per 1,000 kilos.	0·25
21. Sulphuric acid		
22. Urate and sulphurated urine		
Matches	Per gross	0·75*
	On boxes containing each not more than 100 matches and a proportional duty on boxes containing more than 100 matches.	
Oils:		
Castor	Per 100 kilos.	2·0
Gingely, mustard, and pistachio	„	2·50
Cocoanut (when not imported from the Oil islands).	Per hectolitre	1·50
Olive in cases	Per case not exceeding 12 litres.	0·50
Neatsfoot	Per hectolitre	3·50
Petroleum	„	1·50
Colza	„	2·50
Linseed	„	1·75
All other sorts (except perfumed)	„	2·50
Imported from the Oil islands with payment of Rs. 4,000 on or before the 15th January in each year.	„	0·06
Do., in default of said payment	„	0·50
Opium, crude	Per kilo.	20·00
refined	„	40·00
Pitch and tar	Per 100 kilos.	0·50
Plaster of Paris	„	5·75
Rosin	„	0·70
Skins, sheep and goat (tanned)	„	6·00
Soap (ordinary, not including scented)	„	1·25
Soda, caustic	„	0·75
Solder	„	3·50
Spirits, plain or compounded, of any strength not exceeding proof according to Sykes' hydrometer, and a further proportional duty for any greater strength.	Per litre	1·10
Starch	Per 100 kilos.	0·75
Steel, unwrought	„	2·0
Sulphate, iron	„	0·50
„ copper	„	1·50
Tallow	„	2·00
Tin plates	„	1·25
Turmeric	„	1·50

* Under Ordinance 21 of 1890 matches pay this duty for one year.

CUSTOMS TARIFF OF MAURITIUS—*continued.*

Description of Goods.	Rates of Duty.	
		Rs. C.
Turpentine	Per hectolitre	2·00
Varnish (all kinds)	„	5·00
Vinegar	„	1·25
All goods, wares, and merchandise not otherwise charged with duty, and not mentioned above, or not specially exempted, shall be liable to an *ad valorem* duty of ...	7½ %	

EXTRACTS FROM DIPLOMATIC AND CONSULAR REPORTS.

DUTCH COLONIES.

Drugs, Soaps, and Perfumes.

By far the greater part of the chemicals used for hygienic purposes and by pharmacists in Java are of German manufacture. British industry, although otherwise quite capable of competing successfully, is left far behind here in consequence of the intimate connexions existing between the Dutch and Dutch-Indian medical men, pharmacists and scientists, and the manufacturing and scientific circles in Germany, where many of them have studied. The quinine used here in very large quantities against tropical fever is nearly all of German make. Paints are nearly all British, only white lead in powder being obtained from Germany, but aniline and other dyes are mostly German. In soap Germany tries to compete to some extent, but cannot do so successfully against the cheap English soaps, especially common yellow washing soap in bars from Liverpool. German soap dries too rapidly. The best toilet soaps are of French manufacture. In perfumery also the French easily maintain their lead upon the market, but the enormous consumption of eau de Cologne of all brands is supplied by Germany. Lately German firms have also tried to obtain a footing with other perfumes, but they found it very difficult to place their goods here at satisfactory prices.

Mineral Waters.

Almost without exception all mineral waters used here are imported from Germany. Apollinaris is the most favoured kind, but many other brands are also used. The consumption is large, and increases year by year, partly owing to the inferiority of the local drinking-water, partly because of the growing tendency to substitute a mixture of brandy and mineral waters as a beverage for beer, wine, or liqueurs.—*Chemist and Druggist.*

RUSSIA.

Mercury and Phosphorus.

Among the articles of export from Russia which are now beginning to attain a certain importance are quicksilver and phosphorus. Until quite recently Russia obtained all the quicksilver consumed by her from abroad, but since the commencement of exploitations of the mines of Bakhmut, Russian mercury is not only ousting the foreign article from the local markets, but it has become an article of export. In 1887, 7,803 poods of it were exported from St. Petersburg and Libau. In 1889, 3,150 poods of phosphorus were also exported.

Quicksilver.

The mercury mines of Saigewa, near the Nikitowka station of the Azof railway prove to be exceedingly rich. The deposits contain three layers of hydrargerous ore, the total quantity of ore containing metal being estimated at 12,000,000 poods. The ore is sprung by means of dynamite crushed by manual labour and by crushing machines, and finally roasted. In 1889, the yield of the mines was 10,202 poods of pure metallic quicksilver. In working the deposits, traces of former workings and abandoned pits are found, showing that these same mines have already been exploited in ancient times.—*Ibid.*

MISCELLANEOUS TRADE NOTICES.

NEW TANNING PRODUCT IN ANGOLA.

Sir G. G. Petre, Her Majesty's Minister at Lisbon, in a despatch to the Foreign Office, dated the 2nd February, says :—

"The *Official Journal* of the 31st January publishes a Royal decree dated the 28th, granting to Senhores Amado and Swart, merchants in Angola, the exclusive privilege for 10 years of exporting from the province of Angola, the district of Congo excepted, a new industrial product invented by them and extracted from a common tubercle which has not yet been scientifically classified for any industrial purpose. The use to which the product in question, of which no name is given, is to be applied, is that of tanning ("*curtimento*") of hides.

In a postscript Sir G. G. Petre adds : "The export duty on the product in question is fixed in the decree at 5 per cent. *ad valorem* when shipped to foreign ports, and at 3 per cent. *ad valorem* when sent to a Portuguese port."—*Board of Trade Journal.*

BRINE AT STAFFORD.

Boring and pumping operations have been going on for some time past in the neighbourhood of Stafford in connexion with the water supply, and a discovery of brine has now been incidentally made which may prove of considerable importance. Some 10 years ago the Stafford Corporation made an unsuccessful attempt to obtain a water supply by boring on Stafford Common. But after a great loss of money the boring had to be abandoned owing to a thick deposit of salt which was liquefied by the water, and rendered it impossible to obtain pure water from that site. The boring at Eason Moor, not far distant, a few years later revealed a similar obstacle, and the Corporation had also to abandon the measures on that side of the town. The Common site has recently been sold to a private firm. The boring was re-opened, and pumping commenced a fortnight ago. When the water had been reduced to 40 ft. below the surface, brine began to rise with from 17 to 25 degrees of saturation. The supply of brine is large, it being found impossible to reduce the head below 50 ft. from the surface by pumping at the rate of 320 gallons per minute. The brine is said to be the strongest yet discovered in Staffordshire. It is anticipated that brine works will soon be established.—*Chemical Trade Journal.*

UNIFORM CUSTOMS IN THE MANURE TRADE.

The committee of the German Agricultural Society, Section for Fertilisers, has, in drawing up the following regulations, performed a work which will greatly assist the trade in fertilising material, and prove of great use to agriculturists.

a.—Packing.

The sacks in which commercial fertilisers are sold must have the following details printed on them in letters of uniform size :—

1. Firm supplying the article.
2. Name of the fertiliser.
3. Amount of useful material contained in the article.

The name of the manufacturer and the composition of the manure must be printed on one side of the sack; the name of the manure may either be on the same side or on

the other side. Sacks containing 50, 75, or 100 kilos. must be used, but the weight need not be recorded on the package.

The following are the *only* names and abbreviations which may be employed for fertilisers: (1) Ammonia-superphosphate, am. sup. (2) Nitrogenous-superphosphate, nt. sup. (*German* st. sup.). (3) Mixture of ammonia-superphosphate and organic nitrogenous matter, am. nt. sup. (4) Saltpetre-superphosphate, salp. sup. (5) Ammonia-saltpetre-superphosphate, am. salp. sup. (6) Ammonia-saltpetre-superphosphate with organic nitrogen, am. salp. nt. sup.

The constituents are always to be named in the following order, and by the following abbreviations: Nitrogen, n. (*German* st.). Phosphoric acid, ph. Potash, k. The amount of phosphoric acid is to be expressed, if necessary, by two numbers, connected by a sign, the first of which always signifies acid soluble in water (*e.g.* Ph. 13 + 2 means 15 per cent. of phosphoric acid, 13 of which are soluble, and 2 insoluble in water.

b.—Details for the various kinds of Fertiliser.

Superphosphate.—When without further qualification only the soluble phosphoric acid need be stated. The nature of the material used in its manufacture does not require to be given. If, however, a portion of the acid is soluble, and the rest insoluble, the amounts of each must be stated.

Precipitate.—Amount of phosphoric acid.

Ground Thomas-slag and *Thomas-phosphate meal.*—Amount of phosphoric acid and dust.

Bone meal.—In addition to the amounts of phosphoric acid and nitrogen a further statement in agreement with the conditions laid down by the Union of German Research Stations in conjunction with the bone-meal manufacturers, must be made.

Fish guano, flesh meal, Peru guano, foeal guano, poudrette (crude or fine) and *fine bone meal* must be labelled with amount of nitrogen, and total and soluble phosphoric acid.

Ammonia superphosphate prepared from superphosphatic and pure ammonium sulphate, must be accompanied by a statement of amount of ammoniacal nitrogen and soluble phosphoric acid.

Nitrogenous and superphosphate mixtures of superphosphates with valuable nitrogenous organic matter (ground leather, wool, &c. being excluded), sometimes alone and sometimes with sulphate of ammonia, simply require a statement of the amount of soluble phosphoric acid and total nitrogen.

Saltpetre superphosphates.—Mixtures of Chili saltpetre with superphosphates require the amounts of nitrogen and soluble phosphoric acid.

Saltpetre ammonia superphosphates, which are similar to the above, but with sulphate of ammonia in addition, require soluble phosphoric acid and total nitrogen to be noted.

Chili saltpetre and ammonium sulphate, delivered in original packing, require no further designation. If, however, they are in any way prepared, they must be labelled as above and with the amount of nitrogen present.

Blood meal, horn meal, and other nitrogenous fertilisers are required to bear their names and the amount of nitrogen present.

Mixtures containing *potash salts* must, in addition to the above, be labelled with the amount of potassium oxide (not salt) present.

c.—Sampling.

The sampling must be done by the purchaser, or his representative at the railway station, or within two days of receipt at the place of delivery, either in the presence of a representative of the seller, or with the assistance of an impartial person, according to the following method.

An average sample must be carefully taken, if possible by means of a sampling iron from the interior of every fifth sack, if the quantity be less than 200 cwt., and of every tenth sack if it exceeds this amount; sacks which have been injured during transport are not to be included. The samples thus obtained must be well mixed with one another on a clean and dry surface, and three equal samples, each of at least half a pound weight taken out, placed in clean dry glass or earthenware vessels, closed air-tight, sealed, and labelled. A statement must be drawn up by the seller, giving particulars of manufacturer, mark, number of sacks, weight, and guaranteed composition, and must be signed by both parties. In cases of dispute, only such samples as are taken in this way and are accompanied by such a document will be recognised.

These regulations come into force on April 1st, 1891.

It is to be hoped that agriculturists, to whom these regulations give a simple means of control, will do all in their power to assist their introduction, and will make use of the advantages thus offered to them.—*Chemiker Zeitung through Chemical Trade Journal.*

Potash and its Derivatives.

Review of 1890.

There has been a serious reduction in the production of potash in France during 1890, the chief cause of this being the scarcity of raw material—beetroot salts.

About 24 million kilos. of salts have been refined during the year, and in addition to this the surplus stock of crude potash from the preceding year has been converted into the refined article. In spite of this, several potash refiners have been compelled to stop work, either completely or partially. This lack of raw material is the result of the payment of a bonus to the manufacturer, who is thereby induced to exhaust the molasses to the utmost extent.

The amounts produced have been (about):—

6,000,000 kilos. refined potash, 75—80 and 80—85 per cent.
1,500,000 kilos. extra potash, 88—90 per cent.
1,000,000 kilos. hydrated potashes.
4,000,000 kilos. common salt.
4,500,000 kilos. potassium chloride.
3,000,000 kilos. potassium sulphate.

The potash salts have been chiefly employed for agricultural purposes. The chloride in particular, which is still converted into sulphate by some works in the Nord, is entirely devoted to this purpose, and at a price which would not pay manufacturing industries.

Sulphate of potassium is still partially worked up, but its high price will eventually shut it out, like the chloride, from use in this direction.

The production of potash from suint, which is the source of a regular annual supply, has been much less in 1890 than in the preceding years. Not more than 4 million kilos. of suint potash have been produced in the various French wool-washing establishments, and the deficit of each works may be estimated at nearly a quarter of its total production. It appears that similar conditions will probably exist throughout 1891.

The potash thus produced has been mainly employed in the manufacture of caustic potash, and the remainder sent directly to the soap boilers. The manufacture of caustic potash, of which France appears to enjoy almost a monopoly, and which has been greatly restricted of late years, has developed considerably during 1890. The old works have been fully employed and new ones established, all of which have been able to find a market for their products. More than 2,000,000 kilos. of caustic potash of different qualities have been manufactured, and, for the most part, exported. —*L'Engrais through Chemical Trade Journal.*

Scents and Perfumes.

In 1889, 44,608 gallons of perfumed spirits, chiefly eau de Cologne, valued at 87,629*l.*, and paying a duty of 10*s.* 6*d.* per gallon, were imported into England. Of essential and perfumed oils there were 1,078,277 lb., valued at 192,340*l.*; and of perfumery and articles used therein, 1,367,847 lb., valued at 139,746*l.* The lavender water distilled at home, the otto of roses, musk, vetivert, Tonquin bean, patchouli, and other perfumes imported, bring up the total to 500,000*l.* sterling. Of orange-flower water, jasmine and neroli oils, citronelle and lemon-grass oils, a great deal are received.

There are about 10,000 acres under *Andropogon nardus* grass in Ceylon, and over 5,500,000 oz. of the citronelle oil made from it are shipped. Lemon-grass oil is obtained from other species, *Andropogon citratus* and *A. schœnanthus*. About 9,000 oz. are shipped from Ceylon. Geranium oil, which is much used to adulterate otto of roses, is distilled in Algeria to the extent of 12,000 lb.

Otto of roses is chiefly produced in Turkey and India. At Kezanlik and it neighbourhood about 80,000 oz. are made. At Adrianople the yield of an average crop of roses is from 600,000 to 825,000 drachms. It requires about 3,000 lb. of rose leaves to produce an ounce of otto of roses. The Turkish oil is that most found in our market; but much of the rose oil which England consumes comes also from India, it being largely distilled in the North-West Provinces and the Punjab. From India there was exported last year 12,128 gallons of different essential oils, valued at 20,277*l*. Of this quantity, 3,000 gallons came to the United Kingdom, 1,000 gallons were sent to France, and nearly all the rest went to the east coast of Africa, Arabia, and Egypt. But if we use a great deal of perfumery, we also export perfumed waters, distillates, and articles of perfumery, to the value of about 110,000*l*. a year.

Olive Cultivation in Northern Persia.

J. Soc. Arts, 1891, **39**, 278—279.

Her Majesty's Secretary of Legation at Teheran says that this group of villages possesses from 80,000 to 100,000 trees, which yield on an average from 6 to 9 lb. of olives per tree per annum, thus giving an annual produce of 560,000lb. of olives, if the former average be taken. The quantity of good olive oil derived from the Persian presses may be estimated at 17 per cent. of the olives, which would give 127,000 lb. of good oil. The good oil having been extracted, the residue is again pressed, and an oil of inferior quality is produced, which is used in the manufacture of soap. The value of the oil after a good harvest is 2 *krans* (about 1*s*. 2*d*.) per bottle of 2 lb. weight, at Resht or Teheran, whereas the maximum price paid per bottle after a bad harvest is 5 krans In obtaining the oil the following process is employed:—The olives are gathered late in the autumn, and at once stored in a kind of large bin, where they are left to ferment till the first spring suns, that is to say, till about the festival of the Persian new year, March 21. The olives are then spread out to dry on the flat house tops. When perfectly dried, they are again packed till they ferment. After this second fermentation, they are trodden by men, somewhat after the fashion in which grapes are trodden in the wine-press. After having been thus trodden they are boiled, and after boiling crushed in a sort of press between flat stones, a receptacle for the oil being placed beneath the stones. A monopoly for the working and purchase of all the olives in northern Persia was granted to a firm of Russian merchants, in a concession given to them by the Shah in 1890, and in order that no time may be lost in turning a profitable speculation to good account, a member of this firm has, it is said, been already carefully studying the various methods employed in Europe in the pressing and refining of the oil, the method in practice in the olive oil presses of Marseilles having finally been selected by him. Every olive tree in Persia is subject to a government tax of 4 *shahis*, or about 1½*d*. English money.

Papers of Interest to Technologists and Others.

The following articles in the *Board of Trade Journal* for March will repay perusal:—

"United States.—Regulations affecting Marking of Imported Goods," p. 268 *seq.*
"Argentine Republic.—Supplementary Customs Law," p. 275 *seq.*
"Fibre Plants of Coahuila," p. 309 *seq.*
"The Iron Ores of Australia," p. 327 *seq.*
"The Mineral Resources of Bolivia," p. 340 *seq.*

BOARD OF TRADE RETURNS

Summary of Imports.

	Month ending 28th February	
	1890.	1891.
	£	£
Metals	1,918,364	1,891,649
Chemicals and dyestuffs	873,697	864,218
Oils	442,051	522,098
Raw materials for non-textile industries.	2,119,543	2,180,652
Total value of all imports	31,018,842	33,311,354

Summary of Exports.

	Month ending 28th February	
	1890.	1891.
	£	£
Metals (other than machinery)	3,380,286	2,850,721
Chemicals and medicines	725,887	756,000
Miscellaneous articles	2,672,701	2,539,893
Total value of all exports	21,084,228	20,470,621

Imports of Chemicals and Dyestuffs for Month ending 28th February.

Articles.	Quantities.		Values.	
	1890.	1891.	1890.	1891.
			£	£
Alkali ..... Cwt.	2,447	5,349	1,672	3,241
Bark (tanners, &c.) „	19,471	33,494	5,863	9,389
Brimstone ..... „	86,422	24,745	18,057	6,655
Chemicals ..... Value £	..	..	88,866	97,750
Cochineal ..... Cwt.	1,222	554	8,432	3,175
Cutch and gambier Tons	2,615	2,983	71,451	69,567
Dyes:—				
Aniline ..... Value £	..	..	24,703	24,580
Alizarine ..... „	..	..	26,795	31,339
Other ..... „	..	..	2,026	1,079
Indigo ..... Cwt.	19,628	17,672	371,603	361,851
Madder ..... „	846	601	1,046	473
Nitrate of soda .... „	104,219	195,455	38,436	76,554
Nitrate of potash . „	26,850	26,966	23,053	24,387
Valonia ..... Tons	1,932	1,379	38,306	29,644
Other articles ... Value £	..	..	151,888	124,525
Total value of chemicals	..	..	873,097	864,218

Imports of Metals for Month ending 28th February.

Articles.	Quantities.		Values.	
	1890.	1891.	1890.	1891.
			£	£
Copper:— Ore ..... Tons	7,901	5,262	51,638	48,184
Regulus ..... "	8,834	11,113	243,358	307,080
Unwrought .... "	2,175	2,358	111,833	131,000
Iron:— Ore ..... "	183,907	307,053	304,230	239,958
Bolt, bar, &c. ... "	5,648	4,393	46,440	40,281
Steel, unwrought .. "	459	380	5,349	4,748
Lead, pig and sheet "	12,952	12,065	168,671	157,767
Pyrites ..... "	18,248	19,932	89,156	98,625
Quicksilver ..... Lb.	888,975	1,237,895	114,748	142,016
Tin ..... Cwt.	65,015	58,261	302,126	264,800
Zinc ..... Tons	5,121	3 896	116,339	89,069
Other articles ...Value £	..	..	274,476	308,121
Total value of metals	..	..	1,918,364	1,891,649

Imports of Raw Materials for Non-Textile Industries for Month ending 28th February.

Articles.	Quantities.		Values.	
	1890.	1891.	1890.	1891.
			£	£
Bark, Peruvian .. Cwt.	8,570	13,593	31,815	39 504
Bristles ..... Lb.	154,428	249,700	23,067	32,010
Caoutchouc ..... Cwt.	22,978	22,015	301,525	277,065
Gum:— Arabic ..... "	3,772	3,438	14,827	10,774
Lac, &c. ..... "	6,248	8,705	22,929	32,122
Gutta-percha .... "	7,216	6,793	88,811	87,362
Hides, raw:— Dry ..... "	31,142	32,143	90,156	80,820
Wet ..... "	35,131	48,836	80,005	108,190
Ivory ..... "	888	697	17,304	30,527
Manures:— Guano ..... Tons	202	1,482	1,161	12,612
Bones ..... "	7,281	13,157	37,257	70,621
Paraffin ..... Cwt.	25,251	53,415	32,215	72,908
Linen rags ..... Tons	3,071	2,187	31,655	21,906
Esparto ..... "	18,819	17,625	91,102	84,058
Pulp of wood .... "	8,844	12,237	18,077	68,417
Rosin ..... Cwt.	57,171	134,656	9,847	31,130
Tallow and stearin "	58,871	55 491	73,190	71,510
Tar ..... Barrels	3,030	6,240	2,059	4 662
Wood:— Hewn ..... Loads	118,967	82,478	200,133	132,203
Sawn ..... "	58,340	49,009	135,505	121,829
Staves ..... "	2,953	3,315	13,189	17,976
Mahogany ..... Tons	286	5,273	2,588	47,701
Other articles....Value £	..	..	716,766	723,745
Total value	..	..	2,119,543	2,180,652

Besides the above, drugs to the value of 54,000*l*. were imported, as against 75,147*l*. in February 1890.

Imports of Oils for Month ending 28th February.

Articles.	Quantities.		Values.	
	1890.	1891.	1890.	1891.
			£	£
Cocoa-nut ..... Cwt.	10,201	7,849	12,055	10,849
Olive ..... Tuns	2,187	1,000	83,638	40,084
Palm ..... Cwt.	55,190	64,562	57,049	78,282
Petroleum ..... Gall.	5,552,907	9,779,717	136,748	202,283
Seed ..... Tons	1,440	2,509	10,593	58,726
Train, &c. ..... Tuns	438	954	9,122	22,029
Turpentine ..... Cwt.	13,887	33 522	21,986	47,509
Other articles .. Value £	..	..	80,859	47,509
Total value of oils ...	..	..	412,051	522,098

Exports of Metals (other than Machinery) for Month ending 28th February.

Articles.	Quantities.		Values.	
	1890.	1891.	1890.	1891.
			£	£
Brass ..... Cwt.	8,070	8,844	37,279	38,701
Copper:— Unwrought ..... "	86,543	58,376	233,401	165,752
Wrought ..... "	28,629	30,631	88,274	104,379
Mixed metal .... "	31,773	18,634	87,435	53,529
Hardware ..... Value £	..	..	212,430	193,497
Implements ..... "	..	..	100,737	99,343
Iron and steel ..... Tons	277,082	218,581	2,392,042	1,964,309
Lead ..... "	4,878	3,179	72,288	48,699
Plated wares... Value £	..	..	27,278	26,511
Telegraph wires, &c. "	..	..	201,591	22,306
Tin ..... Cwt.	6,499	9,089	32,011	43,223
Zinc ..... "	11,857	14,090	11,097	14,652
Other articles .. Value £	..	..	78,420	75,820
Total value	..	..	3,580,286	2,850,721

Exports of Drugs and Chemicals for Month ending 28th February.

Articles.	Quantities.		Values.	
	1890.	1891.	1890.	1891.
			£	£
Alkali ..... Cwt.	472,784	514,469	144,640	182,092
Bleaching materials "	147,046	97,742	43,173	32,983
Chemical manures. Tons	26,168	24,506	212,398	197,637
Medicines ..... Value £	..	..	93,309	84,893
Other articles ... "	..	..	232,367	257,495
Total value	..	..	725,887	756,000

EXPORTS OF MISCELLANEOUS ARTICLES FOR MONTH ENDING 28TH FEBRUARY.

Articles.	Quantities.		Values.	
	1890.	1891.	1890.	1891.
			£	£
Gunpowder..... Lb.	768,200	843,400	19,778	18,816
Military stores.. Value £	..	..	113,851	67,591
Candles..... Lb.	1,165,000	1,022,200	21,455	20,710
Caoutchouc ..... Value £	..	..	85,224	97,939
Cement..... Tons	50,830	44,544	101,332	88,666
Products of coal Value £	..	..	109,074	136,402
Earthenware ... „	..	..	161,011	141,932
Stoneware ..... „	..	..	12,610	9,323
Glass:—				
Plate..... Sq. Ft.	271,265	276,427	15,166	17,086
Flint..... Cwt.	8,181	8,469	19,198	19,181
Bottles..... „	74,356	68,452	34,924	31,666
Other kinds.... „	13,399	17,126	11,858	15,753
Leather:—				
Unwrought .... „	12,797	13,522	118,514	116,882
Wrought ..... Value £	..	..	28,681	32,777
Seed oil..... Tons	5,855	5,655	129,067	123,906
Floorcloth ..... Sq. Yds.	1,570,000	1,480,700	73,201	70,980
Painters' materials Val. £	..	..	127,421	126,846
Paper ..... Cwt.	80,017	70,913	139,474	125,626
Rags..... Tons	4,518	3,689	32,955	29,519
Soap..... Cwt.	33,501	36,938	35,881	43,183
Total value	..	..	2,672,701	2,539,893

Monthly Patent List.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

APPLICATIONS.

2790. L. A. Comolli and C. Conteville. A continual burning gas furnace. Filed February 16. Date applied for October 15, 1890, being date of application in Brazil.

2799. W. T. Lewis. An improved furnace for the better combustion of fuel. February 16.

2946. G. Goodlet. Improvements in apparatus for compressing and accumulating fluids. Complete Specification. February 18.

3051. L. Archbutt and R. M. Deeley. A process for treating chemically softened water so as to prevent the formation of an adherent deposit in the feed apparatus or steam boilers. February 19.

3187. A. W. Ellis. An improved stand for chemical or other purposes. February 21.

3435. E. Nelson. Improvement in method of treating heated liquid wastes, and apparatus therefor. Complete Specification. Filed February 25. Date applied for August 30, 1890, being date of application in United States.

3461. O. Howl. Accessible bends for thick fluids. February 26.

3511. I. Singer and H. A. A. Dombrain. Improvements in apparatus for extraction of liquids from pulverulent materials in which they are absorbed. February 26.

3514. B. Willcox.—From F. Fouche, France. Improvements in apparatus for condensing steam or vapour. February 26.

3668. T. Ledward. Improved apparatus for separating fluids. February 28.

3836. H. E. Newton.—From C. C. Worthington, United States. Improvements in surface condensers. Complete Specification. March 3.

3902. J. F. H. Gronwald and E. H. C. Oehlmann. Improvements in sterilising apparatus Complete Specification. March 4.

3916. F. Lennard. *See* Class II.

3952. E. Lowe. Improved apparatus for straining or filtering liquids. March 5.

3955. E. Luck. Improvements in or connected with vacuum distillatory apparatus. March 5.

3997. C. Smith.—From A. de Kunwald, France. Improvements relating to apparatus for pumping, forcing, or exhausting liquids or gases. Complete Specification. March 5.

4065. G. E. Belliss and A. Morcom. Improvements in machinery for compressing atmospheric air and compressing and condensing gases. March 7.

4203. P. Taaffe. An improved apparatus for dealing with the waste products of combustion and other purposes. March 9.

4208. R. J. Hooper-Rastrick. Improvements in apparatus for evaporating solutions, especially suitable for brine. March 9.

4229. R. Hirsch. A process and apparatus for the separation of mixtures of gases. March 9.

4292. The Brins Oxygen Company, Limited, and K. T. Murray. Improvements in apparatus for automatically changing the direction of flow of currents of fluids through pipes or passages. Complete Specification. March 10.

4308. E. B. Caird and T. J. Rayner. An improvement in surface condensers. March 10.

COMPLETE SPECIFICATIONS ACCEPTED.*

1890.

4309. J. Foster. Evaporating and distilling apparatus. March 18.

5038. H. Trott. Apparatus for operating valves for controlling the passage of fluids. March 18.

6088. E. Brook. Improvements in kilns. February 25.

6221. J. W. Lovibond. Instruments for estimating measuring, or comparing colour, texture, and appearance of transparent or opaque bodies, and for testing colour vision and light perceptive power. March 11.

6399. J. von Langer and L. Cooper.—From G. Pietzka. Reverberatory furnaces. March 4.

6484. G. Fletcher. Evaporating pans. March 11.

7075. B. Hunt and W. M. Mackey. Filtering apparatus. March 11.

12,897. G. A. Hart. Kiln for drying moist materials. March 18.

13,127. T. Young. Valves for corrosive and other fluids. March 11.

16,881. J. F. Pease. Improvements in furnaces. February 25.

* The dates given are the dates of the Official Journals in which acceptances of the Complete Specifications are advertised. Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the said dates.

19,667. C. C. Leathers.—From W. Radam. Tank or vessel for the manufacture of medicines. March 4.

20,318. E. H. Cohn. Sterilising apparatus. March 4.

1891.

84. C. G. Mayer. Refrigerating apparatus. March 4.

II.—FUEL, GAS, AND LIGHT.

Applications.

2889. W. P. Thompson.—From G. S. Sandford, United States. Improvements in apparatus for the manufacture of gas from petroleum oil. Complete Specification. February 17.

2948. J. H. R. Dinsmore. Improvements in or connected with the manufacture of illuminating and heating gases. February 18.

3034. F. Fanta. A new process for producing oxygen gas. Filed February 19. Date applied for, October 22, 1890, being date of application in Belgium.

3042. J. Y. Johnson.—From P. Nadar, France. Improved means or apparatus for producing artificial light for photographic and other purposes. February 19.

3125. P. Dvorkovitz. Improvements in apparatus for making gas and distilling crude hydrocarbon oils. February 20.

3358. P. Dvorkovitz. Improvements in the manufacture of gas from fluid hydrocarbons. February 24.

3367. E. Creighton. Improvements in coal block fuel. February 24.

3475. H. M. Carter and C. E. Fraser. Improvements in the manufacture of brick or briquette fuel. February 26.

3525. J. C. Chandler. Improvements in apparatus for purifying gas. February 26.

3778. A. Gray. Purifying air and gases from mechanically suspended and from gaseous impurities. March 3.

3862. W. Dyson. Improvements in the process of making gas and a product arising therefrom. March 4.

3912. A. Collingbridge. Improved treatment of certain hydrocarbon substances susceptible of general application to illuminating and heating purposes. March 4.

3916. F. Lennard. Improvements in apparatus for carburetting gas or air, or for distilling, evaporating, or concentrating. March 4.

4134. A. B. Lewes. Improvements in or appertaining to the manufacture or production of hydrogen. March 7.

4279. C. F. Claus. Improvements in the purification of water gas or other producer-gas from sulphur compounds. March 10.

4321. J. Baxter and W. Baxter. Improvements in means and apparatus for refining paraffin. March 11.

4500. F. J. Jones. Improvements in gas purifiers. March 13.

Complete Specifications Accepted.

1890.

1237. R. Mannesmann. Manufacture of illuminating gas, and apparatus therefor. March 4.

1238. R. Mannesmann. Production of water-gas and illuminating gas, and apparatus therefor. March 4.

1283. O. Imray.—From R. and M. Mannesmann. Production of coke, and apparatus therefor. March 4.

1285. O. Imray.—From R. and M. Mannesmann. Gas producers. March 4.

1236. W. E. Smith.—From S. T. J. Bray. Apparatus for burning liquid fuel. March 18.

4326. C. A. Sahlström and A. F. Hill. Burner for liquid fuel. March 11.

4457. E. Edwards.—From F. Strochmer. Coke ovens, and method of using same. February 25.

5434. H. Williams. Manufacture of water-gas, and other gases for lighting and manufacturing purposes. March 18.

5637. G. C., M. B., and G. A. Fowler. Night-lights and other similar lights. March 4.

5971. J. Dewar and B. Redwood. Distillation of oils and other viscous liquids. March 11.

6217. S. Griffin. Apparatus for producing combustible gas. February 25.

6256. T. D. Rock. Application of anthracite gas to metallurgical and other furnaces. March 11.

6282. R. de Soldenhoff. Means employed in charging coke ovens. March 4.

6466. C. M. Pielsticker. Distillation of hydrocarbon and other oils. March 11.

6575. J. H. W. Stringfellow. Manufacture of gas, and apparatus therefor. March 11.

7335. G. M. Cruikshank.—From J. C. Reissig, P. F. Macallum, and J. Landin. Incandescent lighting, by means of calefacient gas, and apparatus therefor. March 4.

12,638. G. Frank. Compressed fuel. March 18.

16,762. W. P. Thompson.—From A. Mason and J. Wilson. Method and apparatus for burning petroleum and other hydrocarbons. March 18.

17,921. C. Eitle. Machine for charging gas retorts. March 4.

20,002. A. Dauber. Gas producers or generators. March 18.

20,030. L. van Vestraut. Apparatus for charging inclined gas retorts. March 4.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

Complete Specifications Accepted.

1891.

219. H. E. Ryeroft and A. Mason. Process and apparatus for distilling and refining petroleum and other hydrocarbons; applicable for distilling and refining animal, vegetable, and fruit oils, saccharine juices, syrups, essential oils, &c. March 4.

327. M. Bohm. Distilling crude petroleum, mineral oil, tar, &c., and apparatus therefor. February 25.

130 S. C. M. Pielsticker. Continuous distillation of hydrocarbon and other oils and liquids. March 18.

IV.—COLOURING MATTERS AND DYES.

Applications.

2805. H. H. Lake.—From Wirth and Co., agents of A. Leonhardt and Co., Germany. Improvements in the manufacture of colouring matters. February 16.

2817. O. Imray.—From the Society of Chemical Industry, Switzerland. Production of orange-yellow to brown azo colouring matters for dyeing and printing. February 16.

2818. O. Imray.—From The Farbwerke vormals Meister, Lucius, and Bruning, Germany. Production of azo colours in discharge printing on indigo dyed fabrics. February 16.

3247. E. Coen. Improvements in the manufacture of copying ink. February 23.

3263. J. C. L. Durand, D. E. Huguenin, and A. J. J. d'Andiran-Koechlin. Manufacture of colouring matters derived from pyrogallic acid, and their application to dyeing and printing. Complete Specification. February 23.

3270. A. Fischesser. An improved process for producing azo colouring matters. February 23.

3439. B. Willcox.—From The Farbenfabriken vormals F. Bayer and Co., Germany. Improvements in the manufacture of azo dyes. February 25.

3622. R. Vidal. Improvements in the production and separation of methylamines, ethylamines, phenylamines, and naphthylamines. February 27.

3758. J. Dawson and R. Hirsch. The manufacture of brown azo colours suitable for dyeing with metallic mordants. March 3.

4543. J. Y. Johnson.—From The Badische Anilin and Soda Fabrik, Germany. The manufacture and production of improved dyestuffs suitable for dyeing vegetable fibre with or without a mordant. March 13.

Complete Specifications Accepted.

1890.

4596. S. Pitt.—From L. Cassella and Co. Manufacture of sulphonated thionines. February 25.

4946. O. Imray.—From The Farbwerke vormals Meister, Lucius, and Brüning. Production of ethylether of cinnamic acid. February 25.

5722. B. Willcox.—From The Farbenfabriken vormals F. Bayer and Co. Manufacture of diquinoline derivatives. February 25.

5736. O. Imray.—From La Soc. Anon. des Matières Colorantes et Produits Chimiques de St. Denis, A. F. Poirrier and D. A. Rosenstiehl. Manufacture of azo colouring matters derived from azoxyamines. February 25.

6195. S. S. Bromhead.—From Die Chemische Fabrik Grunau, Landshoff, and Meyer. Preparation of new sulphonic acids for the production of a blue colouring matter for cotton. March 11.

6486. J. Imray.—From La Soc. Anon. des Matières Colorantes et Produits Chimiques de St. Denis. Manufacture of nitrated colouring matters. February 25.

6932. C. D. Abel. Manufacture of colouring matters. March 11.

6946. S. Pitt.—From L. Cassella and Co. Production of new basic blue colouring matters. March 11.

7421. R. Holiday. Production and utilisation of a new hydroxyquinone. March 18.

8215. J. Hall. Manufacture of colouring matter. March 18.

8303. J. Y. Johnson.—From The Badische Anilin and Soda Fabrik. Treating alizarine blue for the obtainment of new compounds thereof, and alizarine blue S. February 25.

V.—TEXTILES, COTTON, WOOL, SILK, Etc.

Applications.

2753. J. D. Tomlinson and J. Porter. Improvements in means for "gassing" and finishing silk and other yarns and fibres. February 16.

2808. W. Barton. A new or improved process for utilising leather waste, and preparing therewith a material for covering floors, walls, roofs, and the like. Complete Specification. February 16.

3447. T. Mitchell. Improvements in or applicable to the manufacture of linoleum and like floorcloths. Complete Specification. February 25.

3885. E. Dezwarte, and The General Financial and Industrial Corporation, Limited. Improvements in the treatment of ramie, hemp, flax, and other fibrous plants, to obtain the fibres therefrom. March 3.

3960. W. H. Hughes. Cleaning, restoring, and bleaching damaged cotton, or other products from cotton seed, sponges, and all textile material. March 5.

Complete Specifications Accepted.

1890.

6155. G. H. Croker. Process and apparatus for removal of fibre or lint from, and cleaning cotton seed. March 4.

14,246. D. Gantillon. Treating silk or mixed fabrics to give them the appearance of China crape. March 11.

18,119. C. Brodbeck. Imparting a silk-like appearance to fabrics, threads, and fibres. March 18.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, and BLEACHING.

Applications.

2993. J. Leitz and W. Weise. An improved process for printing and shaping textile materials. Complete Specification. February 18.

3385. W. Watson and E. Bentz. A new or improved method of manufacture of certain compounds of chromium used in dyeing and calico printing. February 24.

3931. J. R. Shearer. Improvements in washing, degumming, and bleaching fibrous substances. March 5.

4449. C. S. Bedford. Improvements in the fixation of colouring matters on cotton. March 12.

Complete Specifications Accepted.

1890.

1157. G. Young and F. Pearn. Apparatus for dyeing and bleaching cotton and other fibres in the raw, manufactured, and intermediate state. February 25.

6202. S. Stepanow. *See* Class XI.

7522. W. Elbers. Obtaining designs in red on textile fabrics dyed with indigo. February 25.

VII.—ACIDS, ALKALIS, and SALTS.

Applications.

2812. J. N. Zeitler. Process for converting carbonate of lead, obtained by decomposition of sulphate of lead or other compound of lead with carbonate of sodium, into basic salt. Complete Specification. February 16.

3230. J. Ascough. Improvements in the manufacture of sodium biborate of borax, sodium crystal carbonate, or soda and other compounds containing sodium or boron or both. February 23.

3345. J. S. Fairfax.—From F. Crane, United States. Improvements in or relating to sulphuretted solutions and compounds used for the production of films or coatings. February 24.

3557. M. N. d'Andria. Improvements in the manufacture of barium nitrate and strontium nitrate. February 27.

3657. J. J. Howitt. Improvements in or appertaining to apparatus for the manufacture of carbonates of soda. February 28.

3677. B. E. R. Newlands. Improvements in the treatment and utilisation of waste acid liquors from galvanising works. February 28.

3785. J. Simpson. Improvements in the treatment of a certain material (mineral) containing phosphate of lime, for the purpose of obtaining the latter in a highly concentrated condition, as dicalcic phosphate, together with certain by-products. March 3.

3925. F. Ellershausen. Improvements in the treatment of soda waste. March 4.

4068. F. M. Lyte. Improvements in the production of chlorine. March 6.

4311. C. F. Claus. Improvements relating to the manufacture of the aluminates, sulphates, and carbonates of soda and potash, and to the production or recovery of alumina and other by-products. March 10.

4429. F. Hurter. Improvements in the manufacture or production and utilisation of nitroxyl-chloride. March 12.

4547. J. Anderson and A. Brand. Improvements in the manufacture of carbonates of sodium and potassium and of chlorine. March 13.

Complete Specifications Accepted.

1890.

1015. F. Ellershausen. Manufacture of soda and potash. March 18.

3992. G. Horsley and A. C. Wilson. Means or apparatus to be employed in the production of solutions containing sulphurous acid or its salts. March 18.

4171. C. S. Negrier. Method and apparatus for concentrating sulphuric acid. February 25.

4394. F. Ricard. Manufacture of soda by the ammonia process. March 11.

5205. T. Wilton. Saturators used in the manufacture of sulphate of ammonia. February 25.

5442. C. A. Burghardt. Manufacture of nitrate of ammonium and of resulting by-products. February 25.

5571. A. Campbell and W. Boyd. Obtaining chlorine, and utilising calcium chloride or other by-products. March 4.

6416. G. E. Davis and A. R. Davis. Preparation of chlorine. March 11.

6698. G. E. Davis and A. R. Davis. Manufacture of chlorine. March 18.

6831. G. E. Davis and A. R. Davis. Preparation of chlorine. March 11.

13,240. L. M. C. Folie-Desjardins. Process and apparatus for the simultaneous manufacture of phosphorus and of alkaline silicates by the treatment of the mineral phosphates of lime, alumina, or bone ash. February 25.

19,121. T. Needham. Packages for putting up chloride of lime, carbonate of ammonia, and other articles and deliquescent substances. March 4.

21,078. J. Leith. Production of bicarbonate of soda and sulphuretted hydrogen, and apparatus therefor. March 4.

VIII.—GLASS, POTTERY, and EARTHENWARE.

Applications.

3365. H. H. Lake.—From E. Sochaczewski, Germany. Improvements relating to the production of a plastic moulding material and to articles made therefrom. Complete Specification. February 24.

3532. C. Breuer. Method of manufacturing artificial stones with glass surfaces. February 26.

4391. T. C. J. Thomas. Improvements in the manufacture of glass. March 11.

4610. F. Plant. Improvements relating to ovens, kilns, or furnaces for firing, pottery, or earthenware, and for other purposes. March 14.

Complete Specifications Accepted.

1890.

3286. J. G. Sowerby. Manufacture of glass. March 4.

4592. H. T. Parfitt. Kilns or ovens for firing glass, enamel ware, and for other purposes. February 28.

5830. W. H. Sharman and R. E. Oldham. Machines for moulding pottery and the like. March 11.

17,255. H. Baggaley. Manufacture of tiles and other porcelain, earthenware, and similar goods. March 11.

17,573. J. Dunnachie. Kilns for firing firebricks, earthenware, and the like. March 18.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, and CEMENTS.

Applications.

2865. H. F. Williams. An improved composition for paving, roofing, and building purposes. Complete Specification. February 17.

2894. C. Claussen. A new or improved paving. Complete Specification. February 17.

2941. F. G. Edwards. Improvements in the combination of iron and concrete, or similar materials for building purposes. February 18.

3035. B. H. Thwaite. Improved methods of manufacturing Portland cement, and in apparatus therefor. February 19.

3086. H. Parry. Improvements in kilns for burning lime. February 20.

3351. R. R. Coursen. Improvements in plaster slabs. Complete Specification. February 24.

3532. C. Breuer. *See* Class VIII.

3581. J. W. Savage. An improved road paving. February 27.

3797. G. H. Skelsey. Improvements in the manufacture of Portland cement. March 3.

Complete Specifications Accepted.

1890.

5581. G. H. Skelsey. Cement and other kilns. March 4.

5719. W. R. Taylor. Method and means for manufacturing cement. February 25.

20,164. T. Curran. Portable plaster slabs, methods of making same, and moulds therefor. March 11.

X.—METALLURGY, MINING, Etc.

Applications.

2747. W. Hutchinson and F. W. Harboard. The utilisation of blast furnace and other slags in conjunction with finely divided oxides of iron. February 16.

3001. J. Gardner. Improvements in the utilisation of, or the manufacture of useful products from "lead bottoms," or other sulphates of lead. February 19.

3057. C. A. Faure. Improvements in the manufacture or production of aluminium alloys. Filed February 19. Date applied for December 2, 1890, being date of application in United States.

3222. J. Clark and G. W. Clark. Improvements in reducing metallic oxides. February 23.

3226. S. R. Smyth, of the Steel and Iron Co., Lim. Improvements in the treatment and smelting of ores and metals in furnaces, and in the apparatus connected therewith. February 23.

3278. A. French and W. Stewart. Improvements in obtaining gold, silver, and copper from ores. February 24.

3348. B. C. Tilghman and R. A. Tilghman. The manufacture of chilled iron globules. Complete Specification. February 24.

3387. H. Lafone. Improvements in and connected with the manufacture of aluminium from alumina. February 25.

3510. J. Lang and F. H. Wigham. A process for protecting iron and steel wire against corrosion. February 26.

3624. R. Millar. Improvements in the casting of metals to secure solidity and homogeneity. February 28.

3992. C. T. J. Vautin. An improved hydro-metallurgical method of the extraction of gold or platinum from their ores. March 5.

4050. M. Mannesmann. Improved method of and apparatus for forming rolling, and calibrating metals. March 6.

4069. T. Causer, C. H. Fitzmaurice, and T. H. Dale. Improved metallic compound. March 6.

4146. R. B. Hansell. Improvements in the castings of ingots for the manufacture of weldless tires, bars, and such like. March 7.

4384. J. von Ehrenwerth. Improvements in processes and appliances for the manufacture of iron and steel. March 11.

4396. J. Strap. Process for the separation of copper, nickel, and silver from matts or alloys containing the same, and the treatment of the residues resulting therefrom. March 11.

4549. W. E. May. Improvements relating to the casting and working of metals, and to apparatus for use in connexion therewith, and for other purposes. March 14.

Complete Specifications Accepted.

1890.

840. R. Mannesmann. Means for mixing molten metal in furnaces or converters. February 25.

4560. T. Teague. Refining raw tin, and extracting and utilising the combined metals therefrom. February 25.

5545. A. Turner, A. Baird, and M. B. Baird. Manufacture of iron and steel. March 18.

5937. W. C. Loe. Treating metal-bearing bodies, and recovery of metals therefrom. March 11.

6256. T. D. Rock. *See* Class II.

6316. S. Fox. Manufacturing steel in connexion with the open-hearth system. March 4.

6821. Sir H. H. Vivian, Bart. Manufacture of copper. March 18.

6960. J. Neill. Manufacture of steel-plated and gated ingots, and moulds for same. March 18.

7129. J. D. Danton. Process and apparatus for reduction of iron and other oxide ores, and for fusion and purification of the produced metals. March 18.

13,723. F. H. Molesworth. Treating metalliferous ores. March 18.

15,341. O. B. Peck. Treatment of slag, and removal thereof from furnaces. March 18.

15,342. O. B. Peck. Apparatus for treatment of slag. March 18.

15,343. O. B. Peck. Centrifugal apparatus for treating molten material. March 18.

15,348. O. B. Peck. Centrifugal apparatus for treating molten material. March 18.

15,349. O. B. Peck. Centrifugal apparatus for treating molten material, and means for removing the said material from such apparatus. March 18.

18,726. M. R. Garcia. Recovery of tin from tin plate and other sources. March 11.

19,164. J. Johnson. Reduction of iron ores. March 18.

21,129. H. C. W. Harmsen. Untinning the waste of tin plates by heating it with fused nitrate of potash or soda. March 18,

1891.

652. O. B. Peck. Machinery for centrifugally treating particles of metallic or mineral-bearing substances of different specific gravity. March 11.

674. O. B. Peck. Machinery for centrifugally treating particles of metallic or mineral-bearing substances of different specific gravity. March 11.

XI.—ELECTRO-CHEMISTRY and ELECTRO-METALLURGY.

Applications.

19,942A. W. P. Thompson.—From F. Marx, Germany. Improvements in the electro-chemical formation of chlorine and chlorine compounds. Complete Specification. March 5. Originally included in No. 19,942 of December 6, 1890, and therefore takes that date.

2798. H. J. Altman. Improvements in solutions and salts for electro deposition and other purposes. February 16.

2876. E. R. Dale. Improvements in the application of electricity to various useful purposes. February 17.

3003. E. W. Mayer. Improvement in element for electric battery. February 19.

3170. D. Rylands. Improvements in the manufacture of Leclanch cells. February 21.

3198. F. Poudroux. Improvements in galvanic batteries. February 21.

3331. S. C. C. Currie. Improvements in secondary or storage batteries. Complete Specification. February 24.

3336. H. H. Lake.—From H. Lemp and L. M. Schmidt, United States. Improvements relating to welding, brazing, or otherwise joining metal strips, bars. rods, and the like by electricity, and to apparatus therefor. Complete Specification. February 24.

3349. M. W. Dewey. Improvements in electric welding apparatus. Complete Specification. February 24.

3417. W. H. Munns.—From G. A. Smith, Canada. An improved galvanic battery. February 25.

3450. W. H. Power. Improvements in primary batteries. February 25.

3524. R. D. Sanders. Improvements in apparatus for use in the manufacture of metal tubes by electro-deposition. February 26.

3589. H. H. Lake.—From W. B. H. Dowse, United States. Improvements in electric batteries. Complete Specification. February 27.

3738. J. Marx. Improvements in and apparatus for electrolysing and bleaching. March 2.

3789. B. J. B. Mills.—From A. Bellemain, France. Improvements in the depolarisation of electric batteries. March 3.

3799. A. Clark. A new or improved solution or composition for charging electric batteries. March 3.

4044. R. H. Simpson. Improvements in electrical storage batteries or accumulators. March 6.

4188. J. A. Mays. Improvements in electrolysis. March 9.

COMPLETE SPECIFICATIONS ACCEPTED.

1890.

5938. K. E. Boettcher. A new secondary element. March 4.

6202. S. Stepanow. Electrolytic preparation of a liquid for bleaching fabrics, paper pulp, &c. March 18.

6223. M. Ancizar.—From R. Z. Bayon. Galvanic batteries. March 18.

9861. A. J. Boult.—From D. Tommasi and C. Therye. Electrical storage batteries. March 11.

20,126. C. E. Dutton, jun. Galvanic batteries. February 25.

20,540. W. P. Thompson.—From C. L. Coffin. Welding and otherwise working metals electrically. February 25.

1891.

400. T. D. Bottom. The desilverisation of lead, and simultaneous manufacture of white lead by electrolysis of argentiferous lead. March 11.

667. W. P. Thompson.—From The Hess Electric Storage Battery Co. Electrodes for voltaic accumulators. February 25.

XII.—FATS, OILS, AND SOAP MANUFACTURE.

APPLICATIONS.

2998. W. P. Thompson.—From A. H. J. Bergé, E. A. Stein, and E. J. A. de Roubaix, Belgium. Improvements in the saponification of fatty substances by the action of sulphurous acid or bisulphites under pressure. February 19.

3584. E. Livesey and J. Warburton. An improved lubricating composition. February 27.

3768. W. F. Butler. Improved apparatus or means for liquefying or heating grease, oils, or the like. March 3.

4146. W. S. Chenhall and W. F. S. Chenhall. An improved method for the solidification of mineral, animal, and vegetable oils, and volatile and inflammable fluids. March 12.

4454. R. Stone. Improvements in the manufacture of soap, and in the utilisation of the residue of the substances used therein. March 12.

COMPLETE SPECIFICATIONS ACCEPTED.

1890.

3503. M. Williams. A new or improved soft soap, and manufacture of same. March 11.

7019. C. A. Serre. Manufacture of soap. March 11.

21,196. J. W. Evans. Improvements in the naphtha process of extracting oil. February 25.

XIII.—PAINTS, PIGMENTS, VARNISHES, AND RESINS.

APPLICATIONS.

3573. T. Holden. An improved antifouling preparation or compound for the preservation of bright or polished metallic surfaces. February 27.

3832. J. H. Noad. A process for manufacture of white lead. March 3.

3887. G. H. Hedley. Improvements in the manufacture of red oxide of iron. March 4.

4334. W. Grimshaw. Improvements in the preparation of pigments or colouring compounds. March 11.

COMPLETE SPECIFICATIONS ACCEPTED.

1890.

5380. A. F. St. George. Method and apparatus for preparing copal and other gum resins and resins, and for manufacturing varnish. March 18.

16,786. W. A. Hall. Manufacture of paints. March 4.

17,346. J. Hoake. Preparation of colours for distempering. March 11.

19,160. M. E. Dejouge. Anti-corrosive and anti-fouling compounds. March 18.

20,690. A. van Winkle and E. N. Todd. Protecting sheets of gelatin by pyroxiline or nitro-cellulose varnishes. March 11.

XIV.—TANNING, LEATHER, GLUE, AND SIZE.

APPLICATIONS.

2808. W. Barton. *See* Class V.

3176. W. Bolt. A quicker process for tanning all kinds of hides or skins. February 21.

3910. O. Brunner. Improvements in and relating to the waterproofing of leather. March 4.

4234. H. A. Harvey. Improved compositions for treating, colouring, and dressing leather. March 10.

4385. A. Foelsing. Process for clarifying and bleaching tannin extracts or tannin liquors. March 11.

4586. W. A. Brown. An improved light size or cop-bottom paste for cotton spinners and manufacturers. March 14.

COMPLETE SPECIFICATION ACCEPTED.

1890.

7509. F. B. Maggs. The preparation of skins, kips, and hides by an improvement in the process known as "unhairing" or pulling. February 25.

XVI.—SUGARS, STARCHES, GUMS, Etc.

COMPLETE SPECIFICATIONS ACCEPTED.

1890.

7737. A. Niemöller. Production of glutinous material from the seed kernels of the fruit of the carob tree (Ceratonia). March 11.

8029. E. Steiger, E. Schulze, and C. Auer-Schollenberger. Treating vegetable cellular membranes to obtain glutinous substances. March 11.

XVII.—BREWING, WINES, SPIRITS, Etc.

APPLICATIONS.

2936. H. J. Haddan.—From J. Batallé, Spain. A method of improving wine and other alcoholic liquors. Complete Specification. February 18.

3207. G. F. Redfern.—From J. Hradil, Germany. An improved method of increasing the formation of cells during the process of fermentation. February 21.

3978. F. L. Calmant. The manufacture of charcoal from sawdust, wood shavings, and the like, and the treatment of wine, alcohol, brandy, cider, beer, and other matters therewith. March 5.

4153. J. Laing. Improvements in the distillation of alcohol, and in apparatus therefor. March 9.

4196. F. T. Simson and J. Cox. Improvements in malt liquors, fermented wines and spirits. March 9.

4207. G. A. Clowes. Improvements in fermentation. March 9.

Complete Specifications Accepted.

1890.

5673. J. Salamon. Fermenting process for beer, wine, &c. February 25.

13,694. M. Konig. Malt curing apparatus. March 11.

18,212. E. J. Mills and R. Barr. Treatment of alcoholic liquids. January 28.

20,430. P. L. F. E. Vignier. Improvements in the manufacture of pure grape spirit, in apparatus used for same or other spirits, and in the ageing of the same. March 4.

20,985. H. H. Lake.—From H. Götter. Manufacture of fermented liquids, and apparatus therefor. February 25.

1891.

1214. A. G. Burkhardt and G. Schule. Apparatus for distilling and rectifying. March 18.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, and DISINFECTANTS.

Applications.

A.—Chemistry of Foods.

2816. O. Imray.—From Calberla, Fitz, and Consorten, Germany. Process and apparatus for sterilising liquids. February 16.

2944. J. Oakhill and R. H. Leaker. An improved process for preserving milk. February 18.

3257. H. M. Dowson. Improvements in the use and application of malt culms for food purposes. February 23.

3481. J. Hillaby. A preparation of extract of malt in combination with extract of liquorice and other substances. February 26.

3842. J. Stube and M. Spiro. A process for increasing the value of whey. March 3.

4195. F. T. Simson and J. Cox. Improvements in food preparations and medicines. March 9.

4288. J. White. Improvements in or connected with the manufacture of table jelly. March 10.

4291. W. Robertson. An improved article of food or solidified malt extract jelly. Complete Specification. March 10.

B.—Sanitary Chemistry.

2846. A. McDougall and J. J. Meldrum. Improvements in the disinfection and deodorisation of sewage, and in the apparatus for preparing and applying the disinfectant. February 17.

4177. W. H. Watson. Improvements in the means employed for the purification and discolouration of water, dye, and other manufacturing refuse liquors, sewage, or other aqueons or saline liquids. March 9.

4243. C. W. Chancellor. A method of and apparatus for the treatment and disposal of sewage. March 10.

4284. R. H. Twigg. Improved means and apparatus for effecting oxidation of organic matters contained in liquids. March 10.

4390. E. Devonshire. Improvements in apparatus for purifying or treating water. March 11.

C.—Disinfectants.

3242. F. Idle and I. Pearson. A fire lighter and disinfectant. Complete Specification. February 23.

4352. A. Lutschannig. A new or improved manufacture, being a disinfectant, antiseptic, deodoriser, vermin and insect destroyer, and also applicable for use in an ingredient in and as fire lighters. March 11.

Complete Specifications Accepted.

B.—Sanitary Chemistry.

1890.

6252. J. Longshaw. Apparatus for filtering or purifying water, sewage, &c. March 11.

XIX.—PAPER, PASTEBOARD, Etc.

Applications.

2872. J. Beveridge. Improvements in the treatment of fibrous plants for the manufacture of paper pulp. February 17.

3061. J. Feirabend. A process for the manufacture of cellulose wadding. February 19.

3878. R. N. Redmayne. An improvement in the manufacture of paper pulp for paper-making and other purposes. March 4.

Complete Specifications Accepted.

1890.

4360. J. Robertson. Glazing paper, and apparatus herefor. March 18.

6993. C. Kellner. Apparatus for separating or disintegrating fibres in the manufacture of paper pulp. February 25.

17,268. A. Wilbaux. Treatment of vegetable parchment and the like. February 25.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES and EXTRACTS.

Applications.

3731. W. Noetzel, M. Rapp, and E. Istel. Process for the manufacture of symmetrical diamido-diphenyl-thio-urea. March 2.

4487. R. Ancizar.—From Rafael Zerda-Bayon, Colombia. Improvements in the manufacture of sulphate of quinine. March 12.

Complete Specifications Accepted.

1891.

249. H. E. Ryeroft and A. Mason. *See* Class III.

853. A. J. Boult.—From O. Schweissinger and L. Hoffmann. Manufacture of extract of hops. February 25.

XXI.—PHOTOGRAPHIC PROCESSES AND MATERIALS.

Applications.

2880. T. R. Dallmeyer. Improved means and devices for obtaining optical projections of photographs in natural colours. February 17.

2956. W. G. Thomson and W. Ward. Improvements in the method of and apparatus for focussing in photography. February 18.

3319. S. Waters. Improvements in the art of photographing in colours, and in the means employed therein. February 24.

4040. S. H. Crocker. Improved means for producing photographs in colours. March 6.

4062. W. P. Thompson. Improvements in photography. March 6.

XXII.—EXPLOSIVES, MATCHES, Etc.

Applications.

2970. W. P. Thompson.—From La Société Coignet and Cie., France. Improvements in the manufacture of phosphorus in sticks or blocks. Complete Specification. February 18.

3181. J. T. Mackintosh. Improvements in wax and wooden matches. February 21.

3208. H. Maxim. Improvements relating to the manufacture of nitro-substitution compounds of cellulose. February 21.

3679. G. A. Rosenkolter. Improved lucifer matches. Complete Specification. February 28.

3881. G. A. Rosenkolter. Improvements in the manufacture of lucifer matches. Complete Specification. March 4.

4129. H. Maxim. Improvements relating to the manufacture of nitro-substitution compounds of cellulose. March 7.

4184. F. Wilson. An improved method of treating picric acid as an explosive. March 9.

4381. E. A. Ventris. To secure a greater certainty in the burning of any matches when lighted. March 11.

Complete Specifications Accepted.

1890.

3819. E. C. Manee. Signal rockets. March 4.

5209. H. H. Lake.—From H. S. Maxim. Manufacture of explosives, and apparatus therefor. February 25.

5535. R. Low. Percussion fuses. February 25.

7301. C. O. Lundholm and G. H. Hosie. Manufacture of explosives. March 18.

1891.

330. C. R. E. Bell. Manufacture of matches. March 18.

XXIII.—ANALYTICAL CHEMISTRY.

Application.

2785. A. Tropenas and A. E. Weels. Improvements in apparatus and appliances for the rapid determination of carbon of steel. February 16.

Printed and Published by Eyre and Spottiswoode, East Harding Street, London, E.C., for the Society of Chemical Industry.

THE JOURNAL

OF THE

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NOTICES.

In accordance with the provisions of Rule 18 of the Bye-laws, notice is hereby given that those Members of Council whose names are placed in italics in the annexed list will retire from their respective offices at the forthcoming Annual General Meeting.

Professor J. Emerson Reynolds, F.R.S., has been nominated to the office of President; and Mr. E. Rider Cook has been nominated Vice-President under Rule 11.

Dr. John Evans, F.R.S., Mr. A. Norman Tate, and Sir John Turney, have been nominated Vice-Presidents under Rule 8.

The Treasurer and Foreign Secretary have been nominated for re-election.

Members are hereby invited to nominate fit and proper persons to fill four vacancies among the Ordinary Members of Council under Rule 18. Special nomination forms for this purpose can be obtained from the General Secretary upon application.

Extract from Rule 18.—"No such nomination shall be valid unless it be signed by at least ten Members of the Society who are not in arrear with their subscriptions, nor unless it be received by the General Secretary, at the Society's Office, at least one month before the date of the commencement of the Annual General Meeting, to the election to take place at which it refers. Nor shall any such nomination be valid if the person nominated be ineligible for election under Rules 12 or 15. No member shall sign more than one nomination form."

Annual General Meeting.

Notice is hereby given that the next Annual General Meeting will be held in Dublin on Wednesday, Thursday, and Friday, the 8th, 9th, and 10th of July next. Detailed arrangements and the programme of proceedings will appear as soon as complete. Tickets of membership will be issued in time for the meeting, and will form, as heretofore, vouchers for visits to works and excursions.

Post Office Orders should be made payable at the General Post Office, London, to the Honorary Treasurer, E. Rider Cook, and should be forwarded to him at Bow, unless it be desired to notify a change of address.

Members who require extra sets or back numbers of the Journal are requested to make application to the General Secretary only, to whom also changes of address should be communicated.

Authors of communications read before the Society, or any of its Local Sections, are requested to take notice that under Rule 41 of the bye-laws, the Society has the right of priority of publication for three months of all such papers. Infringement of this bye-law renders papers liable to be rejected by the Publication Committee, or ordered to be abstracted for the Journal, in which case no reprints can be furnished to the author.

Notice is hereby given, for the information of members and advertisers, that the advertisement columns of this Journal have been contracted for by Messrs. Eyre and Spottiswoode, the Society's printers and publishers, to whom all communications respecting them should be addressed.

The Secretary is instructed to negotiate for the purchase of copies of the Society's Journal for January and May 1883, and January, February, and April 1886. Members possessing odd copies of these numbers are particularly requested to communicate at once, stating price required, with Mr. Cresswell. The stock of all other numbers is at present sufficient for the Council's requirements.

LIST OF MEMBERS ELECTED, 23rd APRIL, 1891.

Blass, Edw., Essen (Ruhr), Germany, civil engineer.

Boyd, Saml. F., 18, Leeson Park, Dublin, manufacturing chemist.

Brewis, Edw. Theodore, c/o Boileau and Boyd, Bride Street, Dublin, works chemist.

Burnet, Henry K., North Brook Vitriol Works, Bradford, Yorks, vitriol maker.

Conradson, Pontus H., Great Northern Railroad, St. Paul, Minn., U.S.A., chemist.

Cotton, Chas. P., Ryecroft, Bray, co. Dublin, engineer-in-chief, Local Government Board.

Cotton, Wm. F., Hollywood Roebuck, co. Dublin, secretary and manager, Gas Company.

Geoghegan, Saml., St. James's Gate Brewery, Dublin, mechanical engineer.

Gorvin, Jno. C., English Crown Spelter Works, Port Tennant, Swansea, assayer.

Heron, Jno., Chemical Works, Wicklow, Ireland, manager.

Hetherington, Albert E., 32, High Street, Wavertree, Liverpool, chemical student.

Holliday, Jno., St. James's Gate Brewery, Dublin, mechanical engineer.

Hopkinson, Jno., Marion Street, Lister Hills, Bradford, Yorks, viscosine lubricant manufacturer.

James, J. Hermaman, Welwyn Lodge, Swansea, assayer.

Macallan, John, 171, St. Helen's Terrace, Clonliffe Road, Dublin, analytical chemist.

Mackenzie, Jas. Scott, 132, Tritonville Road, Sandymount, Dublin, shipowner.

Phillips, G. Brinton, 2007, De Lancey Place, Philadelphia, Pa., U.S.A.

Pigot, Thos. F., Royal College of Science, Stephen's Green, Dublin, professor of engineering.

Ross, Wm., 66, North Wall, Dublin, mechanical engineer.

Ryder, Arthur Gore, First Lock, Grand Canal, Dublin, cement manufacturer.

Taylor, Malcolm, 18, Forest Road, Claughton, Birkenhead, chemical student.

Thomson, A. W. Ferguson, 14, Hills Place, Oxford Circus, W., iron merchant.

Tichborne, Dr. Chas. R. C., 15, North Great George Street, Dublin, professor of chemistry.

Valentine, Geo., St. James's Gate Brewery, Dublin, analytical chemist.

Wells, Jas. G., 26A, St Paul's Street West, Burton-on-Trent, brewery chemist.

Wilson, Wm. Wesley, St. James's Gate Brewery, Dublin, civil engineer.

CHANGES OF ADDRESS.

Aldrick, E. J., I to Charles Street; 26, Alpha Road, West Ferry Road, Millwall, E.

Bott, Dr. Wm., I to Raffles Institute; Government Science Lecturer, Singapore, S.S.

Burn-Murdoch, J. Y., I to Transvaal; Riverhead Vicarage, Sevenoaks, Kent.

Callander, W. S., Journals to Phœnix Alkali Works, Widnes.

Conrad, E. C., l/o Gravesend; Stroofabriek, Raamsdonk, Holland.

Fielding, Patrick J., l/o Blackrock Road; 8, St. Joseph's Place, Cork, Ireland.

Haig-Brown, R., l/o Old Trafford; 21, Ladyborn Road, Fallowfield, Manchester.

Hasenclever, R., Chemische Fabrik Rhenania, Aachen (not "Anache") Prussia.

Heywood, J. H., l/o 68; 127, Sutherland Avenue, Maida Vale, W.

Isherwood, Oswald, l/o Crescent View; 105, West High Street, Salford.

Lomas, Thos., l/o Weston; Cleveland, Minehead, Taunton, R.S.O.

Maconochie, J. R., l/o East India Avenue; Saracen's Head Buildings, Snow Hill, E.C.

Mellon, E. L., l/o Clayton Bridge; Malvern Grove, Withington, Manchester.

Merry, Jas. S., l/o Richmond Villas; 1, Somerset Place, Swansea.

Morris, Herbert N., Littondale, Manley Road (not Manby Road), Manchester.

Muir, J. Stanley, Journals to 27, Huntley Gardens, Kelvinside, Glasgow.

Pitblado, L., Journals to Mont Albion, viâ Herberton, Queensland.

Procter, H. R., l/o Tynemouth; Yorkshire College, Leeds; and (Journals) 4, Montpellier Terrace, Hyde Park, Leeds.

Sadler, A. E., l/o Sandside; Sand Hall, Ulverston.

Sill, T. T., l/o Wallsend; Runcorn Soap and Alkali Co., Lim., Weston, near Runcorn.

Smith, J. Tertius, Pattiswick Hall, Braintree; and (Journals) c/o Jeyes Sanitary Compounds Company, Limited, Plaistow, E.

Speakman, Jas., l/o Dundee; Cree Hill P.O., Calgary, Alberta, Canada.

Terry, Albert, l/o Kew; Verulam, Mont Albert Road, Balwyn, near Melbourne, Victoria.

Thorne, Dr. L. T., l/o Tooting; 8, Dynevor Road, Richmond-on-Thames.

Vandenbergh, Dr. F. P., l/o The University; 32—33, Lewis Block, Buffalo, N.Y., U.S.A.

Wallace, Robt., l/o Belfast; 1, Coates Place, Edinburgh.

Welsh, T. L., l/o St. Vincent Crescent; 3, Prince's Gardens, Dowanhill, Glasgow.

Wood, Milton R., l/o Brooklyn; Wyandotte, Mich., U.S.A.

Yule, Wm., l/o Sunderland; Hollins Paper Works, Darwen, Lancashire.

Zinkeisen, Wm., l/o Berlin; 508, New City Road, Glasgow.

Death.

Alex. Whitelaw, 87, Sydney Street, Glasgow. March 13th.

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Chemical Society's Rooms, Burlington House.

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A. G. Green.	*John Spiller.*
S. Hall.	W. S. Squire.
C. W. Heaton.	Wm. Thorp.
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C. C. Hutchinson.	*C. R. Alder Wright.*
R. Messel.	

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T. W. B. Mumford, 1, Glendale Villas, Sylvan Road, Wanstead, E.

The names in italics are those of members of Committee who retire at the end of the current Session.
The following have been elected to fill the vacancies, and will take office in duly next:—*Committee:* C. F. Cross, J. Heron, W. Kellner, G. N. Stoker, and F. Napier Sutton.

SESSION 1890—91.

May 4th.—Mr. L. Archbutt and Mr. R. M. Peeley. "An Improved Process for Softening and Clarifying Water."

June 1st.—Dr. W. S. Squire. "The Artificial Production of Cold theoretically and practically explained."

Meeting held Monday, March 16th, 1891.

MR. THOS. TYRER IN THE CHAIR.

OBSERVATIONS MADE IN THE WORKING OF VITRIOL CHAMBERS.

BY WILLIAM CROWDER, F.I.C.

In an article in a recent number of the "Nineteenth Century," Sir Benjamin Baker commenced as follows:—"Writing 40 years ago on the future of science, Monsieur Ernest Renan said the work of the 19th century should be the writing of monographs on every point of science, a hard, humble, and laborious task no doubt, but a solid and lasting work withal, as for many long years science will stand in need of those patient researches that might take the title of 'Memoranda for the use of Somebody.'"

It is in this spirit that I desire to lay before you the results of a long series of observations on certain special points in the manufacture of sulphuric acid in the hope that the results may, in the words of Monsieur Renan, prove to be memoranda for the "use of somebody."

It is with extreme diffidence that I approach the subject on which I propose to address you this evening, and I will at once say that my object is not to discuss the theory of the process of vitriol making, but simply to record a series of observations upon a large plant that has been under my own superintendence for many years, and upon which I have bestowed a great deal of time and attention in order to obtain results that would enable me to gain a clear insight into the consecutive changes that take place from the burning pyrites at the kilns to the finished product from the chambers.

The process of vitriol making is so well known that it is unnecessary for me to enter into any detailed description. Nevertheless we are sometimes apt to assume a greater familiarity on the part of our audience with details which can only be familiar to those who are in daily contact with the operations.

I propose therefore to give you (first) a short *résumé* of the process. Next, a description of the plant of a well-equipped vitriol works. Then the function performed by each portion of the plant and the means of control, and finally, a consideration of the working of the plant as a whole.

Under one or other of these heads I shall introduce the results of my own observations.

The process of vitriol making consists in the production of sulphurous acid, by burning pyrites or bisulphide of iron (which contains about half its weight of sulphur) in suitable furnaces and conveying the gas so formed into large leaden chambers along with a certain proportion of air, a proportion of nitric acid vapours, and a proportion of water in the form of steam. These various gases and vapours react upon each other, cause, first, a reduction of the nitric acid to the second oxide of nitrogen, and this, on coming in contact with the oxygen of the air, becomes re-oxidised, again becomes reduced by fresh portions of sulphurous acid, and thus the circle of operations is completed, so that, except for losses which occur from various causes, the process is continuous as long as any sulphurous acid remains.

The plant of a complete acid works consists of :—

Kilns for burning the pyrites.
An arrangement for producing nitric acid.
The nitre stack and flue leading to the Glover tower.
The Glover tower or denitrator.
The cooler and storing tanks.
A series of leaden chambers.
The Gay-Lussac or absorbing tower.
The exit from the tower and its pipe and damper leading to the chimney for the discharge of the waste gases.
The air engine and compressors and eggs for raising acid to the towers.
Boilers for raising steam.

It is observations I have made in working these different portions of the plant which forms the subject of my paper this evening.

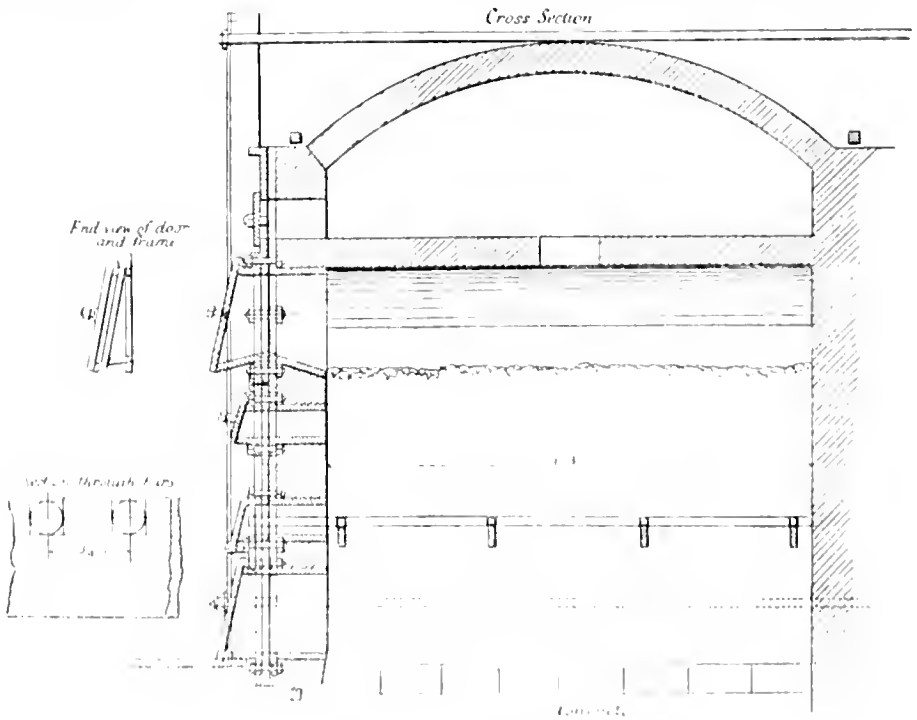
The essential portions of a sulphuric acid works are the kilns, nitre pots and stack, and the chambers; the towers and coolers are of comparatively recent introduction, and although indispensable in the economic production of the acid, have really nothing to do with the original process, there being many works where towers are not employed even to this day.

The diagrams on the wall show sketches of these various portions of the plant. I propose to discuss them separately and to describe some of the results of working them.

The first diagram (*see* p. 302) is merely a sketch, not drawn to scale, to show the sequence of the operations, beginning with the kilns and showing the course of the sulphurous gas and air as it passes through the nitre oven into the pipe leading to the Glover tower, passing out of the tower into the first chamber and traversing each chamber successively, arriving finally at the exit pipe leading to the absorbing tower, and conveying the waste gases from thence to the chimney.

Kilns.—For the production of sulphurous acid the pyrites is burned in suitable kilns which are chosen according to the kind of ore to be treated. These kilns are of two kinds, viz., those for burning lump ore and those for burning the smalls, *i.e.*, the portion of dust which is either produced in breaking the ore to a uniform size or the small ore which is obtained in the process of mining in Spain.

The kilns for lump ore are very simple in construction, being merely a series of square fireplaces arched over, and their products of combustion led into a common flue to the Glover tower. But the kilns for burning smalls are much more complicated and difficult to manage.



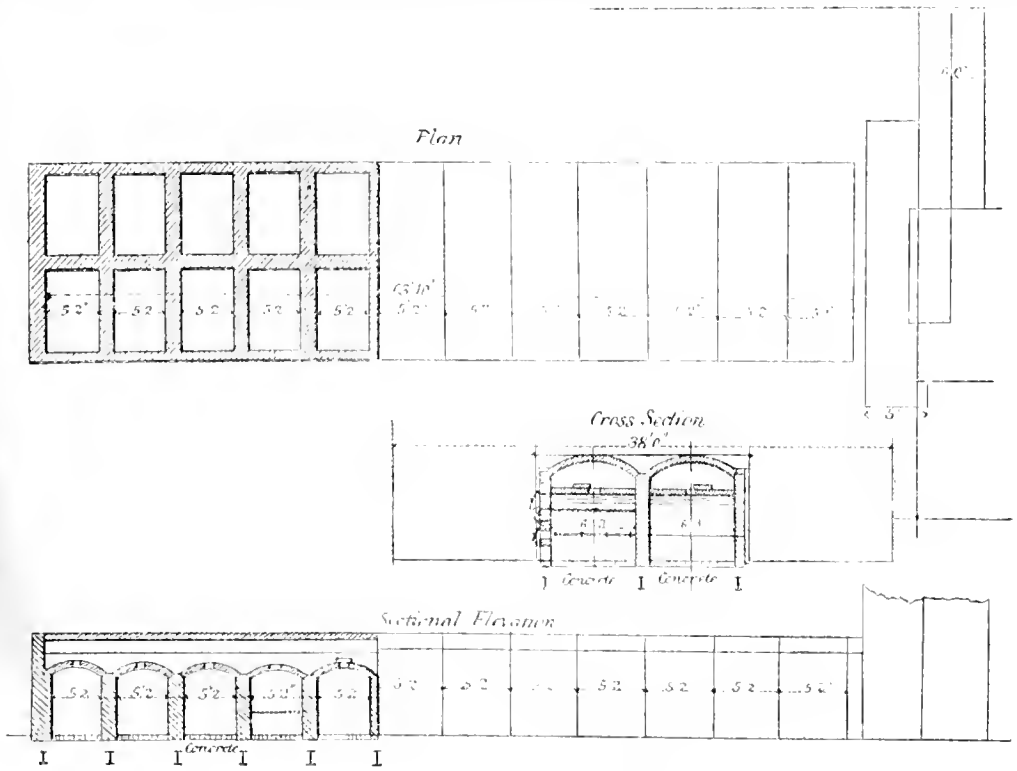
Section of Lump Ore Kilns.

In some cases the two kinds of kilns are combined so that a few dust kilns are built alongside the lump ore kilns to burn off the dust produced in the breaking of the lumps.

Much ingenuity has been expended in the construction of various forms of furnace for burning smalls, but till recently success has been very partial.

The plant is much more expensive, more easily deranged, and more difficult to repair. Generally they consist of a series of seven or eight beds or shelves, on which the ore is fed from the top through a hopper and gradually raked down lower at regular intervals till the sulphur is burned out, and when withdrawn at the bottom contains only a small percentage of sulphur.

I am informed that in some of these furnaces the smalls of Spanish pyrites have been burned down so low as 1½ per cent. sulphur, though I confess I have not been able to do

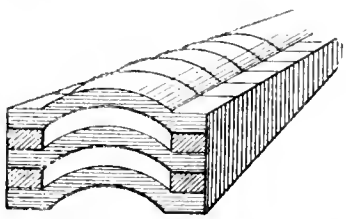


Lump Ore Kilns in Plan and Section.

this in our kilns. Still I have burned the ore down to 2½ and 3 per cent. over a period of two or three years. Probably this arises from a difference in construction.

I have here a diagram showing the way in which these dust burners are constructed. They require to be erected in the most substantial manner or they are soon knocked to pieces by continued raking and poking.

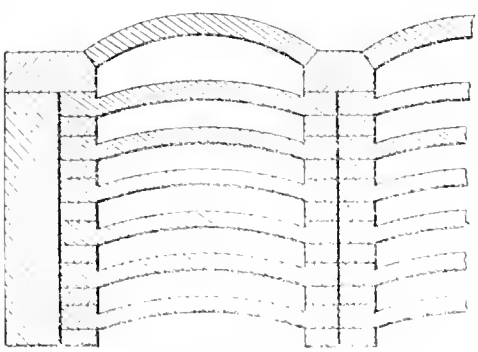
When they are built back to back the partition wall is required to be especially strong otherwise the whole affair gradually breaks up and becomes useless. To avoid this I have had the wall built of fire lumps. The beds are constructed thus:—



This method allows of a kiln being easily taken to pieces where one of the beds are broken and replaced by a fresh one, whereas by the kilns with a simple arch it is almost impossible to pull down the structure without breaking the rest of the beds. Every portion of the work requires to be bound together with iron ties in the strongest and most substantial manner, and in our own kilns the ties that go through from end to end are embedded in a groove in the partition wall. I have made a long series of experiments to trace the gradual combustion of the ore from charging at the top to discharging the burnt ore at the bottom, and the following is the average result of a month's working of each bed, an analysis of a sample of each bed being drawn every day for a month.

The charge of ore is put in the kiln once every eight hours, and as there are seven beds, the charge takes 7 × 8 = 56 hours to completely consume the sulphur.

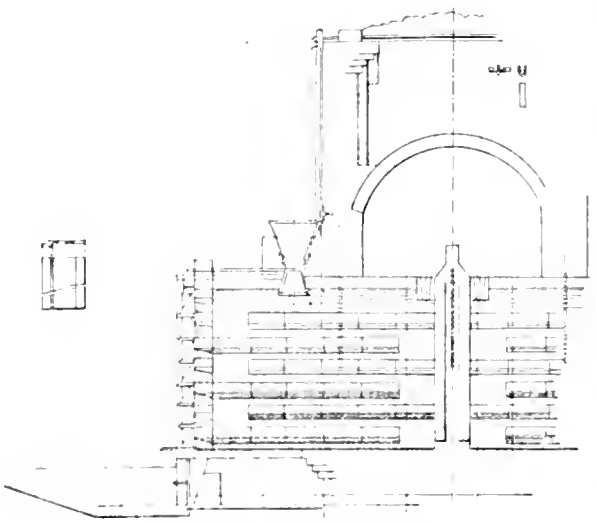
Dust Room.—In kilns burning smalls, it is found necessary to make provision for settling out the dust from the shelves, which rises in great quantity when the charge is raked over from one bed to another. A long distance must be traversed before the gas arrives at the Glover tower to give time for its perfect subsidence.



Dust Shelves.

If this precaution is neglected, the tower would become choked and the draught so much impeded that the process would soon be brought to a stand. There are many ways of accomplishing this, but the diagram shows a very effective arrangement. The flues require cleaning out every two or three years. Notwithstanding all precautions, a certain portion of dust passes into the tower, and, meeting the down current of sulphuric acid, dissolves. A solution of sesqui-

sulphate of iron in sulphuric acid is formed, which again deposits in the cooler, and greatly impedes the refrigeration of the hot acid coming from the tower.



Section of Dust Burner.

Gases from Kilns.—Being desirous to ascertain the limits of fluctuation in the composition of the gases from the kilns, I have made a long series of trials both upon lump and upon two sets of dust kilns. The gases were in all cases drawn from the flues before reaching the nitre stack and so avoiding the nitre gases.

Table No. 1.

Sulphur Tests of Pyrites Dust containing 50 per Cent. Sulphur.

Taken from the top to bottom shelves of a kiln.

Average per Cent. of Sulphur.	November, 23 Trials to each Shelf.	December, 26 Trials to each Shelf.
No. 1 shelf	32·27	32·81
No. 2 shelf	21·41	17·55
No. 3 shelf	12·77	11·69
No. 4 shelf	6·59	5·05
No. 5 shelf	4·08	3·42
No. 6 shelf	2·85	2·56
No. 7 shelf	2·27	1·93

The ordinary charge of pyrites was in all cases the same both for lumps and smalls, so that a strict comparison can be made.

It will be observed upon inspecting the table that the fluctuations in the sulphurous acid and oxygen range within extremely narrow limits whether we compare the results from the two sets, dust kilns together, or with the lump ore kilns.

I may state that all through these trials upon different sets of kilns, towers, chambers, &c., they are all of the same capacity, and the charges are of the same weight, so that the results are in almost every respect strictly comparable. The experiments are made on two distinct acid plants, but of exactly similar measurements.

Table No. 2.

Analyses of Gases from Pyrites Kilns.

Old Dust Kilns. By Volume.		New Dust Kilns. By Volume.		New Lump Kilns. By Volume.	
SO_2	Oxygen.	SO_2	Oxygen.	SO_2	Oxygen.
6·67	9·27	6·83	8·98	6·31	9·90
7·02	10·00	7·03	8·90	6·63	9·60
6·77	9·10	6·10	9·52	4·97	11·21
6·80	9·25	5·88	9·79		
6·73	9·55	6·21	9·13		
6·54	9·70	5·95	9·61		
6·03	10·00	5·82	9·51		
6·08	9·80	5·42	10·01		
6·22	9·61	5·12	10·17		
		5·21	10·14		
Another Ore.		4·86	10·68		
6·91	8·21	5·82	10·00		
7·01	7·78	5·70	10·29		
6·56	8·42				
6·95	8·51				
7·01	8·35				
7·03	7·96				
6·63	8·78				
6·77	8·68				
6·54	8·82				
6·34	8·82				
6·46	8·53				
6·57	8·47				
7·31	8·06				
6·71	8·82				
7·03	8·32				
7·04	8·32				

Temperature of the Kiln Gases.—I have had some little trouble in ascertaining the exact temperature of the gases as they enter the Glover tower.

With lump ore the heat is considerably greater than with dust, the reason being that the distance traversed in this case is very short, whereas in dust kilns a considerable amount of heat is lost by radiation in traversing the long winding chambers forming the dust depositing room.

In a set burning lump ore the heat will melt both lead and zinc but not antimony. Now as zinc melts at 773° F. and antimony at 800° F. it follows that the temperature is between those two numbers. On the other hand the heat of the gases from dust kilns ranges about 610° or thereabouts, sometimes it is rather lower, but it is difficult to test with a mercurial thermometer although I have made many observations in which the heat was not more than 570° to 580° F. Generally it will melt lead which is 620° F.

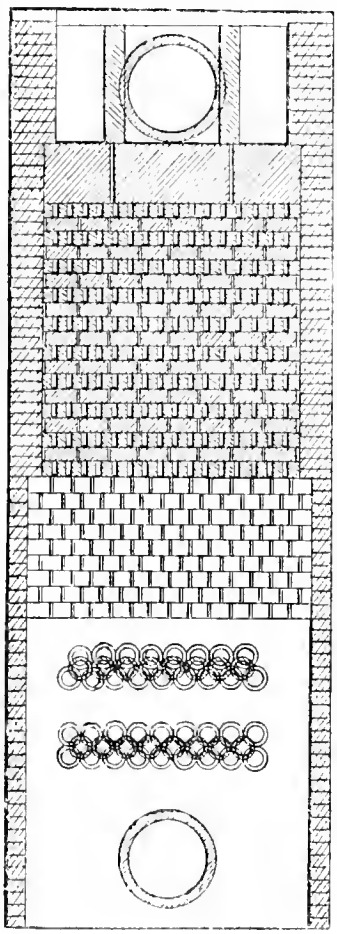
The Nitre Pots.—In the stack connecting the kilns with the kilns on one side, and the pipe leading to the Glover tower on the other, there is a space in which the pots containing the nitre are placed. There are generally two such pots which are charged alternately with the proper proportion of nitre and sulphuric acid.

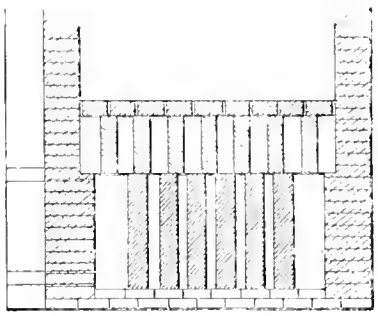
I do not like this plan myself, since it is impossible to regulate the heat of the oven. A much preferable arrangement is to fix the pots on the outside and lead the nitric vapours into the stack. This can be so arranged that not the smallest quantity escapes into the air and the heat from a small coke fire being regulated to suit the charge, avoids the difficulty of frequent breakages from the sudden chilling of the nearly red-hot iron pot when a new charge of acid is introduced.

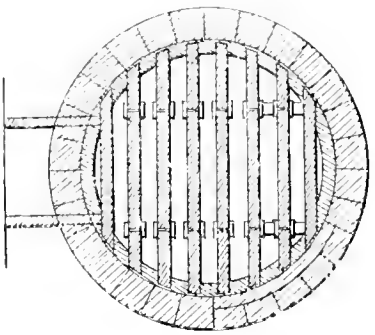
The nitric acid vapours along with the sulphurous acid of the kilns mix and pass together into the Glover tower.

The Glover Tower or Denitrator and Concentrator.—The use of the Glover tower is two-fold, viz.:—1st, To reduce the nitrous act collected at the Gay-Lussac or absorbing tower (by means of the SO_2 of the kiln gases) and return it to the chambers: and 2nd, to concentrate the weak acid of the chambers and so obtain acid of 150 Tw., suitable for using in the Gay-Lussac tower for absorbing a fresh portion of nitrous acid.

The construction of a Glover tower is very simple. It is a framework of iron lined with lead. This again is lined with acid-proof bricks. The interior is packed either with coke, flints, acid-proof bricks, or with cylinders as in the accompanying diagram. The hot gases pass up, and a stream of nitrous vitriol mixed with weak acid from the chambers passes down. The nitrogen compounds and the steam from concentrating the weak acid pass upwards into the chambers whilst a stream of denitrated and concentrated







Glover Tower Denitrator.

acid continually passes down and runs into a cooler at a temperature of 280° to 300° F.

The temperature of the concentrated and denitrated acid which runs from the tower ranges from 285° to 300° F., and depends upon the heat from the kilns and the amount of acid run down the tower.

From lump ore kilns, the amount of concentration greatly exceeds that of the dust kilns, so that in certain cases, as where strong acid is required, this becomes a very important point. In either case, if the towers are well attended to, the quantity and strength being once fixed, the daily feed of nitrous and weak acid ought never to vary.

From a tower 30 ft. high and 10 ft. diameter 26·2 tons of acid of 135° Tw. are concentrated to 150° Tw., producing 23·8 tons of 150° Tw., and 2·4 tons of water evaporated; and in addition 21 tons of nitrous vitriol are heated from 80° F. to 300° F. if heated by lump ore kilns in which the gases are delivered direct to the tower; but from the same weight of pyrites smalls the gases from which pass through the long dust chamber and by consequence lose a great amount of heat by radiation in their passage to the tower, not more than 16 tons of acid of 135° Tw. are concentrated to 150° Tw., producing 14·29 tons of acid 150° Tw., and 1·71 tons of water evaporated; and in addition 21 tons of nitrous vitriol are heated from 80° F. to 280° to 290°.

The hotter gas of the lump ore kilns produces more steam than the dust kilns and at times tends to reduce the first to second chamber drip so low as to keep the last chamber pale, unless a larger portion of nitre is used. On the other hand, while occasionally a somewhat lower consumption of nitre occurs in the dust burners, a much smaller proportion of strong acid is produced as already stated.

The effect of this difference in evaporation of water is that the lump ore kilns do not require steam to be thrown

into the first chamber, whilst the dust set always requires the addition of steam.

The height of the Glover tower attached to the lump ore kilns is 30 ft. and 10 ft. diameter.

The height of the tower connected with the dust kilns is 42 ft. and 10 ft. diameter.

What are called the "odd dust burners," is a set attached to the tower of the present lump ore kilns and which were pulled down.

Originally these two towers were of the same height, but, with a view to lowering the temperature of the gases passing into the first chamber, we increased the height by 12 ft. The result was not so satisfactory as we desired, the reduction of temperature only amounted to about 10° instead of 30° or 40°.

The tower burning lump ore delivers its gases into the first chamber at an average temperature of 302° F., whilst the high tower connected with dust burners delivers the gases at about 190° F.

Indeed, I scarcely think even this diminution is all ascribable to the height of the tower, but rather to the low temperature of the kiln gases entering the tower. This confirms an opinion of Dr. Affleck expressed some time ago.

Extract from Dr. Affleck's address to the Tyne Chemical Society. He says:

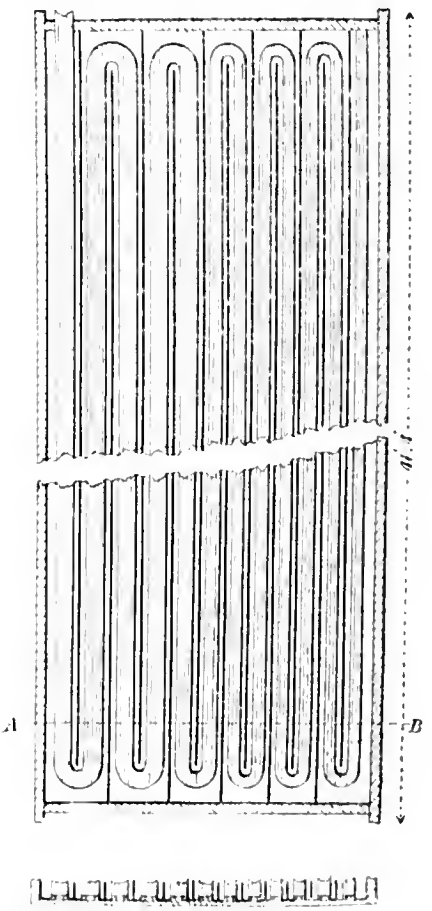
"I consider, in fact, that in such cases the upper part of the tower undoes to some extent what has been done in the lower and hotter part. The steam evaporated from the acid in the lower and middle sections of the tower and carried along by the hot gases in their passage upwards, is partly condensed again, when they have been cooled down below the boiling point, by the colder stream of acid they encounter near the top. And thus less concentration is effected than would be if the gases were allowed to escape from the tower at a temperature more approaching the boiling point, or say 200° F. And this result would be equally produced by a too high or too closely packed tower, the cooling effect on the gases being the same. Hence it follows that a tower might be made so high as to have practically no concentrating power at all, the gases being cooled at the outlet to near the temperature of the air, and the cold acid poured on at the top running away at the bottom hot, but not increased in strength. This view has been confirmed by the improved concentration along with freer draught, obtained by working with short towers of about 18 ft. in height, and by diminishing the packed space in higher ones in various works in the neighbourhood."

So much for Dr. Affleck.

But I cannot quite understand from these remarks whether he means 18 ft. from the top of the tower to the bottom of the saucer, or 18 ft. of working space, which would make the tower about 25 ft. high. There is some difficulty in getting the exact temperature of the gases entering the towers, but, as already stated, there is about 150° difference between that of the lump kilns and the dust burners.

The Coolers.—As the temperature of the acid running from the Glover tower is so high as 280° to 300° F., it is necessary to cool it to as near the temperature of the air as possible. Various contrivances have been adopted to effect this; some makers pass the acid through lead pipes surrounded with water, the objection to which and some other forms is the difficulty of cleaning the deposit which invariably forms after a short time, and which stops the pipes and protects the acid from the cooling by the water in which the pipes are laid. This is especially the case with acid made from pyrites smalls. A thick coating is formed on the surface of the lead.

I have here a diagram of an open cooler which answers better than the tubes because it allows of cleaning while in use. You will see that the acid and the current of cooling water run in opposite directions, and there is also a current running underneath the lead. It is 11 ft. long and 9 ft. wide. It has 12 double channels for acid, so that the acid travels in all about 500 ft., and as there are two coolers it travels about 1,000 ft., and the cooled acid runs out at a temperature of from 83° to 120° F. By the annexed table you will see the progress of the cooling as the acid travels from one channel to another. Two of these coolers will reduce the temperature of 38 to 40 tons of acid of 150° Tw. —1·750 sp. gr.—from 300° F. to from 83° to 120° F.,



Scale 4 ft.

Cooler for Acid from Glover Tower.

depending on the season of the year, being 180° per 24 hours. The further cooling takes place in the store tanks. The acid cools more slowly as the temperature approximates to the temperature of the water used for refrigeration, as may be seen by the diagram showing the amount of fall in temperature in each successive channel. From 280° to 216° the fall is very rapid, but from 216° F. the—

Table No. 3.

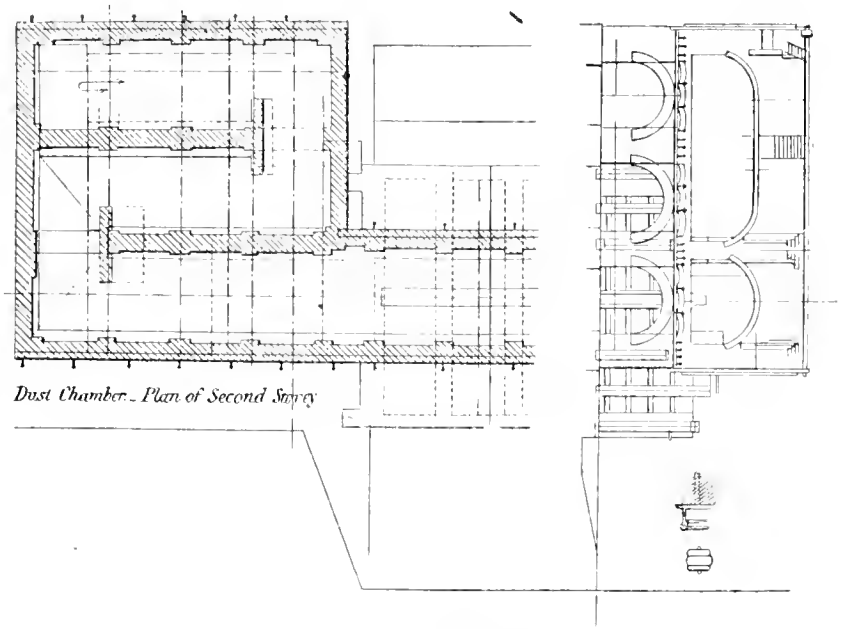
	F.
1st fall of temperature	15
2nd fall of temperature	15
3rd fall of temperature	17
4th fall of temperature	13
5th fall of temperature	7
6th fall of temperature	6
7th fall of temperature	8
8th fall of temperature	3
9th fall of temperature	5
10th fall of temperature	4

Chambers.—The chambers on which I have made observations are two sets of four.

Each chamber is 130 ft. long, 20 ft. wide, and 16½ ft. high = 42,900 cb. ft. per chamber, working with about 19 to 20 cb. ft. of space to 1 lb. of sulphur charged per 24 hours.

After passing through the Glover tower and as it enters the first chamber the gas has a temperature of between 189° and 203° F. (according to whether it is from lumps or dust).

At the extreme end of the pipe from the last chamber to the Gay-Lussac tower there is a further fall of about 28° F. in the exist gases.



Sections of Dust Chamber.

These gases, consisting of nitrogen, oxygen, nitrous acid and small quantities of sulphurous and sulphuric acid, then pass up the Gay-Lussac tower, and in their passage undergo partial absorption.

From this diagram it will be seen that the average fall in temperature in passing from the entrance of No. 1 chamber to the extreme end of the chamber was:—

Table No. 4.

Loss of Heat in Chambers.

	Old Dust Kilns.	High Tower. New Dust Kilns.
	F.	F.
Glover tower to No. 1 mean temperature	197	186
Chamber No. 1 to 2, top	47	31
Chamber No. 2 to 3, top	15	19
Chamber No. 3 to 4, top	32	34
No. 4 to Gay-Lussac	26	28
Entering Gay-Lussac	3	4
Exit from Gay-Lussac	4	5

The diminution in temperature arises from diminution of chemical action in the successive chambers, so that roughly the temperature is an exponent of the quantity of acid produced in each chamber.

You will observe by the diagram plotted that I have recorded the maximum and minimum temperatures of the air, and you will, I think, see that the rise or fall of temperature in the chambers is more or less affected by external circumstances. This fall in temperature fluctuates within well defined limits, it depends partly on the diminution of chemical action in the chambers, and partly on the external temperature of the air; in summer it rises, in winter it falls.

The observations were not taken inside the chambers, but in the pipe leading from one chamber to the other. This appears to be a much more accurate way of getting the average either of temperature or composition of the gases.

The method by which the progress of the operation is observed and controlled consists in noting the colour of the gases in the last chamber, which should always be a dark brownish red indicating the predominance of nitrous acid, and by constantly noting the specific gravity of the acid which collects in the drip glasses.

It is customary at most works to collect the samples of acid from the sides of the chambers, but this is generally a very slow progress. I find it much better to obtain the drips from the pipes connecting the chambers together, because the flow of acid is much more rapid and the indications consequently much more instantaneous. A large test glass can easily be filled in a few minutes, whereas if drawn from the sides of chambers, hours are sometimes required to get sufficient acid for a single test.

For a set of four chambers the drips should stand as follows:—

Table No. 5.

Normal Drips.

Drip from tower to 1st chamber	95 to 105
Drip from No. 1 to No. 2 chamber	130
Drip from No. 2 to No. 3 chamber	122
Drip from No. 3 to No. 4 chamber	105
Drip from No. 4 to Gay-Lussac	85

The drip from No. 1 to No. 2 should never stand lower than 130°. If it does so the consumption of nitre is increased. This, however, cannot always be avoided if the tower is producing an excess of steam.

The strength of the acid made in the chambers (of which the drips are the indicators) is increased or diminished according to the supply of steam, derived partly from the weak acid which is undergoing concentration in the Glover tower, and partly from jets of steam thrown into each chamber. Great difficulty is often experienced in regulating the strength of the first chamber, but it is upon the

proper regulation of this strength that the working of the subsequent ones depend.

If the kiln gases are too hot an increased evaporation of water from the tower takes place, and keeps down the strength of the drip considerably below 130°. In that case a high consumption of nitre is sure to take place.

The composition of the gases as they pass from one chamber to the other is shown in the following table:—

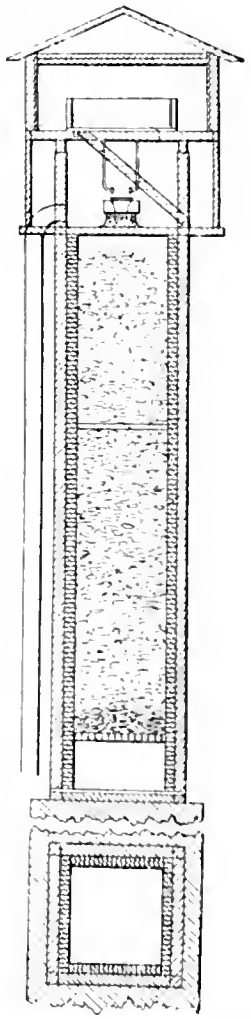
TABLE No. 6.

	Lump Ore Kilns.		Dust Kilns.	
	SO_2	Oxygen.	SO_2	Oxygen.
Glover Tower to No. 1 chamber	6·9	8·0	5·2	11·8
No. 1 to No. 2	4·4	7·5	2·4	11·8
No. 2 to No. 3	1·9	5·7	1·2	10·6
No. 3 to No. 4	0·4	6·1	0·6	10·2
No. 4 to Gay-Lussac	0·3	5·7	0·4	9·3

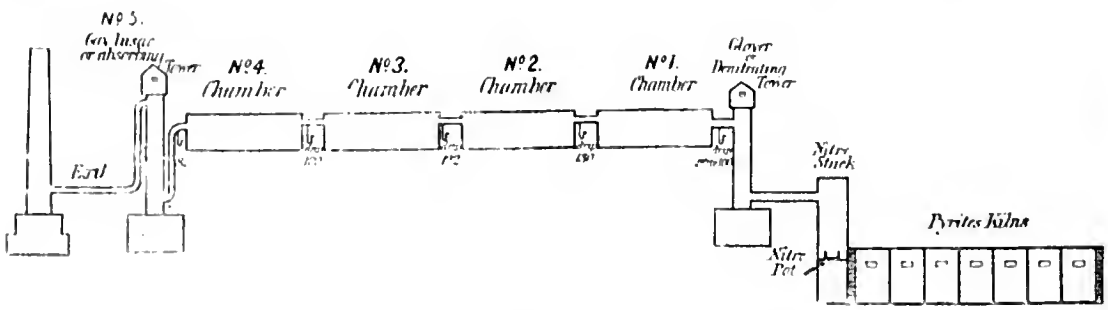
In another series of analysis of the gases of a set of six chambers from a Scotch works there was obtained the following results:—

	SO	Oxygen.
Glover Tower to No. 1	6·318	12·554
No. 1 to No. 2	4·441	11·806
No. 2 to No. 3	2·630	11·280
No. 3 to No. 4	1·402	10·855
No. 4 to No. 5	0·704	10·614
No. 5 to No. 6	0·261	10·460
No. 6 to Gay-Lussac	0·035	10·382

Gay-Lussac Tower or Absorber.—This tower is used for the purpose of economising the consumption of nitrate of soda by collecting the spent nitrous acid as it passes out of the last chamber.



GAY LUSSAC OR ABSORBING TOWER.



SKETCH SHOWING THE CONSECUTIVE ORDER OF THE PROCESSES.

Before the invention of this tower there was required from 8 to 10 lb. of nitre to every 100 lb. of sulphur consumed. By the use of this contrivance the consumption may be reduced to from 2 to 3 lb.

The operation consists simply in allowing the waste gases from the last chamber to draught through this tower which is packed with hard engine coke and down which a stream of strong acid of 150 Tw. is continually running.

The waste nitrous acid vapours are absorbed in their passage up through the tower by the strong acid, which runs into a cistern and is returned to the Glover tower and used instead of so much fresh nitrate.

The construction of a Gay-Lussac tower is as simple as the Glover tower. It is merely a wooden framework lined with lead, the inside being again lined with bricks. It stands 46 ft. high. There is a series of bars or an arch with suitable openings for allowing the spent gases to pass through, and on this arch to the top of the tower the space, as already stated, is packed with coke.

TABLE No. 7.

MONTHLY AVERAGES OF ACID GASES PASSING INTO "GAY-LUSSAC" TOWER AND FROM THENCE TO EXIT.

Old Dust Kilns.		New Dust Kilns.		Lump Ore Kilns.	
Acidity in Grs. of SO_3 per cb. ft.		Acidity in Grs. of SO_3 per cb. ft.		Acidity in Grs. of SO_3 per cb. ft.	
In.	Out.	In.	Out.	In.	Out.
4·42	1·87	3·51	1·85	3·51	1·13
4·24	2·06	4·57	2·49	3·48	1·69
4·56	2·27	3·20	1·45	3·40	1·61
3·27	1·76	2·79	1·31	3·55	1·80
3·05	1·50	3·93	2·10	3·13	1·43
2·27	1·11	3·21	1·68	2·86	1·39
1·93	1·14	2·87	1·32	3·91	1·97
2·33	1·27	3·36	1·54	4·29	1·03
		3·38	1·57	4·32	1·92
		3·29	1·43	3·27	1·14
		3·31	1·23		
		3·29	1·36		
		3·82	1·82		
		3·54	2·03		
		2·61	1·31		
		4·38	2·08		
		3·73	1·46		
		3·04	1·53		
		2·50	1·69		

The spent gases from the last chamber in entering this tower generally contain 3 to 4 grains of acidity reckoned as SO_3, but in passing out only about 1 to 2 grains, consisting of SO_2, SO_3, and nitrous acid not absorbed. They contain also 6 to 7 per cent. by volume of oxygen, the rest being nitrogen. There is a curious observation with reference to the oxygen, viz., that the gases always contain a small proportion more oxygen in passing out than they contained in entering the tower.

Formerly I ascribed this to some possible leakage of air inwards, but on reconsideration I think it may be caused by the removal of the sulphurous acid and consequent diminution of volume, thereby slightly raising the percentage of oxygen; or, again, it may arise from some decomposition of the oxides of nitrogen, by which oxygen is eliminated, but it always takes place.

The total amount of acidity remaining in the exit gas as it passes to the chimney is a matter of very great importance, since it is an indication as to the working of the chambers.

If the exit contains more than 1 to 2 grains of acidity it indicates that sulphurous acid is getting into the absorbing tower, the result of which is the reduction of the nitrous acid and consequent loss of nitre.

Under the Alkali Act, also, not more than 4 grains of acidity per cubic foot of gas are allowed to be passed into the air, any excess resulting in a notification from the Government inspector that you are exceeding the limit allowed.

By a daily comparison of the temperature of the acid which is poured into the tower with the temperature as it runs out at bottom the heat will be found in many cases to diminish, but more frequently to increase. The explanation of the increase is probably to be found in the greater or less quantity of SO_2 in the spent gases, but more particularly in the greater or smaller quantity of moisture accompanying the gases.

TABLE No. 8.

MONTHLY AVERAGES OF THE OXYGEN ENTERING AND PASSING OUT OF THE "GAY-LUSSAC" TOWER.

Old Dust Kilns.	New Dust Kilns.			Lump Ore Kilns.		
Per Cent of Oxygen.	Per Cent. of Oxygen.			Per Cent. of Oxygen.		
Out.	In.	Out.	Increase.	In.	Out.	Increase.
7·36	..	6·00	..	7·70	8·00	0·30
9·85	..	5·32	..		8·20	
8·28	..	5·10	..			
7·20	..	5·41	..			
8·27	..	5·66	..			
7·38	..	5·18	..			
6·33	..	5·76	..			
6·85	4·88	5·42	0·54			
6·25	5·11	5·64	0·53			
	5·67	5·84	0·17			
	5·06	5·18	0·12			
	4·72	5·03	0·31			
	4·31	4·39	0·08			
	5·16	5·32	0·16			
	4·76	5·10	0·34			
	4·90	5·00	0·10			

An excess of moisture passing into the absorbing tower and coming in contact with strong sulphuric acid, raises the temperature considerably, as well as causing the disengagement of nitrous acid.

Table No. 9 shows the average temperature of the acid at the point where it runs into the distributor on top of the tower, and the corresponding temperature when it arrives at the bottom and passes into the store tank. The plus or minus sign shows the amount of rise or fall in temperature.

Since the temperature of the chamber exit gas is usually lower than the temperature of the acid running into or out from the tower, it would seem that other causes are in operation to produce the increased temperature.

The daily testing of the acid running out of this tower is an absolute necessity in order to know how the absorption of nitrous acid is proceeding. The usual method is by a standard solution of permanganate of potash, or by working with Dr. Lunge's nitrometer.

Of course it is necessary to arrange that the same quantity of strong acid is poured down the tower every hour, otherwise the results must be quite fallacious. We use a standard solution of permanganate, of which 100 cc. are equivalent to 0·1900 N_2O_3, and we find the chambers continue in good working order so long as 10 cc. = 175 grains of the nitrous acid vitriol continues to require from 60 to 80 cc. of permanganate. If less than 60 cc., we increase it. This strength (say 75°) represents about 0·8142 per cent. N_2O_3 = 18·238 lb. per ton or = 1·157 per cent. nitrate of soda, or 48 lb. $NaONO_3$ per ton.

Now, as we pour down 21 tons of 150 acid in 24 hours = 12 eggs, at $1\frac{3}{4}$ tons, the total nitrous acid absorbed during the day will be equal to about 857 lb. nitrate of soda.

It is the general opinion of vitriol manufacturers that the temperature of the acid poured down the Gay-Lussac tower should be as low as it is possible to cool it, in order that the absorption of nitrous acid may be complete. It will be in the recollection of members of this Society that I

expressed some doubts about the necessity of these precautions at one of our meetings.

I drew your attention to the difference between some kinds of absorption and others, and I instanced the case of a tower down which hot acid was poured and up which ammonia gas was passed. Here it was clear that the combination would be instantaneous without regard to temperature.

TABLE No. 9.

MONTHLY AVERAGE OF TEMPERATURE OF THE ACID ON TOP AND AT THE BOTTOM OF GAY-LUSSAC TOWER.

Old Dust Kilns.		New Dust Kilns.		Lump Ore Kilns.	
A. Set.		B. Set.		A. Set.	
Temperature F.		Temperature F.		Temperature F.	
Top.	Bottom.	Top.	Bottom.	Top.	Bottom.
86	78 + 8	105	102 + 4	95	90 3
75	76 1	116	112 + 4	110	88 2
87	84 3	105	107 + 1	99	107 + 8
90	101 + 11	90	101 + 14	160	120 + 20
93	116 + 23	93	103 + 10	107	115 + 8
87	111 + 24	86	95 + 9	103	113 + 10
99	110 + 11	83	87 + 4	108	127 + 19
100	103 + 3	76	78 + 2	98	115 + 17
95	92 3	80	83 + 3	90	105 + 15
89	82 7	77	78 + 1	73	85 + 12
97	83 14	91	86 5		
100	80 20	90	83 = 3		
92	77 15	100	106 + 6		
92	81 2	100	116 + 16		
90	96 + 6	119	114 5		
		101	112 + 8		
		109	118 + 9		
		99	97 + 2		
		90	91 1		
		74	71 3		

On the other hand, I instanced a tower down which water was passed and carbonic acid passed up. Unless the water was exceedingly cold, little absorption would take place, whilst heat would be quite fatal to combination.

Comparing these two operations, I considered that nitrous acid and strong sulphuric acid belonged to the first category, since when once combined they cannot be separated even upon boiling. I had tried this experiment. But Mr. Newlands reminded me that I had not tried the converse experiment, viz., passing nitrous acid into hot sulphuric acid. I have recently made some experiments with a view to determining this question, and the following are the results

In order to obtain results on a small scale comparable with those of the Gay-Lussac tower, it must be borne in mind that the proportion of nitrous acid in the spent gases from the chambers is exceedingly small, and therefore many hours are required to produce an acid of corresponding strength to the nitrous vitriol from the tower if it really is absorbed at all.

The first experiments were made to ascertain whether absorption of nitrous acid would take place at all, at a temperature of 212°.

For this purpose I obtained two sets of absorbing bulbs such as are here exhibited. These were inserted into a leaden box, with a cover in two halves. A pipe for inserting a jet of steam and another for the exit of steam was used for heating water surrounding the bulbs to 212°, and a thermometer was inserted to note temperature.

An india rubber tube connected with the pipe entering the Gay-Lussac tower supplied the gases which were drawn therefrom and through the bulbs, filled with 70 cc. of acid of 150° Tw. by means of an aspirator.

The pump was kept working from 8 to 24 hours in the various experiments. When the trial was completed the bulbs were detached, the acid poured out, and a portion tested for nitrous acid in the usual way with standard solution of permanganate. The remainder of the acid was placed in a small retort and heated to boiling for some time, allowed to cool and again tested with standard permanganate to ascertain whether it had lost its nitrous acid. A corresponding experiment was made at the ordinary temperature of the air, and the product tested as before.

The preliminary trials were made with only one set of bulbs. It was found necessary afterwards to add further absorption bulbs. The results are as follows:—

I made six experiments to ascertain if acid of 150° Tw. would absorb the nitrous gases from the tower at a temperature of 212° F.

TABLE No. 10.

COMPARATIVE RESULTS OF PASSING THE NITROUS GAS THROUGH 70 CC. OF 150° TW. ACID DURING A PERIOD OF 12 HOURS.

At the Temperature of 212° F.		At the Temperature of 50° F.	
	N_2O_3		N_2O_3
70 cc. absorbed	0·4788	70 cc. absorbed	0·5820
	0·5054		0·6118
	0·5453		0·6004
	0·5852		0·7448
	0·5985		0·8512
	0·6946		

N.B.—Nitrous vitriol from the absorbing tower contains from 0·7980 to 1·0610 grms. N_2O_3 in 70 cc.

This led me to conclude that the absorption was at any rate very considerable, even at so high a temperature as 212° F., a temperature far higher than any heat that is likely to be used in an absorbing tower.

As the current of gas, although passing through the acid for equal times, might vary in rapidity and therefore in quantity, I arranged a fresh series of trials, in which the amount of gas was measured by means of an aspirator during 12 hours, and in order to ascertain whether any nitrous or other acid gas escaped absorption, I used a third absorption bulb of acid, and finally a set of bulbs containing a standard solution of caustic soda to remove the last traces of acidity of any kind.

During the period of 12 hours about four to five cubic feet of gas passed through the absorbing apparatus. The results were as follows:—

TABLE 11.

COMPARATIVE RESULTS OF PASSING THE NITROUS GAS THROUGH 140 CC. OF 150° TW. ACID DURING 12 HOURS AT THE TEMPERATURES OF 212° AND 50° F.

AT 212° F.

Cubic Feet passed through in 12 Hours.	NO Absorbed in 140 cc.	Grammes of N_2O_3 Absorbed from 1 cb. ft. of Gas.	Grammes of N_2O_3 Escaped and Reabsorbed in Cold Acid.	Grains of Acidity as SO_3 Absorbed by NaO.
2	0·2856	0·1113	0·00997	3·21
4	0·4783	0·1197	0·00497	0·80
5·3	0·6517	0·1230	0·00503	0·60
5·3	0·7980	0·1505	0·01254	0·18

At 50° F. =	the same experiments conducted at 50° F.			
5·3	0·5852	0·1104	0·00997	0·67
5·3	0·6384	0·1204	0·00997	1·34
5·3	0·8778	0·1656	0·00997	0·70
5·3	..	..	..	..

It would appear from a comparison of these results that the absorption at so high a temperature as 212° F. goes on almost as energetically as when the gas is passed through cold acid, and confirms the opinion I had formed that such would probably be found to be the case on trial.

Nevertheless, I would by no means advocate the use of very hot acid at the towers because there are other reasons against it, such as the rapid destruction of the lead of the plant. I merely wish to show that during hot weather there does not seem to be any reason for adopting extra or special methods for cooling the acid before passing it down the absorbing tower, and that when an increased consumption of nitre takes place the cause must be sought elsewhere, and not in the higher temperature of the acid.

In working a set of chambers and towers there are certain indications which may be regarded as prophetic of a coming change. The derangement of the working can frequently be averted by attention to these indications, viz. :—

1. A considerable and continuous fall in the percentage of nitrous acid in the nitrous vitriol from the Gay-Lussac tower.

2. A considerable rise in temperature in the acid from the Gay-Lussac.

3. A rise in the quantity of SO_2 in the exit gases ; and

4. When the change has taken place the gases of the last chamber become colourless.

When the chamber acid becomes sulphurous a reddish precipitate forms, due to the separation of selenium, of which I have here a specimen.

I have now traced the operations of manufacturing sulphuric acid through all the stages of its progress, from the production of sulphurous acid at the kilns and the nitric acid which mixes with it and passes together into the Glover tower, from thence to the chambers and on to the Gay Lussac absorbing tower, and finally the exit of the spent gas.

The observations I have made, and which you will see in the tables have involved an immense amount of work which has been carried on for years—for you will please observe that each of these figures are not single observations but are mostly the average daily results of a month's work, and therefore amount in each table to hundreds.

To me, they have thrown light upon many questions about which I was unacquainted and which have considerably helped me in my daily work, and it was with a feeling that they might possibly help some of my younger professional brethren who may be in charge of vitriol works, and who may not have similar opportunities for this study, that I have collected and systematised this work which I now lay before you, and which I trust will prove to be "memoranda for the use of somebody." I am only too sensible that I have but touched the fringe of a very large and interesting subject, but the time allotted for such a paper will not admit of further elucidation. On some future occasion I hope to take up some other points on which I have been unable to dwell this evening.

Discussion.

The Chairman, in inviting discussion, said that it would probably be very interesting to those who were concerned in the production of vitriol to compare the paper with the historic work of Lunge, and thus see how far his researches were confirmed by the most recent work on the large scale. He wished especially to direct the attention of members to the elaborate series of results which Mr. Crowder had brought before them in the form of diagrams. It ought, he thought, to be clear to the younger technologists among them that no amount of trouble was too great for the purpose of arriving at information and results which in these days of competition were absolutely necessary to success. That lesson, if no other, might certainly be drawn from the series of results which Mr. Crowder had brought before them.

THE CHEMISTRY OF WHISKY AND ALLIED PRODUCTS.

BY ALFRED H. ALLEN.

In this paper I propose to include, with some original observations, a number of facts and figures I have collated from various sources, believing that I shall be doing a service to others and spare them much of the trouble I have had in collecting the information. I must premise that this paper is one on the *chemistry* of whisky, and I do not propose to discuss the technical details of the manufacture of spirit, except in so far as they may be supposed to have an influence on the composition of the products obtained.

The process of manufacturing malt whisky as practised in the Highlands of Scotland commences with the malting of the barley. The product is dried for two days on perforated tile or wire floors, through the holes in which pass the products of combustion of a fire chiefly or entirely fed with peat. The dried malt is crushed between metal rollers and treated with hot water in a mash tun in much the same manner as in a brewery. The initial temperature of the water in mashing is commonly about 160° F., the next quantity being at 170°, and the third at 180°—185° F.; but of course the temperatures vary within certain limits at every distillery.

The *draff* or *spent grain* has much the same composition as brewery grains, and finds a ready sale as a cattle food to the farmers in the neighbourhood of the distilleries. When wet, the draff usually contains from 75 to 78 per cent. of water.

Following are the results yielded by two samples of dried grains from pure malt distilleries, analysed in my laboratory :—

	Spent Grains from Malt.	
	Per Cent.	Per Cent.
Moisture	10·32	8·00
Oil	6·70	5·07
*Proteids or albuminoids	19·88	19·80
Sugar, starch, digestible fibre, &c.	41·06	49·66
Woody fibre	19·00	13·16
Mineral matter (ash)	3·04	4·31
	100·00	100·00
*Containing nitrogen	3·14	3·13

The wort is cooled to about 70 to 80° F. as quickly as possible, to prevent it becoming soured or "blinked," and is then fermented with brewers' yeast, the fermentation being pushed much further than in the brewing of beer. The fermented wort, technically called "wash," is then transferred to the wash-charger and thence to the wash-still.

The distillation of the wash is conducted in the Highland malt whisky distilleries in what is known as a "pot-still." This is simply a copper still, with head or capital and worm of copper, without any special fractionating arrangement. It is furnished with a mechanical stirrer, which is necessary to prevent the particles of solid matter settling on the bottom and becoming charred by the open fire by which the still is heated. In some distilleries about 1 lb. of soap is

added for every 100 gallons of the wash, to prevent frothing. The Highland pot-stills have a capacity usually ranging from 6 to 12 thousand gallons.

The first product obtained by distillation of the wash is a weak alcoholic liquid called *low wines* or "singlings." The residue left in the retort is known as *pot ale* or *burnt ale*, and is run to waste. After separating the suspended matter the pot ale contains, according to my friend Mr. C. F. Cross, about 3 per cent of solid matter, consisting of about 1 per cent. of lactic and other acids, 0·7 of peptones and other nitrogenous matters, 0·6 of non-nitrogenous extractive matters, and 0·7 of mineral matters, in which phosphates predominate. I understand that the utilisation of this product is likely to be effected very shortly, if not already accomplished.

The "low wines," or first product of the distillation of the wash, is then subjected to a second distillation in a still just like that used in the first operation, except that it is not provided with an agitator. The products of this second distillation are:—

1. Foreshots;
2. Clean spirit or whisky;
3. Feints; and
4. Spent lees.

The spent lees are run away. The foreshots and feints both become milky when diluted with an equal measure of water, and this behaviour is employed to ascertain the time when the distillate should be diverted from one receiver to another. In some distilleries the specific gravity is taken as the indication of the end of the second stage, clean spirit being run until the distillate has a strength varying from 10 over proof to less than proof, according to the practice of the works. The third fraction is run till the distillate contains a very trifling proportion of spirit (2 to 3).

The foreshots and feints obtained in the foregoing process are returned to the low wines still, and hence redistilled with the low wines of the next period. Hence the only *distillate* which is ultimately obtained is the clean spirit or whisky. No fusel oil or other secondary distillate is ever obtained when working with the pot still.

The clean spirit or new whisky manufactured in pot-stills has usually an alcoholic strength ranging from 13 to 50 over proof, but is usually reduced in Scotland to 11 over proof and in Ireland to 25 over proof, before bonding.

When new, pot still whisky has a disagreeable, and in some cases extremely nauseous, flavour. But this gradually disappears by storing in casks, the improvement being usually attributed to changes produced by oxidation in the pores of the wood. Sherry casks are preferred to plain wood casks for storing whisky. The wood is in all cases oak, and usually American oak.

The loss of alcohol by keeping in wood varies much with the condition of the warehouse, being greatest where the atmosphere is most. It is estimated by the Excise to average 2¼ per cent. of proof spirit in the first year, nearly 4 per cent. in 3 years, and from 6 to 8 per cent. in 5 years.

The improvement of pot-still whisky by ageing continues for a number of years, and it is an interesting fact that some brands of whisky which are the finest in the market when matured, are when raw of the rankest and most nauseous flavour. The flavours of many makes of malt whisky are peculiar and perfectly distinctive, and can be recognised by an expert even when blended with the products of several other distilleries. The whiskies made in pot-stills in Islay and the West of Scotland are usually stronger in flavour than the whisky distilled in Glenlivet and the neighbourhood of Elgin and Inverness.

Scotch pot-still whisky differs from *Irish* pot still whisky in the fact that the malt is dried by means of peat, and that malted barley is practically the only grain used. With the exception of two distilleries in the North of Ireland, Irish pot-still whisky is distilled from a mixture of malted and unmalted barley, with the addition in some cases of a small proportion of other grains.

"*Potheen*," by which is meant the spirit made in illicit stills, is a product almost peculiar to Ireland, where 1,739 detections of illicit stills occurred in 1889, whereas there were only 31 cases of the sort in Scotland and 11 in England in the same year.* Most of these distilleries were very small affairs, but considering that the duty on spirit is 10*s.* 6*d.* per proof gallon, while the cost of production is only a few shillings, and that it is a very easy matter, with very imperfect appliances, to distil 5 or 10 gallons a day, there is considerable pecuniary inducement to practice the art, to say nothing of the pleasure to be derived from cheating the Government and hoodwinking the police. In many, probably the majority of cases, Irish potheen is distilled from fermented molasses, and not from malt, as is commonly supposed. It is therefore more nearly allied to rum than the whisky proper. It is said to be a common practice to put a lump of peat in the still "For the sake of ould Ireland."

Rum was formerly made by distilling the fermented juice of the sugar cane, but is now a spirit distilled from fermented molasses, or other residual products of the manufacture of sugar either from the sugar-cane or beetroot. The most common source is the "*megass*" or crushed cane, from which the juice has been expressed by means of rollers. This retains from 8 to 10 per cent. of sugar and 50 per cent of water, and hence is an admirable source of spirit. The flavour of rum is said to be chiefly due to the presence of butyrate and acetate of ethyl.

Brandy is a term properly applied to the spirit obtained by distilling fermented grape sugar, whether as contained in the wine or fermented grape juice itself, or in that which it retained by the skins of the fruit after the juice has been expressed. Of course, the latter is the ordinary source of brandy. The word "brandy" is evidently a corruption of *Brannt wein*, which may be translated as "burnt" or "distilled wine." But the term is now extended in its application so as to include the spirit distilled from maize, rice and other cereals, potatoes, turnips, beetroot, molasses, &c., all of which are lumped together under the comprehensive name of "*Branntwein*." This word is unfortunately commonly translated as "brandy," thus wrenching the word from its original and proper meaning, and causing serious confusion in the definition of brandy.† Wine-brandy, like whisky, owes its flavour to the presence of certain bodies which undergo a marked change by ageing. In fact, wine-brandy and pot-still whisky, and perhaps rum, are the only kinds of spirits extensively manufactured which undergo marked improvement by maturing, apart from the modification in flavour which may be produced by the sherry or other liquid previously stored in the cask.

Pot still whisky, rum, and real brandy are all produced in stills of simple construction and so designed as to prevent rather than encourage the removal of the subsidiary ingredients by fractionation. On the other hand, the various kinds of fractionating still, of which the Coffey still is the

* A large illicit distillery was discovered in Birmingham in 1889. In addition to defrauding the revenue, the conductors in this manufacture stole the gas they required by tapping the main, and are still undergoing punishment for this offence.

† The *Berliner Borsen Zeitung* asks: "What do they understand by the word 'Cognac' in France?" and says: "The district of Charente is the place of origin of real 'Cognac,' and has, during the last seven years, produced an annual average of 20,000 hectolitres, while the annual export by France of liquor known as 'Cognac' has exceeded seven times this quantity. In trade we usually understand by 'Cognac' a brandy obtained by the distillation of wine, and which was formerly known as *Franzbranntwein*, that is, 'French brandy;' but it has been shown by analysts, as also in a bulky volume issued by the State Department of Hygiene, that there is no reliable means of distinguishing real brandy as distilled from wine from the spurious stuff. It will, nevertheless, be interesting to those in the trade to learn the decision of a French court of law as to what it understands by the word 'Cognac.' A merchant of Angoulême who bought brandy in Valenciennes and labelled it 'Cognac,' was prosecuted for so doing, but was acquitted on the ground that the word 'Cognac' is not to be exclusively understood as descriptive of the place of production, but often, as in the present instance, as descriptive of the nature of the product. According to this decision, it is, then, to be regarded as sufficient when labels announce the nature of goods to which they are affixed, and it is not requisite that the contents of a bottle should have been produced in the place mentioned on the label. This fundamental decision is, however, not consistent with sentences pronounced by various French law courts upon manufacturers of sparkling wines, who have been heavily fined for introducing into trade wines which they described as 'champagne,' and which had undergone a similar process to that of the genuine article, but had not been made from wine grown in the champagne district."

best known and most widely used, aim at the removal of the subsidiary constituents of the spirit, economy of fuel, and the production of an alcohol of high strength and comparatively great chemical purity. In fact, spirit is obtained in the patent still at one operation, as strong as 55° to 70 over proof.* The purest spirit of the patent still (chemically speaking) is known as "silent spirit," as its odour and flavour give no indication of its origin; but unless the process is very carefully conducted the spirit is liable to retain sufficient odour or flavour to enable an expert to distinguish it as derived from potatoes, beetroot, grain, &c., as the case may be. In fact, the patent-still spirits manufactured in Ireland and the South of Scotland possess some of the characters of whisky, which the true silent spirit made in Germany does not.

In the manufacture of spirit in the patent still, unmixed malt is never employed. In the United Kingdom a mixture of unmalted barley, rice, maize, and other cereals is employed, together with the minimum of malt requisite to furnish the diastase for the conversion of the starch of the unmalted grains. Hence, apart from the differentiation effected by the fractionating still, the materials used for producing spirit in the patent still differ in a marked manner from the pure malt or mixture of malted and unmalted barley almost exclusively used for manufacturing whisky in the pot-still. The patent-still spirit is much milder in flavour than the pot-still product, and does not undergo so great a change by ageing, though of course it is just as liable to take up flavouring matters from the cask in which it is stored, and may undergo more or less change by oxidation. But its different origin and characters and the comparatively low cost of its production appear to be fair grounds for the contention of the Highland distillers that the present practice of blending pure malt pot-still whisky with from one to ten times as much patent spirit ought not to be allowed, as at present, to be conducted in bond under excise supervision (or what Mr. Healy calls "under the very nose of the lion and the unicorn"), and the resultant mixture ought not to be sold, as it frequently is at present, as "pure malt whisky."

Potatoes, turnips and other roots, and acid-made glucose are not employed in this country for the manufacture of any kind of spirit, though they are largely used on the Continent. Foreign silent spirit is imported to a considerable extent, though not so largely as is commonly supposed, the total amount imported during the year ending March 1890 being 1,791,386 proof gallons. A considerable proportion of this was used for methylating.

I have compiled the following tables relating to the production of whisky during the year ending 30th September 1889, from the figures given in evidence in July last, by the officials of the Inland Revenue Department, before the House of Commons Committee on British and Foreign spirits.

Distilleries using		England.	Scotland.	Ireland.	Total.
Pot-stills only	Number	None†	113	22	135
	Produce	None	7,367,727	5,745,764	13,113,491
Both pot and patent stills	Produce	1,482,282	4,715,672	3,665,210	Pot 2,086,509; Patent 7,866,645
	Number	10	13	8	31
Patent stills only	Number				
	Produce	7,626,740	7,301,678	1,993,813	16,922,231

Annual Production of British Spirits.

	Gallons.
Pot-still whisky	15,200,000
Patent still spirits sold as whisky	6,628,284
Patent still spirits sold as gin, brandy, &c.	6,000,000
Spirits consumed as beverages	27,828,284
Retained in bond	6,194,135
Exported	3,371,396
Methylated	1,118,361
Wasted	2,440,088
	117,081
Total	40,960,295

Importation of Foreign Spirits in 1889.

	Gallons.
Brandy	2,858,774
Rum	4,087,109
Geneva	304,493
Unenumerated unsweetened spirits	3,199,470
Unenumerated sweetened or mixed spirits	84,275
Total	10,534,091

During the year ending 30th September 1889, the following quantities of materials were used in the United Kingdom for the production of spirits :—

Material.	Quantity.	Capable of producing Proof Spirit.
Malt	907,971 quarters‡	18 gallons per quarter.
Unmalted grain	1,055,222 quarters	21 gallons per quarter.
Sugar	31,152 cwt.	10 gallons per cwt.
Molasses	211,161 cwt.	7 gallons per cwt.
Rice	57,721 cwt.	7½ gallons per cwt.
Jawarree	8,898 cwt.	1½ gallons per cwt.

The distilleries using malt alone number 115, of which 113 are in Scotland (corresponding to the distilleries using pot-stills only), and two in Ireland. The distilleries where mixed malt and unmalted grain are used number 42, while five distilleries use sugar and molasses in addition, and four employ rice as well. But it must be remembered that the majority of the malt distilleries produce comparatively small quantities of whisky, while the distilleries making patent-still spirit are in most cases of enormous producing capacity, so that the total production of patent-still spirit considerably exceeds that of pot-still whisky.

With regard to the actual *composition of spirits* apart from their alcoholic strength, it is well known that alcohol and carbonic acid are by no means the sole products of fermentation by yeast. Pasteur recognised succinic acid and glycerin as constant products of alcoholic fermentation,

* "Rectified spirit B.P." contains 155·45 per cent. of proof spirit, or is 55·45° over proof. Absolute alcohol is 75·25° over proof.

† There are no distilleries in England where pot-still spirit only is manufactured, but two distilleries have pot-stills in addition to patent stills.

‡ A quarter of malted barley weighs from 300 lb. to 336 lb.

and the higher homologues of ethyl alcohol are also known to be present in small but distinct amount.* Even the species of ferment affects the character of the product, the *saccharomyces cerevisiæ* of ordinary brewers' yeast producing subsidiary products distinctly different from those of the *saccharomyces ellipsoides*, which is the ferment of grape-skins. In fact it has been found that by adding the latter ferment to molasses and other saccharine liquids distinct from grape-juice, the product of the fermentation after distillation has all the characters of cognac brandy. The most marked distinction between the products of the two ferments is that whereas in the case of the grape-juice ferment *normal* butyl alcohol results, in other cases this is replaced by *iso*-butyl alcohol. Of course the proportion of higher alcohols to be found in the spirit itself is very small, but they become concentrated on fractionation, and hence constitute the greater part of the fusel oil which is obtained from the last runnings. Thus, by the fractional distillation of cognac brandy 25 years old, Ordonneau obtained the following substances (Compt. Rend. **102**, 217):—

	Grms. per 100 Litres.
Normal propyl alcohol	10·0
Normal butyl alcohol	218·6
Amyl alcohol	82·8
Hexyl alcohol	0·6
Heptyl alcohol	1·5
Ethyl acetate	35·0
Ethyl propionate, butyrate, and caproate	3·0
Octanethic ether (about)	1·0
Aldehyde	3·0
Acetyl	Traces
Amines	Traces

Ordonneau's results have been substantially confirmed by Claudon and Morin (Compt. Rend. **104**, 1187), who found the percentage composition of the same fusel oil to be as follows:—

	Claudon and Morin.	Ordonneau.
Propyl alcohol	11·9	11·7
Normal butyl alcohol	19·3	63·8
Iso-butyl alcohol	4·5	0·0
Amyl alcohol	34·4	24·5

The following proportions of various alcohols, &c. were obtained by Rabuteau (Compt. Rend. **87**, 501) from one litre of potato fusel oil:

	c.c.
Iso-propyl alcohol	150
Normal propyl alcohol	30
Iso-butyl alcohol	50
Normal butyl alcohol	65
Methyl-propyl carbinol	60
Iso-amyl alcohol	275
Products boiling above 132 and retaining amyl alcohol	170
Ethyl alcohol, aldehyde, and ethyl acetate	75
Water	125

Trimethyl carbinol also appears to have been present.

The fusel oil from Chicago, produced from a spirit derived from maize, with smaller quantities of other grains, has been examined by Long and Lindsay (American Jour. Anal. Chem. January 1890). The specific gravity of the water-saturated oil was 0·810 at 20° C. It was found impossible to dry it completely by anhydrous sulphate of copper, but a subsequent treatment for two hours at 40—50° C. with dry potassium carbonate removed the remainder of the water. Only a very inconsiderable portion of the oil boiled at a higher temperature than 132° C. It consisted in part of alcohols, and in part of bodies of an ethereal nature, the amounts of the latter being too small for identification. About three fourths of the sample consisted of a mixture of inactive and active amylic alcohols, with possibly some of the isomeric methyl-propyl-carbinol. Iso-butyl alcohol appeared to be present in next largest amount, and after that iso-propyl and ethyl alcohols, with traces of normal propyl and normal butyl alcohols.

From these results it is evident that fusel oil varies considerably in composition. This will be apparent also, on examination of the specimens before you, which include fusel oil from beetroot-spirit, potato-spirit, and from grain-spirit of Scotch and Irish manufacture. As already mentioned, fusel oil from pot-still whisky is not produced on a commercial scale, and probably has never been seen in quantities greater than would be extracted by a chemist in the laboratory; and as the proportion present does not exceed 0·1 per cent. the quantity isolated has been very small.

Many attempts have been made to estimate with tolerable accuracy the fusel oil in spirits. Of the physical processes, that of Röse, as modified by Herzfeld, is the one which has met with most favour. It consists in diluting the spirit until it contains 30 per cent. of alcohol by weight, and this must be done so exactly that the error is not more than ·01 per cent. in deficiency or excess. This is a degree of accuracy by no means easy to attain in practice. The spirit is agitated with chloroform, which increases in bulk, not simply in accordance with the amount of fusel oil it extracts from the spirit, but to a larger extent depending on the quality of the chloroform and other circumstances. The process is doubtless of use for the examination of crude spirits containing a notable proportion of impurities, but fails just at the point where it might give interesting results in the case of whisky and allied products. It is official in Switzerland, where its indications would lead to the condemnation of most pot-still whisky, even that of the finest quality, as having too large a proportion of matters extractable by chloroform.

Another physical method is based on the observation of the height to which the properly diluted spirit ascends a capillary tube.† I have been at some trouble to try this process without much success. The methods which seem really best for the determination of fusel oil are those based on the determination of the contained amylic alcohol, which can be effected with tolerable accuracy, if proper precautions be taken, by oxidising it to valeric acid and estimating the valeric acid formed. Substantially the process is based upon E. J. Chapman's well-known method of limited oxidation by chromic acid mixture. This oxidises amylic alcohol to valeric acid, butylic alcohol to butyric acid, and so on. The acids produced can be determined by ascertaining their neutralising power, or by converting them into and weighing their barium salts. A combination of the two methods enables the mean combining weight of the acids produced by the oxidation to be ascertained, and therefore an estimate to be formed of the proportion the amylic alcohol bears to the other constituents of the fusel oil. A process based on this principle appears to have been first applied to the purpose by Dupré, but his method of working has been greatly improved by Marquardt, who shakes the diluted alcohol with chloroform and then separates the chloroform and subjects that to the oxidation with chromic acid mixture under pressure. When the oxidation is complete the chloroform and aqueous liquid are distilled off and the distillate boiled with excess of carbonate of barium, the liquid filtered, evaporated, and the valerate of barium weighed. In practice, this process presents several inconveniences and sources of error. In the first place it is exceedingly difficult to obtain or purify chloroform so that it will not yield sufficient hydrochloric acid on oxidation to interfere with the estimation unless the mineral acid is estimated and allowed for. I have greatly improved the Marquardt process by substituting tetrachloride of carbon for the chloroform. This solvent has the advantage of boiling at a higher temperature, and hence obviating the necessity of oxidising under pressure, and is obtainable in a state of such purity

* There is good reason to believe that the higher alcohols are chiefly products of a secondary fermentation which is unobservable while the chief ferment is active, but proceeds with vigour during the last stages of the process.

† Traube's stalagmometer has improved by Elsworthy (Journ. Chem. Soc. **53**, 102).

Chief Constituents of Whisky and Fusel Oil.

Empirical Formula.	Name.	Constitutional Formula.	Specific Gravity.	Boiling Point.	Action of H_2SO_4 on Dilute Alcoholic Solution.	Products of Treatment with Caustic Alkali.	Products of Oxidation with Dilute Chromic Acid Mixture.
C_2H_6O	Ethyl alcohol	$CH_3.CH_2.OH$	$\frac{15{\cdot}5^\circ}{15{\cdot}5}$ = ·79384	78·4° C.	Not affected	Not affected	Acetic acid.
C_3H_8O	Normal propyl alcohol	$CH_3.CH_2.CH_2.OH$	$\frac{0^\circ}{4^\circ}$ = ·8198	98	Not affected		Propionic acid.
	Iso-propyl alcohol	$(CH_3)_2:CH.OH$	$\frac{15^\circ}{4^\circ}$ = ·791	83—84	Not affected		Acetone; then acetic and carbonic acids.
$C_4H_{10}O$	α-normal butyl alcohol	$CH_3.CH_2.CH_2.CH_2.OH$	$\frac{20^\circ}{4}$ = ·8096	117	Not affected		Normal butyric acid.
	β-iso-primary butyl alcohol	$(CH_3)_2:CH.CH_2.OH$	$\frac{20^\circ}{4}$ = ·8062	108—109	Strong coloration.		Isobutyric acid; then acetic and carbonic acids.
	Tertiary butyl alcohol	$(CH_3)_3:C.OH$	Melts at 25°	..	.. ..	Not affected	Acetic and carbonic acids.
$C_5H_{12}O$	α-normal primary amyl alcohol	$CH_3.CH_2.CH_2.CH_2.CH_2.OH$	$\frac{0^\circ}{0}$ = ·8282	137—138	.. ..		Normal valeric or pentoic acid.
	β-iso-primary amyl alcohol	$(CH_3)_2:CH.CH_2.CH_2.OH$	$\frac{0^\circ}{4^\circ}$ = ·8238	131·4	Coloration		Iso-valeric or pentoic acid (inactive).
	γ-iso-primary amyl alcohol	$(CH_3)(C_2H_5):CH.CH_2.OH$	·805	128	.. ..		Dextro-rotatory valeric acid.
	Methyl-propyl carbinol	$(CH_3)(C_3H_7):CH.OH$	·8293	119—120	.. ..		Methyl-propyl-ketone; then acetic and propionic acids.
$C_6H_{14}O$	Iso primary hexyl alcohol	$(CH_3)_2.CH.CH_2.CH_2.CH_2.OH$	$\frac{0^\circ}{4^\circ}$ ·8295	152—153	Strong coloration		Iso-caproic acid.
$C_7H_{16}O$	Iso-primary heptyl alcohol	$(CH_3)_2:CH.CH_2.CH_2.CH_2.CH_2.OH$	.. ..	163—165	Strong coloration		Iso-œnanthylic acid.
$C_2H_4O_2$	Acetic acid	$CH_3.CO.OH$	$\frac{16^\circ}{4}$ = 1·0543	118	Not affected	Acetate	Unchanged (acetic acid).
$C_4H_8O_2$	Ethyl acetate	$C_2H_5.C_2H_3O_2$	$\frac{0^\circ}{4^\circ}$ = ·9105	74·3	Not affected	Acetate and alcohol	Acetic acid.
$C_7H_{14}O_2$	Ethyl valerate	$C_2H_5.C_5H_9O_2$	$\frac{18^\circ}{4^\circ}$ = ·866	134·5	Not affected	Valerate and alcohol	Acetic and valeric acids.
$C_7H_{14}O_2$	Amyl acetate	$C_5H_{11}.C_2H_3O_2$	$\frac{0^\circ}{4^\circ}$ = ·8807	137	Coloration	Acetate and amylic alcohol	Valeric and acetic acids.
$C_{10}H_{20}O_2$	Amyl valerate	$C_5H_{11}.C_5H_9O_2$	$\frac{0^\circ}{4^\circ}$ = ·879	188	Coloration	Valerate and amylic alcohol	Valeric acid.
C_2H_4O	Aldehyde	$CH_3.CO.H$	$\frac{20^\circ}{4}$ = ·7799	21—22	Coloration	Resin, acetate, and alcohol	Acetic acid.
C_3H_6O	Acetone	$CH_3.CO.CH_3$	$\frac{18^\circ}{4^\circ}$ = ·8140	56·5	Not affected	Not readily affected	Acetic and carbonic acids.
$C_4H_{10}O_2$	Acetal (diethyl-aldehydate)	$CH_3.CH:(O.C_2H_5)_2$	$\frac{15^\circ}{15}$ = ·8319	104—106	Forms alcohol and aldehyde.	Not affected	Acetic acid.
$C_5H_4O_2$	Furfurol (furfuraldehyde)	$C_4H_3O.COH$	$\frac{15{\cdot}5^\circ}{2}$ = 1·1656	161	Strongly blackened	Pyromucate, furfuryl alcohol, and resinous products.	Pyromucic acid, $C_4H_3O.CO.OH$.
C_5H_5N	Pyridine	C_5H_5N	$\frac{0^\circ}{0}$ = ·9858	116·7	Forms pyridine sulphate.	Not affected	Not affected.

as to yield no mineral acid whatever on oxidation. The distillate can be titrated with standard baryta water, and the process therefore much shortened; while, if desired, the solution of valerate of barium can be evaporated and the salt weighed, from which can be deduced the combining weight of the acids. Working on pure amylic alcohol, the product obtained has very closely the combining weight of valeric acid, and the same is approximately true of fusel oil from which any ethylic alcohol has been removed by washing with water. There are some precautions which must be taken with the process to ensure accurate results, among which must be mentioned the use of chloride of sodium or other salt to ensure complete extraction of the amylic alcohol from the dilute spirituous liquid; but the details of the process I reserve for a future occasion. The oxidation method of estimating amylic alcohol gives results which are affected more or less by other foreign bodies. Alcohols do not materially affect the results, as they yield acids which are ultimately expressed in terms of valeric acid, and even the isomers which are converted by chromic acid mixture into products other than the corresponding primary acids do not cause such error as might be expected. Thus, for instance, isobutyl alcohol is oxidised first to isobutyric acid and subsequently to acetic and carbonic acids, but the acetic acid produced is exactly equivalent to the isobutyric acid from which it is derived, and hence by titrating the products of oxidation a correct result is obtained. Amylic acetate, on the other hand, will cause error by conversion into valeric and acetic acids, and hence will combine with twice as much baryta as the amylic radicle of the original ethereal salt. Again valerate of ethyl will show apparent valeric acid equal to twice the quantity really produced.

If the oxidation process of determining amylic alcohol be applied directly to a spirituous liquid containing ethereal salts, aldehyde, and furfurol, the apparent fusel oil will be gravely above the truth, for the acetate and valerate of ethyl will pass into the chloroform, and be subsequently estimated as undesirable fusel oil; whereby most erroneous conclusions may be arrived at. Furfurol will also vitiate the results. It follows that to obtain accurate results the spirit should, after distilling it to remove extractive matter, be boiled with alkali to saponify the ethereal salts and decompose the aldehyde and furfurol, and the distillate from this treatment extracted with chloroform or chloride of carbon before oxidation. Notably different results are obtained on the same samples of whisky when this modified process is adopted. I pointed out the necessity of the removal of ethers last summer when reviewing the evidence given by Dr. James Bell before the House of Commons on British and Foreign Spirits. It is probable that it is in great measure the omission of this precaution which has caused Dr. Bell to assert that the proportion of amylic alcohol in matured spirits is somewhat greater than in new. This anomalous conclusion is so opposed to chemical expectation and common experience that it is important to know that the methods of analysis on which it was based are open to exception. Besides oxidising in presence of the ethers and furfurol contained in the spirit, Dr. Bell used acid permanganate instead of chromic acid mixture. This alteration in Marquardt's process seems to me open to grave objection on several grounds, but I prefer to ascertain more fully how far the objections are well founded before discussing the matter further.

Among other constituents of ordinary spirits must be mentioned *aldehyde*, which may be supposed to result from the oxidation of ordinary alcohol. I am unable, however, to find that the process of ageing in casks affects very materially the proportion of aldehyde which we should suppose would be among the first constituents to oxidise. It seems probable that it is converted into acetic acid, and that this then forms acetate of ethyl. At any rate the aldehyde does not increase during the process of ageing, and the proportion of acetic and other acids in either new or matured whisky is very insignificant, amounting only to two or three grains per gallon.

There is one constituent of whisky apparently always present in the pot-still product, but absent from spirit manufactured with the patent still. This is *furfurol*, which can be detected with great facility, both in new and old spirit, by its reaction with a solution of aniline in glacial acetic acid, which produces a fine red colour. This reaction is much more delicate than that with strong sulphuric acid, which test is adopted by some chemists. In fact, the reaction with aniline acetate appears to be absolutely peculiar to furfurol, and enables it to be detected and the proportion roughly ascertained with great facility. The furfurol doubtless owes its origin, together with other pyrogenous products, to the action of the open fire on the contents of the still during the first distillation of the wash. There is more or less suspended matter always present in the wash, and, in fact, a mechanical stirrer is always kept in motion to prevent charring, which, however, is never entirely obviated, and hence the product of the pot-still contains furfurol and other products of the action of heat on cellulose and proteids.* Distinct traces of pyridine, collidine, and probably other bases have been found in spirits, and doubtless owe their origin to the same cause. The peat over which the malt is dried also contributes to the flavour of the whisky, and it is probable that a careful search would result in the detection of a distinct trace of phenoloid bodies. It should be borne in mind that addition of water causes a turbidity, due to the separation of oily globules, not only in the feints or last portions of spirit distilled, in which the furfurol and fusel oil become concentrated, but also in the foreshots, from which these products are presumably absent. I do not say they are absent altogether, for at the end of a period the head and worm of the still must necessarily retain more or less feints rich in fusel oil, and at the commencement of the next distillation these will pass over into the foreshots or first spirit distilled. So far very little is known of the actual composition of the oily matter precipitated from the foreshots on addition of water. We may expect it to contain the essential oil from the grain, and, not improbably, fatty acids produced from the fixed oil. Where soap is employed the composition will be further complicated. A partial examination of a sample of foreshot oil extracted by Mr. Ross, of Teaninich, showed that a considerable portion could be distilled, while the remaining part consisted largely of fatty acids which could be saponified by treatment with alkali. No soap was used in this still. The distilled portion was examined in my laboratory, and found to have a specific gravity of ·896; the free acid, in terms of oleic acid, was 23 per cent.; the unsaponifiable matter, 6·4; and there were also sensible quantities of ethers present. The liquid had a most intolerable odour, quite distinct from that of fusel oil.

I may say that the exact cause of the improvement in whisky, by maturing in casks, is by no means clearly made out. It is usually ascribed to oxidation and the formation of ethers. I have obtained some interesting evidence on these points, but prefer to reserve any comments for a future occasion. As to the question of the change in the proportion of amylic alcohol by ageing, I have certainly demonstrated, to my own satisfaction, that oxidation does occur, but I doubt if the improvement in flavour is due so much to that cause as to the change in more undefined constituents. One thing seems to be quite certain, and that is that the proportion of amylic alcohol, and even fusel oil in the widest sense, present in whisky, either new or old, is very trifling, and it is difficult to understand that it is capable of producing the injurious physiological effects attributed to it.

Up to June last a few results by Dupré, and one by Cameron, were apparently the only published figures showing the proportion of fusel oil in *whisky*. Chemists and others have been very ready to talk of "fusel oil" as

* Lindet (Compt. Rend. **111**, 236; and this Journal, **9**, 1155) has shown whenever the distillation of the spirit has been conducted over a naked fire (as in a pot-still), or whenever the wort has been treated with acid, furfurol is present in the distillate, the proportion in the former case ranging from 0·02 to 0·04 cc. per litre, and in the latter from 0·06 to 0·10 cc. A small quantity of furfurol (0·01 cc. per litre) was found when the conversion of the starch was effected by diastase, its production in this case being attributable to a preliminary lactic fermentation and the lactic acid acting in a similar manner to, though to a less extent than, the mineral acids. Spirit distilled by steam instead of over an open fire is free from furfurol unless produced by one of the above causes.

if its presence in considerable proportions in spirits was an ascertained fact, but scarcely anyone has taken the trouble to ascertain the amount. The following table shows the only estimations published up to the present time pretending to show the proportion of fusel oil in whisky. There are plenty of determinations in brandy, potato-spirit, and other foreign products, but whisky has apparently been left severely alone.

APPARENT AMYLIC ALCOHOL IN WHISKY.

Observer.	Date.	Description of Spirit.	Per 100 Parts of Proof Spirit.	Grains per Proof Gallon.
A. Dupré	1877	Scotch Whisky	0·095	66·5
		Cape Smoke	0·120	84·0
		Common "Samsho"	0·090	63·0
		Fine "Samsho"	0·065	45·5
Sir C. Cameron	1880	Potheen	0·184	128·8
A. H. Allen	1890	Irish whisky: Disputed sample	0·070	49·0
		Irish whisky: 1. (Typical specimens)	0·077	53·9
		Irish whisky: 2. (Typical specimens)	0·114	79·8
		Irish whisky: 3. (Typical specimens)	0·061	42·7
		Irish whisky: 4. (Typical specimens)	0·069	48·3
		Irish whisky: 5. (Typical specimens)	0·078	54·6
		Irish whisky: 6. New	0·087	60·9
		Irish whisky: 7. Old	0·080	56·0
		Scotch whisky: 1. New	0·085	59·5
		Scotch whisky: 2. Old	0·080	56·0
		Scotch whisky: 3. New	0·062	43·4
J. Bell	1890	Whisky: A. New	0·120	84·0
		Whisky: A. Old	0·140	98·0
		Whisky: B. New	0·090	63·0
		Whisky: B. Old	0·120	84·0
		Whisky: C. New	0·080	56·0
		Whisky: C. Old	0·140	98·0
		Whisky: D. New	0·060	42·0
		Whisky: D. Old	0·070	49·0
		Silent spirit: Native. New	0·027	18·9
		Silent spirit: Native. Old	0·027	18·9
		Silent spirit: Foreign (new)	0·009	6·3
Szilagyi	1890	Raw Hungarian spirits: Molasses	0·18	126
		Raw Hungarian spirits: Maize	0·11	77
		Raw Hungarian spirits: Maize and potatoes	0·18	126
		Raw Hungarian spirits: Potatoes	0·13	91
		Raw Hungarian spirits: Potatoes	0·16	112
		Raw Hungarian spirits: Turnips	0·39	273
		Raw Hungarian spirits: Turnips	0·42	294

It cannot be too clearly understood that the figures in the table represent the *apparent* fusel oil without the separation of the ethers and other interfering bodies, and not the actual true amylic alcohol, which would be materially lower.

I believe all the results by Dr. Bell and myself are gravely in excess of the truth, owing to the spirit not having been previously treated with alkali, which is a precaution I have taken in all my more recent experiments.

In this connexion I may mention that furfurol appears to undergo, by the action of dilute alkali, almost quantitative saponification, with formation of furfuryl alcohol, and pyromucic acid. *Acetal*, which is also a constituent of spirits, is not affected by dilute alkali, but is immediately decomposed by acids into aldehyde and alcohol. I have not been able to find any delicate test for its presence.

With regard to the sample described in the table as "disputed," I may mention that in 1889 a certain firm of Irish distillers supplied a cask of whisky to a customer. When the whisky was finished, the customer declined to pay for it, alleging that it had made him ill; and when sued brought a counter-action for damage to health owing to being supplied with whisky containing a "large percentage" of fusel oil. The case went into court, and I analysed the whisky at the request of the distillers. I obtained only ·07 per cent. of fusel oil. A chemist employed by the purchaser found 0·22 per cent. But we know that chemists, no less than judges, lawyers, and doctors, sometimes disagree; and so the judge, at my suggestion, instructed us to make a joint analysis, the result of which was that we agreed that ·07 per cent. was the correct figure.

My subject has gone beyond bounds. I have been at work on it for some months, and have a number of figures which I should have liked to have brought forward, but that they relate to a class of facts upon which I am bound to preserve silence until a future occasion. I may, however, in conclusion, direct your attention to a sample of whisky which I have here, and in which I am personally interested. It is a sample of some whisky which I have been taking every evening when at home for some time past, with a view of ascertaining whether it did me any harm. It contains 2 per cent. of added fusel oil, and yet I have not had even a headache through taking it. My friends say that that is because I have not taken enough of it. It is extremely nauseous, but it leaves no doubt in my mind that the effects of amylic alcohol, or whatever other substances there may be in fusel oil, have been absurdly exaggerated. I believe that the whole theory was trumped up by some alchemist about the year 1, and yet people have gone on making these statements while there was not a single figure or accurately observed fact to support them.

I have no doubt the amylic alcohol and other subsidiary constituents of spirituous liquids are of great importance with respect to the flavour and bouquet, but I have grave doubts of their physiological importance. It is worth remembering that taking the whole oxidisable substances present in whisky and calling them amylic alcohol, there is not more than one-tenth per cent., or say a drop in a wine glass, and hence any *local* effects, such as have been attributed to fusel oil, are more probably due to the ordinary alcohol than the minute quantity of amylic alcohol contained in it, whatever may be the case as to the effect on the system.

I am indebted to Mr. James Greenlees for the loan of the model and the diagrams which are before you, and to Mr. Wm. Chattaway, Dr. A. Colefax, and Mr. Chas. Harrison for extremely able and zealous assistance during the nine months we have been at work on this subject.

Discussion.

The Chairman said that the points raised by Mr. Allen were certainly contrary to the opinions generally held, and would, he thought, require confirmation.

Mr. J. A. Wanklyn said that for the last 15 or 20 years he had been of opinion that amylic alcohol had nothing to do with the injurious effects produced by whisky. He had long been of opinion that such effects were due to some exceedingly powerful essential oils; and he was pleased to find from Mr. Allen's paper that the subject had been investigated from that point of view, and that the opinion which he had held was now authoritatively confirmed.

Mr. W. Cobleigh Sawtle was glad to be able to corroborate the results of Mr. Allen's experiments, more especially with regard to the effects of fusel oil. He also had experimented by drinking for a month past spirits to which had been added various percentages of fusel oil, and had found no ill effects to result, except the nauseousness referred to by Mr. Allen.

Mr. C. F. Cross said that some investigations of his into the composition of the by-product known as "pot ale" having been alluded to by Mr. Allen, he would take the opportunity of calling attention to it in reference to its most characteristic constituent, lactic acid. There were present in addition peptones, carbohydrates and such inorganic constituents as potash and phosphoric acid; and the solution would appear, "on paper," to be susceptible of a further lactic fermentation. All attempts, however, to bring about such a result had failed.

He now had information from America of the establishment on the large scale of the manufacture of lactic acid by the fermentation of glucose. Mr. Waite, of Boston, informed him that he was able so to control the lactic fermentation that not more than 2 per cent. of the total acidity of the fermented liquors was due to other acids, and that he was producing a 33 per cent. acid at a cost of 2*d.* per pound. He (Mr. Cross) had suggested that "pot-ale" and similar by-products containing the necessary nutrient materials, in addition to a certain percentage of lactic acid, might be available in such a process, requiring only the addition of the glucose, and Mr. Waite was carrying out experiments in the direction of so utilising them.

There was no doubt a great field open for a lactic acid industry, its limited use hitherto having depended upon its limited production. As a substitute for acetic acid (and vinegar) in several of its applications, it would come largely into use, and it was already consumed in quantity in the States as a substitute for tartar in wool-dyeing. (See *Textile Record*, August—September 1890.)

Mr. A. P. Hoskins said that, assuming Mr. Allen's results to be correct, as he had no doubt they were, there was one point of very great interest to him, viz., that in the foreshots of the whisky no amylic alcohol was found. He had had in his custody for some time past a small quantity of a distillate, which he had not yet investigated chemically, but which corresponded to "foreshots" whisky. It was distilled not from whisky, but was the first running from distilled vinegar. It was old, and had been kept in a bottle, and judging by the smell it contained among other things amyl acetate and amyl alcohol. Why the amylic alcohol had come over so early he could not explain, but hoped to be able to do so shortly.

Mr. Greenlees, referring to Mr. Cross' remarks respecting the utilisation of "pot-ale," said that in the district of Campbeltown in Scotland, where there were 22 distilleries, "pot-ale" was largely used as a fertiliser. It was pumped up to the top of a hill, from whence it was allowed to run through furrows to the fields below; and its fertilising properties were so great as to add from 10*s.* to 20*s.* per acre to the value of the land on which it was used.

Dr. W. S. Squire said that in the manufacture of whisky in Great Britain there was practically no attempt at purification. As Mr. Allen had pointed out, in the manufacture of "pot-still" whisky no such thing was known as fusel oil. The first portions which came over, and which were nasty in flavour, went back again into the next distillation, and practically came into the better part of the whisky, since they never left the process. The manufacture of "pot-still" whisky was, therefore, simply the separation of water from the fermented wash, and the spirit did not profess to be rectified in any way, though no doubt some of the fusel oil was left in the spent wash. In the case of the Coffey still one would imagine at first blush that a considerable rectification of the spirit would occur, but it was chiefly rectified from the water point of view. [Dr. Squire here gave an illustration of the Coffey still, and of the method of carrying on the distillation therein.] So far, he said, from any rectification being effected in the patent still, nothing was taken out but water and fusel oil, all the more volatile bodies going back into the distillation. Patent still whisky was therefore far from being a pure substance. Fusel oil was by no means the only impurity it contained. Some time ago a sample of whisky of 1,000 litres was examined. It produced 997·968 litres of pure spirit, leaving a total impurity of two parts per thousand. (For the composition of this small proportion of impurities, see note, next page).

The quantity of fusel oil was therefore comparatively small; in fact, not one-third of the total impurities. He might mention that the separation of these bodies presented great difficulty. In the presence of water they were far from distilling in the order of the boiling points of the pure bodies, and it was therefore necessary to eliminate all the water before beginning to fractionate. The question thus arose as to what was the actual change that occurred in the maturing of spirits, if they were so impure as they came from the still. The nature of that change was still somewhat obscure. That the spirit improved if kept in wood was undoubted; that it did not improve in glass was equally undoubted. But that a process of oxidation went on was, he thought, doubtful; at any rate he had never seen any strong evidence in favour of it. Assuming acids to be present, no doubt a certain amount of etherification occurred, but probably the only constituent which would oxidise under such circumstances would be aldehyde, and from its great volatility that would be the first body to

escape by evaporation and be got out of the way. But there was a loss of weight, which was occasioned, he thought, by the more volatile constituents escaping and being volatilised through the pores of the cask, the less volatile constituents being left behind. By determining the fusel oil not directly on the original alcohol, but by first fractionating in considerable quantities so as to eliminate many of the other constituents, the results of his experience accorded with those of Dr. Bell, viz., that the oil did not diminish in the process of maturing, but that the other bodies disappeared to a large extent. He was of opinion, therefore, that the change which occurred was due in great measure to the evaporation of the more volatile constituents of the spirit. Another cause of improvement by ageing was the storing of the whisky in sherry casks, as was shown by the fact that if a sherry cask had been so used once and came back to be filled again, the second lot of whisky did not improve in the same degree as the first; while if new casks were used the improvement was still less. While, therefore, he could not give anything like a clear explanation of the cause of the maturing of whisky, he felt no doubt that, in the case of the Coffey still, if the more volatile products which came from the top of the still were not returned into the distillation, the maturing of the spirit would take much less time than it did at present. But distillers were extremely conservative people, and objected to all change. So difficult was it to get them to introduce any changes that in the case of a large Dublin distillery where a man was killed by the breaking of a crane rope which was used for the purpose of hauling up the grain, the distiller objected to adopt the recommendation of the jury that a chain should be used, on the ground that any alteration in the method of working would spoil his whisky.

Mr. Peter MacEwan, referring to Dr. Squire's statement that he agreed with Dr. Bell that fusel oil did not diminish in whisky during the process of ageing, wished to remind the meeting that Dr. Bell had expressly stated that what he regarded as "fusel oil" was not the so-called amylic alcohol, but the total amount of oxidisable matter in the whisky. The figures, which Mr. Allen had quoted, were, he understood, intended to represent the whole of the oxidisable matter that Dr. Bell had been able to extract expressed in terms of "fusel oil" or amylic alcohol. There was a great difference between Dr. Bell's results and those obtained by Mr. Allen. In the latter actual amylic alcohol had been extracted, oxidised, the amount determined as valeric acid, and expressed in terms of amylic alcohol. It was important to keep that in mind, because everything that had been said that evening pointed to the fact that the "quality" was not to be referred entirely to the small amount of amylic alcohol present, but to those other bodies which were undoubtedly also present. He also reminded the meeting that at the Paris Exhibition a complete series of the constituents of ordinary rectified spirit was shown, evidently based upon the analysis mentioned by Dr. Squire.* Every product was definitely named, as a reference to the periodical literature of the time would show.

Mr. Otto Hehner wished to ask the author one question in order to bring out the degree of accuracy which his estimations of the amounts of fusel oil could claim. Had the author ever made any synthetic experiments by adding to pure spirit known quantities of higher alcohols and ascertaining how much he could get back again? If in such test experiments the total quantity added could be accurately determined by the methods adopted by Mr. Allen, considerable confidence could be placed upon the figures obtained by the analysis of actual trade samples.

Dr. S. Rideal, in estimating fusel oil in spirits by the Rose-Herzfeld method, had found chloroform a most misleading body to work with, and would be glad to know therefore whether the author considered that it would be practicable to use tetrachloride of carbon instead of it. He would like to know also whether Mr. Allen had noticed any variation in the amount of fusel oil in whiskies of different districts. German investigators had come to the conclusion that the spirit produced in Saxony contained a greater quantity of fusel oil than that manufactured in other localities, and it would be interesting to ascertain whether that was due to the different quality of the malt used, or to the particular breed of yeast employed. He did not know whether any attempts had been made in this country or elsewhere to use pure yeast cultivations in the manufacture of whisky, as in the case of beer. But it seemed to him at least possible that the fusel oil difficulty might be overcome by using a pure yeast which would not produce fusel oil.

Mr. F. H. Perry Coste wished to mention a fact bearing upon Dr. Rideal's remarks, which bid fair to become a factor of great importance in the manufacture of alcoholic drinks. The author had referred to the fact that whisky of a different flavour was produced according as one employed a grape yeast or a beer yeast. A great deal of work had recently been done in that direction on the Continent, the result of which was to show that if the grape skins were sterilised so as to destroy the common organisms, and were then inoculated with a growth from the grapes used for the manufacture of special highly-flavoured wines, the effect was that the bouquet and flavour of the commoner wine were indistinguishable from those of the high-priced wines made from the special grapes. It would therefore appear that less importance attached to the material from which the beverage was made than to the cultivation of those special ferments which would impart to it any flavour which might be desired.

Mr. C. E. Cassal inquired whether the author was prepared, or hoped soon to be prepared, to give some working definitions of brandy, whisky, and other spirits of a more satisfactory character than those at present existing. Public analysts at present worked under considerable difficulties in consequence of the want of clear and sufficiently full definitions in regard to substances of that kind. He thought that he had caught some sort of new definition in the author's remarks in relation to brandy, but it would be most desirable if, as the result of his valuable work on the subject, he could give such extended definitions as would be satisfactory from a legal as well as a scientific point of view. There was a great tendency on the part of those who for various reasons were desirous of dealing severely with the sinning publican, to attack him on the ground that he distributed among a poor population an immense quantity of "poisonous" stuff, and when that common statement was analysed down, it was generally found to mean that he was a distributor of that ill-defined substance, "fusel oil." But it was becoming obvious that the popularly-accepted notions about this substance were erroneous. It might be, as Mr. Wanklyn had said, that there were special substances in spirit which, although in minute amount, might account for the peculiarly injurious effects which were not due to ethylic alcohol. But that also was a loose statement, liable to be misunderstood, and to be used with as little justice and accuracy as the fusel oil theory. He would like to ask Mr. Allen whether he had attempted to separate from any of the spirits with which he had dealt recognisable amounts of a pure amylic alcohol. This, while very difficult, if successfully carried out, was the

* The exhibit referred to was the property of M. Eugene Parion, and it was intended to show that by fractionation *Alcohol Brut* (that is dehydrated spirit before final purification) had the following composition per 1,000 litres :—

	cc.	
Alcohol (C_2H_6O)		997·968
Aldehyde (C_2H_4O)	110	
Acetone	5	
Acetic ether	60	
A body of sp. gr. ·872 and boiling point 73°—76° C.	10	
Propyl alcohol	345	
A body of sp. gr. ·809 and boiling point 101°—102° C.	250	
A body of sp. gr. ·808 and boiling point 109° C.	430	
Amylic alcohol	582	
		1·792
Other products		0·240
		1,000·000

(See *Chemist and Druggist*, October 5, 1889.)

only way of obviating the estimation of other substances as amylic alcohol, although it was perhaps hardly worth the trouble.

Mr. ALLEN, in reply, said that he was glad to have been able to make use that evening of a process which originated in part with Mr. Wanklyn, namely, the process of limited oxidation. He and Mr. Chapman were the first to work on the oxidation of ethers, and they now therefore had got a new application of that method which had for so long a time assisted their investigations. He was very glad to find that Mr. Samuel could confirm his opinion as to the innocuous character of fusel oil. It was far more probable that it was the whisky itself rather than the minute proportion of fusel oil which it contained that did the harm. Mr. Cross and himself were concerned some years ago in the investigation of "pot-ale," to which Mr. Cross had referred, and they preserved a lively recollection of the product.

With respect to the vinegar product mentioned by Mr. Hoskins, he would like to know its actual source, for he knew that some so-called "vinegar essence" was sold now which contained 80 per cent. of acetic acid flavoured with acetic ether, and was clearly a factitious product.

Mr. HOSKINS said that it was a real malt vinegar.

Mr. ALLEN, continuing, said that with regard to the observations which had fallen from Mr. Greenlees, it might be taken for granted that "pot-ale" contained a sufficient proportion of nitrogenous bodies, peptones, &c., to make its application to the soil beneficial. He believed that Mr. Coffey, jun., was present during Dr. Squire's remarks, and he regretted that they had not had the advantage of a few words from him. The Coffey still was wonderfully scientific, but its action would be more perfect if arrangements were made enabling one to take off the top products, as pointed out by Dr. Squire. They drove the process to an extreme, and therefore volatilised from the wash the whole of the amylic alcohol present; whereas in the "pot-still" the wash was never entirely exhausted of alcohol. Moreover, in the latter case, the process was conducted far more slowly, and the conditions being so different, it by no means followed that all the amylic alcohol passed into the whisky, some of it probably being left in the spent lees and pot-ale. Dr. Squire had had the advantage of working on much larger quantities than he had, and the investigations which he had described were extremely interesting, especially the fact that of the total impurities in 1,000 litres of whisky only one-fourth consisted of amylic alcohol. Hence, to oxidise all the extractable bodies together in chloroform solution was a faulty method of working, and one that should be avoided. He might remark that a new process for ascertaining the proportion of amylic alcohol had recently been proposed by Muller. It consisted in keeping back the aldehydes with aniline phosphate and treating the distillate with sulphuric acid, which gave a coloration which was supposed to correspond to the amylic alcohol or other higher alcohols present. He had tried the process and found it useless. Even with a proportion of 0·2 per cent. (which was ten times as much as they might have) the colour was indefinite. He therefore placed no confidence in that process at present. With regard to the statement about propylic alcohol, he was glad that Dr. Squire had isolated that body from whisky. The same thing had also been done in Germany. They were in the habit of thinking of amylic alcohol and butylic alcohol as present in spirits because they made themselves evident in the fusel oil, but the lower homologue was forgotten. Mr. Chapman had found it to be the most difficult of all known substances to dehydrate. A hydrate of propyl alcohol existed, which had practically the same boiling point as ethyl alcohol, and as the last trace of water would stick to the propylic alcohol and reduce its boiling point to that of ethyl alcohol, the separation of the two by fractional distillation was extremely difficult. No wonder, therefore, that one did not isolate it by that method, though conversion of the alcohols into the iodides or bromides, and fractionation of these was more promising. He himself had made some experiments to show the presence of propylic alcohol in spirits by a process suggested by Mr. Hehner, but he had not succeeded in finding any sensible quantity of propylic alcohol. That brought him to Mr. Hehner's question, as to whether he had verified the accuracy of the oxidation process. He had taken pure amylic alcohol, dissolved it in a large quantity of proof spirit, shaken the diluted liquid with chloroform or tetrachloride of carbon, and had got an amount of valeric acid equal to from 95 to 100 per cent. of the amylic alcohol originally taken. He had therefore no doubt of the accuracy of the process when carefully conducted, but, as already stated, he preferred tetrachloride of carbon to chloroform for several practical reasons. Dr. Rideal's suggestion as to use of chloride of carbon in Rose's process was a most interesting one, and he should like to try its effect. As to the proportion of fusel oil in the whisky produced in different districts he could give no information. The distillers who had been so kind as to supply him with samples would hardly thank him if he stated that their whisky happened to have two or three more grains of amylic alcohol per gallon than others. The question of flavour referred to by the next speaker was certainly interesting: and in connexion with it he might mention that malt-distillers regarded the water they used as an important factor in producing the characteristic flavour of their whisky. With regard to Mr. Cassal's remarks, a Parliamentary Committee was now sitting to decide, among other points relating to spirits, the question of definition. It was however very difficult to formulate an accurate and acceptable definition. He himself had proposed to define whisky as a spirit made from fermented grain (malted or unmalted) in a pot-still. But that definition excluded altogether the product of the patent still: and whether that was desirable remained to be seen. They could distinguish pot-still whisky by means of the furfurol test, but how were they to find the patent still whisky or silent spirit? It would be useless to have a definition if they could not make use of it.

Meeting held on Monday, April 6th, 1891.

MR. TYRER IN THE CHAIR.

ON THE VOLUMETRIC ESTIMATION OF ALUMINA.

BY G. LUNGE.

A PAPER bearing the above title has been read at the meeting of the London Section of the Society of Chemical Industry, on February 16th. From the first report which I got of that paper through the "Chemical Trade Journal" of February 28th, I saw that the authors, Messrs. Cross and Bevan, performed titrations before the meeting in order to show that the statements made by me were erroneous. To judge from the discussion as it is reported in the Journal of the Society itself, they seem to have succeeded, one gentleman going as far as to say that "the evidence brought before the meeting was, in his opinion, so conclusive that it admitted of no discussion." Other gentlemen present appear to have suggested as a cause of my erroneous conclusions that I was probably colour-blind, and could not distinguish the colour-change with methyl-orange.

I am sorry I cannot admit any defect as to colour vision, as I am really *not* colour-blind. I have now lectured for 15 years on colouring matters and dyeing, and I am considered a very fair judge of delicate tints. I have for 32 years worked in volumetric analysis, and I honestly believe that my accuracy and that of my co-operators may be regarded as unimpeachable in the working out of new specific gravity tables for sulphuric, hydrochloric, and nitric acid, where we ultimately attained to an accuracy of $\frac{1}{50000}$. Last, not least, the very indicator in question, methyl-orange, has been first introduced into science, and its uses have been worked out by myself. Thousands of

other titrations have been made by myself or under my eyes with that indicator, which owes its very name to me (formerly, when it was used as a dye, it was called by various partly misleading names). There is, thus, no excuse whatever for any blunder I may have committed in that direction on the score of colour-blindness. Moreover, all my assistants and co-operators must have been equally colour-blind, which is not a very likely assumption.

It may be said that Messrs. Cross and Bevan have *demonstrated* the correctness of their views by performing titrations in the presence of the meeting. But have they really done that? I think not, because actual proof can be afforded only by the most careful following up of the operations in the laboratory, from beginning to end, including the gravimetrical determinations. Nobody could have suspected from the outset that Messrs. Cross and Bevan did not obtain a change of colour at some point which seemed to them to prove the correctness of their views; and if they were wrong (as I believe they *are*), the fault must have been in some constant source of error, overlooked by them, and hence *repeated in their titrations before the meeting as well*. Where that fault may have been I can only guess, but if that guess, as I shall later on indicate, is wrong, that detracts nothing from the force of my own observations, since it cannot be my duty to point out possible sources of the error to which my critics were liable.

The impurity of some samples of methyl-orange found in commerce was also adduced by some of the speakers as a possible explanation of the discrepancy between our results; but there is really nothing in that. It is true that some of the methyl-orange of commerce is largely adulterated with dextrin or similar matters; but this does not in any way account for the above discrepancies as pointed out by Mr. Cross himself. My own methyl-orange was prepared in my own laboratory, and is a perfectly pure crystalline body; but the rather impure sample sent to me my Messrs. Cross and Bevan gave exactly the same results as my own; it was only necessary to employ a little more of the indicator.

As I was not present at the meeting, Messrs. Cross and Bevan could not be controverted by me, hence, probably, the audience were impressed by their contention. I desire, therefore, to justify the position I have taken now.

The controversy turns upon the point whether, in titrating alumina with methyl-orange a permanent pink shade appears when the ratio : 3 H_2SO_4 to 1 Al_2O_3, or rather, when the ratio : 5 H_2SO_4 to 2 Al_2O_3 is obtained, the latter being the contention of Messrs. Cross and Bevan.

That on titrating solutions of sodium aluminate, the point of saturation is reached when the proportion of 3 H_2SO_4 to 1 Al_2O_3 has been obtained, had been the general opinion before Messrs. Cross and Bevan published their paper. And that opinion was not a mere assumption, but the result of experimental investigation. The above-mentioned ratio has been found for methyl-orange by Mr. R. T. Thomson, whose work on indicators is acknowledged to be of the first order (Chem. News, **47**, 135). Exactly the same was found for tropaeoline, OO, by K. J. Bayer, whose paper was mentioned by Messrs. Cross and Bevan themselves in their first publication. They knew that paper only indirectly; had they seen the original (Zeits. f. Anal. Chem. 1885, 542) they would have found that his results accord with the above ratio. So did mine, obtained with methyl-orange, as published in the Zeits. f. angew. Chem. 1890, 227. Moreover, it has been frequently proposed to titrate any free acid present in commercial sulphate of alumina by means of standard alkali and methyl-orange, which would be clearly impossible if the last-mentioned indicator showed a change at the ratio 5 H_2SO_4 to 2 Al_2O_3. I must emphatically insist on the point that before Messrs. Cross and Bevan's paper there had been a *consensus omnium* as to the ratio 3 H_2SO_4 : 1 Al_2O_3.

It is true that those gentlemen allege that M. Blondel agreed with them, according to a foot-note in a French journal. But I have already, in private correspondence with them, proved that they are labouring under a mistake in that matter. M. Blondel did nothing but abstract the above-mentioned paper of Bayer's; that he made any observations of his own, that these observations were made with litmus and methyl-orange, and that they agreed with the ratio 5 : 2, is simply a gratuitous assumption not warranted by the journal in question. And even if it were true, it would be useless for our controversy, as certainly not a single analysis of Blondel's is quoted anywhere in figures.

As we must dismiss M. Blondel from consideration in our case, we come to the paper by Messrs. Cross and Bevan, published in the Journal of this Society, 1889, 253, in which there is just *one* line on the estimation of sodium aluminate, and *one* analysis bearing upon that matter which formed the subject of my short communication mentioned above, in which I overlooked that line and that analysis.

When I became aware of their paper, I at once set about going over the ground again, and, in order to eliminate any personal errors, I caused my demonstrator, Dr. Rey, to do the same without any bias whatever one way or another. Our results have been published in the Zeits. f. angew. Chem. 1890, 293. A solution of pure sodium aluminate was analysed both gravimetrically and volumetrically. By the first method we found 2·820—2·816; that is 2·818 grms. Al_2O_3 per litre. Volumetrically we consumed for 10 cc. solution in eight tests from 10·53 to 10·69, on the average 10·60 cc. of decinormal acid up to the point where phenolphtalein was decolourised, and in 14 tests from 27·10 to 27·7, on the average 27·19 cc. decinormal acid to the point where methyl-orange gave a *permanent* pinkish tint. Half of the tests were made with standard hydrochloric acid, the other half with standard sulphuric acid, as detailed in the original. Deducting 10·60 from 27·19, we obtain for alumina 16·59 cc. This, multiplied by the factor 0·0017, corresponding to the ratio 3 H_2SO_4 : 1 Al_2O_3, yields 2·8203 cc., which agrees very well indeed with the gravimetrical figure of 2·818. If we had applied Messrs. Cross and Bevan's factor = 0·00212, we should have obtained the impossible figure 3·517 for the alumina present.*

In the course of our work we found an important fact, subsequently completely confirmed by Professor Treadwell and Mr. Häuptli (see below). We observed that at the *ordinary* temperature the action of the acid was very slow. The pink colour appeared long before it was due, but it vanished again after a certain time; when more acid was added the same process repeated itself over and over again; but at last a point came when the pink colour remained permanently, and this point was evidently the end of the reaction. Especially when this was near it took sometimes half an hour or more after each addition to make sure whether the colour was permanent or not. As I noticed that this time was greatly lengthened on a day when the laboratory was badly heated, I tried the opposite measure, viz., heating the liquor to about 40° C. (not above this, because methyl-orange acts badly with hotter liquids), and I now found that at that temperature the process, formerly almost useless on account of its being so very tedious, was quite as expeditious as any ordinary titration. We therefore advised working a little above the ordinary temperature; but the final results are identical in both cases, if enough patience is employed.

Probably that is the explanation why Messrs. Cross and Bevan (as well as their co-operators) obtain erroneous results; they work at the ordinary temperature and they do not wait long enough for the pink shade to fade away again, and they are thus led to believe that the point of saturation comes earlier than it does in reality. Whether that is the case, or whether the error they commit is somewhere else, I cannot, of course, say with any degree of certainty.

My paper led to a somewhat extended correspondence between Messrs. Cross and Bevan and myself, and to fresh experiments on my part, which, however, did not bring my own and Dr. Rey's work nearer to that of Messrs. Cross and Bevan.

I will quote our new results (not yet published, but communicated to them). The same solution of sodium

* We employ the atomic weight 27·1, quoted as nearest the truth in Ostwald's standard treatise.

aluminate which we had employed before was again tested by Dr. Rey and myself, both of us checking all readings. But whilst formerly we had been working in the manner published in my former paper, viz., heating the liquid to about 40° C. and titrating it directly with standard acid till the first pinkish shade permanently remained (when working *in the cold*, this would take many hours, whilst at about 40° the titration could be made in a few minutes), we now operated as described by Messrs. Cross and Bevan, viz., adding a slight excess of standard acid and retitrating with caustic soda, both at the ordinary temperature. Our former experience had taught us that we should get entirely wrong results if we retitrated *at once*, and we therefore allowed the acidified liquid to stand for 24 hours before retitrating with caustic soda. The result was the same as before. Whilst the average of our former tests had been 10·60 cc. for phenolphthalein and 27·16 cc. for methyl orange, the new tests required 27·10, 27·10, 27·12, 27·18, that is exactly as before. In a further experiment we purposely retitrated *at once*, as Messrs. Cross and Bevan do, and consumed only 26·68; but this result was evidently wrong, for the alumina precipitated did not dissolve immediately, thus proving the incorrectness of that way of proceeding.

Even this result is far above that which Messrs. Cross and Bevan's theory would have required, viz., 21·37 cc., and I cannot but ascribe their low results to anything but chance errors repeating themselves in about the same manner owing to the same imperfection of manipulation.

A little later we received from Messrs. Cross and Bevan a sample of the methyl-orange used by themselves, and we went once more into the matter. We first repeated the gravimetrical estimation, and found exactly as much alumina in our solution as before, viz., in 10 cc. 0·1129 (formerly 0·1128) grm. Al_2O_3. On titrating 10 cc. of the same solution, 27·16 cc. decinormal acid was used, deducting 10·60 for the acid consumed with phenolphthalein, we have 16·56 for 10 or 66·24 for 10 cc., or, multiplied by 0·0017: 0·1126 Al_2O_3, exactly as much as by gravimetrical analysis, and again confirming *our* theory. We also made a gravimetrical analysis of the soda contained in our solution of sodium aluminate, and found this to agree exactly with the acid consumed in the phenolphthalein test; thus leaving no shade of doubt that the difference between the two titrations referred entirely to alumina, and that the methyl-orange indicated the point when the compound $Al_2(SO_4)_3$ had been formed.

Although I was (and am) positively sure that no mistake was possible in Dr. Rey's and my work, I could not but admit that any outsiders would accord equal credence to two such able chemists as my honourable antagonists in this controversy. It was clear that a third party would have to be called in as umpire. I therefore submitted the affair to Dr. Treadwell, professor of analytical chemistry and head of the analytical laboratory at the Zurich Polytechnic School, a former pupil of Bunsen's and Victor Meyer's (in company with whom he has published an excellent manual of qualitative analysis). Professor Treadwell has trained many hundreds of chemists in all the subtleties of analysis, and is daily working in that field with fullest assiduity; he is universally acknowledged to be a model of conscientiousness in his work, and I know of no analyst in Europe whose skill and carefulness were superior to his. Professor Treadwell at my request kindly consented to investigate the matter in an entirely independent manner, taking merely the published data into consideration. In order to exclude any chance of error on his part he associated himself with an advanced student of his, Mr. Hauptli, who worked under his eyes. Every single weighing was checked by both of them, and the titrations were performed by each of them independently many times over, and absolutely independently of myself. The following is a faithful translation of the report made to me, in which I have merely left out the details of weighings and titrations, not to make the matter too lengthy:—

A solution of sodium aluminate was made by dissolving 0·5182 grm. aluminium metal in about 9 grms. pure caustic soda made from sodium. The solution was filtered and diluted to 500 cc. 25 cc. was acidulated with HCl, evaporated to dryness, filtered from the silica, the alumina precipitated with ammonia and the soda estimated in the filtrate as NaCl. Results of two parallel analyses:—

			Mean.	Per Litre.
SiO_2	0·0005	0·0006	0·00055	0·022
Al_2O_3	0·0474	0·0476	0·0475	1·900
NaCl	0·6136	0·6130	0·6133	24·532
= NaOH				16·796

For the titrations 50 cc. of the above solution was diluted to 200, and 20 cc. (= 5 cc. of the original solution) taken for each test. The titrations were made with sulphuric and hydrochloric acids, both of them very nearly decinormal and exactly standardised, and the temperature was between 20° and 30° C., too much time being consumed when working at a lower temperature.

A.—Titrations with Sulphuric Acid.

	Phenolphthalein.	Methyl-Orange.
Treadwell	21·0	26·5
	21·0	26·52
	21·0	26·50
	21·0	26·5
	21·0	26·5
	21·0	26·48
Hauptli	21·0	26·5
	21·02	26·48
	21·03	26·49
	21·0	26·5
	21·0	26·51
	21·0	26·50 = 5·50 for Al_2O_3
Corrected		5·53

1,000 cc. hence contain 16·7577 NaOH.
1·8802 Al_2O_3 (factor 0·0017).

B.—Titrations with Hydrochloric Acid.

	Phenolphthalein.	Methyl-Orange.
Treadwell	20·90	26·50
	20·90	26·40
	20·80	26·40
Hauptli	20·93	26·42
	20·92	26·43
	20·93	26·43
Having for Al_2O_3		5·50

This corresponds to 16·727 NaOH
1·870 Al_2O_3 (factor 0·0017).

General result:—

	Found by Weight.	Titrating with H_2SO_4.	Titrating with HCl.
NaOH	16·796	16·758	16·727
Al_2O_3	1·900	1·880	1·870

This is altogether confirmatory of the factor 0·0017 used by *all* previous observers and by myself.

With Cross and Bevan's factor = 0·00212 the impossible figure 2·344 for Al_2O_3 would have come out.

Since in Treadwell and Hauptli's experiments the *soda* as well as the *alumina* were estimated gravimetrically, and since this estimation, as proved by the above figures, entirely agrees with the titration, it is impossible to assume any error in their volumetrical estimation of the soda which would have influenced that of the alumina. Their analyses therefore confirm the results of all previous observers, according to which the change in the colour of methyl-orange occurs when 3 H_2SO_4 has been used for 1 Al_2O_3, and they are a conclusive refutation of those of Messrs. Cross and Bevan.

I cannot imagine any other means for arriving at the truth; I believe that far more than sufficient evidence has now been collected in refutation of the conclusions of Messrs. Cross and Bevan, and I shall, therefore, not continue the controversy. If anybody still believes in the ratio of 5:2, I shall at any rate have done my part in preventing what I believe to be a wrong "fact" to creep into chemical literature.

At the conclusion of their paper Messrs. Cross and Bevan take exception to my statement that the silicate and aluminate present in commercial caustic soda "in well-nigh all practical cases acts like the hydrate."

This statement, they observe, practically amounts to saying that soda which is already combined with an acid is as capable of combining with other acids or bodies of an acid nature as the pure hydrate, and "this will indeed be news to the soap-maker and paper-maker." I for my part think better of the soap-maker and paper-maker than assuming, as my honourable opponents do, that perfectly well-known facts referring to his trade are indeed "news" to him. He *does* know that the term "available alkali" has *always* included the silicate and aluminate; he *does* know that the "acids" combined with soda in those compounds, viz., silica and alumina, are weaker than the weakest of ordinary acids, that is carbonic acid; he *does* know that, in consequence of this, silicate of soda approaches to and sometimes exceeds caustic soda in its action on fatty matters and other "scouring" properties, and that aluminate of soda is actually sold to soap-makers, who want to "fill" the soap with alumina, because the soda combined therewith will saponify their fats like the hydrate; he *does* know altogether that for all practical intents and purposes the fractions of a per cent. of silica and alumina present in commercial caustic do not in the least interfere with the use of the soda itself. Or if he is really ignorant of the above, he is not a very learned member of his trade, and he ought to know better. I am content to leave the judgment to third parties. *Minima non curat prætor*, and the silica and alumina in caustic soda *are* "*minima*."

Discussion.

Mr. E. J. Bevan said that it was not his intention to trouble the meeting at any great length. The matter at issue between themselves and Dr. Lunge had been more or less thrashed out in the various papers that had been read; and if any one who was interested in the subject, and had occasion to perform such an analysis as the estimation of alumina in presence of caustic soda, would be good enough to bear in mind the conflict of opinion that existed, they might try the experiment for themselves and see who was right and who wrong. That would amply satisfy himself and his colleague. With regard to Dr. Lunge's suggestion that there was something wrong with the methyl-orange, that, as had already been pointed out, could not be the case; for samples of the reagent had been exchanged, without any effect on the results obtained by themselves and Dr. Lunge respectively. It was only fair to point out, as Mr. Mumford had not mentioned it, that some of Dr. Lunge's results had been obtained at a higher temperature than that which Cross and Bevan employed. It was not relevant to the question to bring forward numbers obtained in that way, as it constituted an essentially different process. With regard to bringing in third parties to investigate the matter, they had got several third parties to make the examination. One of them was their own laboratory assistant, who had never performed such an operation before. They gave him the solution to titrate with phenolphthalein and methyl-orange, merely instructing him to add excess of acid and then titrate back again. They had similarly got Dr. Evans to confirm their results. It seemed absolutely impossible that independent observers should deliberately and wilfully hit upon such an extraordinary reaction as the one they had obtained if it had no foundation in fact. As he had said, the observation made by Prof. Lunge at a higher temperature, was irrelevant, but he might add that he had tried the experiment at the higher temperature and had got results similar to those obtained at the lower temperature. Still, in his opinion, Dr. Lunge should not have brought forward such numbers, because they might have given altogether different results. He would now leave those who were interested in the matter to read the various papers and decide who was in the right.

The Chairman said that it appeared to be a repetition of the old story of observers differing simply because the conditions differed. After all was not "temperature" at the bottom of this? When Prof. Lunge next visited England, he hoped that he would pay a visit to Messrs. Cross and Bevan's laboratory, and discuss the matter with them and a mutual scientific friend. The result could then be notified to the Society through the Section.

Note by Dr. Lunge.

Having received a proof of my paper, together with the discussion, I beg to point out that the higher temperature employed in some of my and Professor Treadwell's titrations does *not* make any difference in our contention. The results obtained at 30° to 40° are *identical* with those obtained at 15° C., but in the second case it is necessary to wait a long time before the colour changes are definitely pronounced, and the error may lie there.

Errata.

March number of this Journal, page 205, col. 1, line 14, *for* "silver, nitrate" *read* "silver nitrate."

Page 206, col. 1, par. 3, line 1, *for* "experimants" *read* "experiments."

Col. 2, Mr. Veley's second paper, par. 2, line 5 of that paragraph, *for* "pyrometer" *read* "pyknometer."

Ibid, footnote, *for* "hydroxybenzoic acid" *read* "hydroxybenzoic acids."

Liverpool Section.

UNIVERSITY COLLEGE, BROWNLOW STREET.

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Vice-Chairman: F. Hurter.
Committee:

J. Campbell Brown.	C. L. Higgins.
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W. D. Herman.	A. Watt.

Hon. Treasurer: W. P. Thompson.
Hon. Local Secretary:
Dr. Chas. A. Kohn, University College, Liverpool.

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

The names in italics are those of members of Committee who retire at the end of the current Session.

The following have been elected to fill the vacancies and will take office in July next:—*Chairman:* H. Brunner; *Vice-Chairman:* A. Norman Tate; *Committee:* E. Carey, V. C. Driffield, and J. Hutter.

Meeting held on Wednesday, April 1st, 1891.

MR. A. NORMAN TATE IN THE CHAIR.

THE SECTOR AND GREASE-SPOT PHOTOMETERS.

BY F. HURTER, PH.D.

Whilst paying a visit to Liverpool as judge of the Photographic Exhibition, Captain Abney kindly spent a few hours with Mr. Driffield and myself at Widnes. He inspected our instrument for measuring densities, and such other of our experimental work as we have exhibited before this Society. I shortly afterwards took advantage of an opportunity to pay a return visit to Captain Abney at South Kensington, and made some experiments with his own sector photometer. The results of both investigations I hasten to lay before the Society.

With respect to the experiments which Captain Abney made with our photometer at Widnes, they were confined to measurements of the densities of two plates, the mean densities of which were respectively 1·136 and 1·913. Three measurements were made of the first plate, and six of the second. Captain Abney's extreme readings, at as different parts of the scale as possible, differed by 2·57 per cent. in the first plate and by 3·6 per cent. in the second plate, *i.e.*, the instrument gave a mean value ± 1·8 per cent.

We have received a letter from Captain Abney, in which he bestows his unqualified praise upon our instrument, both for its handiness and for the consistency of its readings. In fact, there is only one point about which he now hesitates, and to which I shall presently refer.

The experiments made with the sector at South Kensington showed that, under the conditions as to speed of revolution, distance of screen from sector and lamp, &c., and within those limits between which it was tested, viz., with light intensities ranging from 1 to $\frac{1}{25}$, *the sector accurately agreed with the law of inverse squares of distance.*

Whilst we ourselves used the sector under conditions in which its errors are maxima, viz., with broad flames, and in very close proximity to the lamp and screen, Captain Abney uses the sector under conditions in which we have found that the error is very trifling, viz., with comparatively narrow flames, considerable distances between screen, sector, and lamp, and, more particularly, with a high number of revolutions. Captain Abney's sector has two openings, and makes upwards of 2,000 revolutions per minute, which is equal to a speed of 1,000 revolutions with a single opening, and if our diagram (this Journal, 10, 21) be referred to, it will be found that for this number of revolutions our own experiments show the sector to be almost accurate, even with broad flames and relatively small distances.

We should be extremely sorry if any of our remarks have in the smallest degree detracted from the value of any of Captain Abney's beautiful researches on colour. He was good enough to show me some of these experiments, and I quite agree with him in saying that the revolving sector is the only instrument which could possibly be used in these particular investigations.

After my experiments with Captain Abney's sector, we have no hesitation whatever in stating that, as he uses it, it is a perfectly trustworthy instrument, and it certainly is, as we always considered it, an extremely beautiful device for rapidly varying the intensity of a given beam of light.

There is no longer, therefore, any difference of opinion between Captain Abney and ourselves as to the correctness of our respective instruments, but the Captain is not yet satisfied that our photometer gives the true optical density. As we ourselves know that it does not, and never held that any one particular number could possibly represent the true density, we shall have no difficulty in arriving at an understanding on this point, and we have pledged our word to settle this one remaining difference experimentally in conjunction with Captain Abney, and without any further controversial publications. We designed our photometer with a view to making it a substitute for chemical analysis, in order that its readings should be proportional to the weight of silver deposited, rather than give the true optical density, which, for the purpose of our research, is so far of secondary importance, and our last paper on the relation between positive and negative clearly shows that the density, however expressed, will need different corrections for different printing operations.

FURTHER EXPERIMENTS ON THE INTRODUCTION OF HOME-GROWN SUGAR.

BY G. SCHACK-SOMMER, PH.D.

When I had the honour of coming before you 12 months ago it was for the purpose of describing the then results of my experiments, made with the object of introducing into this country, and into Ireland, the cultivation of beetroot with the object of sugar manufacture as is at present so largely carried on upon the Continent. From all sides I have received the warmest encouragement to go on with my experiments until they are carried to a practical issue. From all sides, that is to say with one exception, which you will admit has been a sufficiently remarkable one, the farmers of all people in the world, have, as a class, been indifferent or apathetic, though to this rule there have been some honourable exceptions. Generally speaking, however, they appear to have entirely failed to grasp any idea of the possibilities—nay, the certainties—of profit opened up by this new branch of agricultural industry. They are content to go on in the old stereotyped ways of their fathers as if the raising of a really profitable new crop was to them a matter of perfect indifference. This may be conservatism or it may be distrust of anything in the nature of experiment, but what is certain is that farmers on the Continent have every reason to be satisfied with a state of things which leaves them without British competition in a profitable industry in the carrying on of which they are much more independent of the kind of weather they have in a season than in the case of ordinary agricultural operations. Under such circumstances it is not, I think, too much to assume that English farmers do not possess the enterprise of their continental rivals, and one surprising evidence of this is supplied by the fact that I have not had an inquiry for seed or for any further particulars from a single farmer in England. From Ireland, on the contrary, I had over 50

applications, and in a lecture I gave in London to members of Parliament on the 12th of last June I was able to say that I had seed in more than 50 farms in about 20 counties in Ireland. This was in consequence of the "Weekly Freeman" having, with my permission, published an extract from my first lecture delivered here, and of an intimation that those who liked to make similar experiments to mine in 1889 could, by applying to me, obtain seed gratuitously.

The names of those who did apply and who got seed from me I forwarded to Messrs. Newlands Brothers, of London, with the very desirable object of having the evidence of an independent chemist with experience in the analysis of beetroot as to the quality of the roots. Messrs. Newlands Brothers sent a circular letter to all these farmers, acquainting them with this fact, yet in one case only they received a consignment of roots which were grown at Ballyteigue Castle, Kilmore Quay, county Wexford, and they sent me the results, which are as follows:—

An average sample taken from these 17 roots gave the following results:—

Specific gravity of juice at 60° F.	1·0745
Degrees by Brix saccharometer	18·02
Quantity of sugar in 100 parts	14·64
Quantity of non-sugar in 100 parts	3·38
Including mineral matter	1·03
Quotient of purity	81·24

Weight of the four roots with leaves:—

	Grms.
Average weight with leaves	1155
Without and trimmed	837·5
Weight of the largest with leaves	1410
Weight of the largest without and trimmed	1030
Weight of the smallest with leaves	1000
Weight of the smallest without and trimmed	714

Weight of the 13 roots without leaves, and trimmed in grammes:—

490, 540, 620, 680, 780, 840, 850, 870, 900, 930, 1050, 1140, 1220.

Average weight of the whole 17 roots trimmed 839 grms. (about 29 ozs.).

With the one exception of the results above, we received in the majority of cases no answer at all, and when we did, it was to the effect that if we, after supplying the seed gratuitously, would pay for the carriage of the roots to mine or Messrs. Newlands' laboratory, they would forward the required number. The proposal, in fact, was treated as if it was one in which I alone had a pecuniary interest, and as if the last thing in the world to interest farmers was the establishing of a new and profitable agricultural industry, even when others were disposed to go out of their way to take all the preliminary trouble off their hands beyond that of simply allowing the roots to grow on their farms. The British farmer in fact, with the prospects of agriculture at their lowest point of depression, did not seem to possess even that sort of gratitude which has been cynically defined by Rochefoucould as a lively expectation of favours to come.

The very few exceptions to this rule which I am able to name are the following. Before everybody else I have of course to name Mr. John Gibbons, who with his steward, Mr. McBride, has given me again this year invaluable help and assistance, and so has Mr. John Ennis, of Ballymitty, co. Wexford, Ireland, and the following gentlemen:—

Rathdown Union Workhouse (Mr. Jno. Conway, agriculturist), Loughlinstown, co. Dublin.

Mr. R. P. Gray, Spring Lodge, Athy, co. Kildare, Ireland.

Mr. J. H. McNaught, Modreeny House, Cloughjordan, co. Tipperary, Ireland.

Mr. W. Smith, Dodsbro', Lucan, co. Dublin, Ireland.

Mr. J. Costello, Graigue Lodge, Tuam, co. Galway, Ireland.

Mr. Jas. Watson, Rose Cottage, Portaferry, co. Down, Ireland.

Mr. J. C. Mayler, Harristown, co. Wexford, Ireland.

Mr. Jas. Kehoe, Moortown, co. Wexford, Ireland.

Mr. M. Byrne, Ballyknock, co. Wexford, Ireland.

Miss Richards, Ballymitty, co. Wexford, Ireland.

Mr. F. Keane, Listernan Farm, co. Mayo, Ireland.

Mr. Jno. Jack, steward, Pakenham Hall, Castlepollard, co. Westmeath, Ireland.

Mr. Mark White, Castletown, co. Wexford, Ireland.

Mr. Thomson Aikman, jun., Glasgow.

Mr. H. J. Mirehouse, St. George's Hill, Easton-in-Gordano, Bristol.

Mr. H. Halix, Henley, Surrey.

Mr. A. Dickson, c/o Mr. Morgan Mooney, Rogerson's Quay, Dublin, Ireland.

And I sincerely thank them for the liberal and enterprising spirit in which they have met me. I only hope that it will not be long before they are abundantly recompensed for any trouble or expense they may have been put to by the successful introduction of this beneficial solution of the agricultural problem of how to enable English and Irish farmers to make a living upon their holdings.

As bearing upon this I may remark incidentally that from the very best authorities on the Continent I have gathered the information that the immediate result of opening a beetroot factory in convenient proximity to the growers is to increase the value of land by one-third.

Before giving you the results of the experiments I made last summer permit me to indicate some of the points which have struck me as capable of further elucidation in my previous dealings with this subject. The first point to which I wish to direct your attention is that of the selection of seed, and I have no doubt you have wondered why I have not limited my experiments to one sort of seed. Though, however, you are members of the Liverpool Section of the Society of Chemical Industry, as I am myself, you are not agricultural chemists, and you will be surprised to hear that all the information I have been able to gather puts the technical chemist decidedly in the background so far as the development of the sugar industry on the Continent is concerned. In this the palm of merit must decidedly be given to the agricultural chemist, who, by incredible industry and inexhaustible patience, has managed to bring the saccharine strength of the beetroot as high as that of the best sugar-cane. I call upon you, therefore, my fellow labourers in this Section, to do honour to achievements which claim your admiration, even though you may regret your inability to grasp for yourselves the laurels of victory. As evidence of what has been done in France in the way of developing this cultivation, pray note the fact that while in 1881—82, the yield of sugar per hectare, a little over two acres, was 1 ton 14$\frac{1}{5}$ cwt., in 1885—86, it had risen to 2 tons 6$\frac{1}{5}$ cwt.; and 1889—90, to 3 tons 1$\frac{9}{10}$ cwt., an actual doubling of the production in the short space of 10 years. Pray note, too, that not only has there been an enormous increase in the saccharine strength of the French beetroot, but that this has been accompanied by great improvements in the machinery and manipulative processes of manufacture. For instance, in France in 1881—82, to manufacture one ton of sugar they used 17 tons 3$\frac{1}{10}$ cwt. of beetroot; in 1885—86, 11 tons 8$\frac{2}{10}$ cwt.; and in 1889—90, 8 tons 11$\frac{1}{5}$ cwt. I will give you the figures for each year so that you may more clearly appreciate the rate of progress:—

——	Average Quantity of Sugar produced per Hectare.	Average Quantity of Beetroot used to make 1 Ton of Sugar.
	Tons. Cwts.	Tons. Cwts.
1881—2	1 11$\frac{1}{5}$	17 3$\frac{1}{10}$
1882—3	1 15$\frac{1}{10}$	17 17$\frac{2}{10}$
1883—4	1 19$\frac{7}{10}$	16 5
1884—5	1 17$\frac{1}{2}$	15 0$\frac{4}{10}$
1885—6	2 6$\frac{1}{5}$	11 8$\frac{2}{10}$
1886—7	2 16$\frac{1}{2}$	10 3
1887—8	2 3	9 8$\frac{8}{10}$
1888—9	2 7$\frac{1}{5}$	9 4$\frac{7}{10}$
1889—90	3 1$\frac{9}{10}$	8 11$\frac{2}{10}$

These figures I have taken from the official figures published by the Government.

I will now endeavour to explain how they have proceeded on the Continent, in order to accomplish these amazing results. In doing this I need not go back to the original Silesian beetroot and others which are to-day only of historic interest, but will direct your attention to the well-known contemporary experts in beetroot cultivation, Messrs. Vilmorin, Andrieux & Co., of Paris, and Messrs. Rabbethge & Giesecke, in Klein Wanzleben near Magdeburg.

Before proceeding further, I may at this point read a letter which I have received from Messrs. Vilmorin, Andrieux & Co., of Paris, on the subject of the selection of seed:—

"Dr. Gustaf Schacks-Sommer,
"Liverpool.

"Dear Sir, "Paris, February 11th, 1891.

"We have read with great interest your pamphlet on the introduction of the sugar industry into the British Isles, and we are of opinion that it may be successful, as no climatal or economic conditions stand in the way of its development.

"Although the German beet seeds are of very good quality and widely used even in this country, we think that it is worth the while to experiment with the French strains, of which we should advise *three* as follows:—

"1st. Blanche amélioré Vilmorin.

"2nd. Rose trative. (Early red-skinned sugar-beet.) This, if inferior to the former variety in the proportion of sugar it contains, is remarkable in being the earliest of all known sugar-beets. The leaves become quite flat on the ground sooner than in most kinds, and the roots are ready for taking up about the middle of September.

"3rd. Français a collet rose. (Red top sugar-beet.)

"This last variety is nearly equal to rose trative in point of richness and the yield per acre would be a good deal heavier. The proportion of sugar would be about 25 per cent. below that of 'Amélioré Vilmorin," but the weight of roots per acre might be above the latter by one-third or even more.

"Now it is an important point to secure the co-operation of the farmers, and it might be no bad policy to try experiments with a variety that would give them a fair return in weight. The roots would be paid for more or less according to their industrial value, but we think the money return to the farmer would be rather higher with a large crop of roots of medium quality than with a fair crop of very rich beets.

"As no tax is put upon sugar in the United Kingdom, all the artificial conditions established on the Continent by the modes of levying the taxes and the premiums which result therefrom are unknown, and the variety can be chosen that gives best satisfaction to both grower and manufacturer."

In 1889 the roots grown from Klein Wanzleben seed succeeded best in my experiments, and this determined me to investigate on the spot the whole process of rearing the seed. Under the German fiscal system it has been to the advantage of the sugar manufacturer to grow a root as rich as possible in saccharine strength, and this led them to grow very small roots. The Klein Wanzleben people, however, were by no means satisfied with this arrangement, as they said that the farmer, being paid by weight, would obviously be a loser by only growing small rich roots. They therefore took the sensible way out of the difficulty, by directing their energies to the raising of a root that surpassed all others in the percentage of sugar per acre, thus meeting the demands of both the farmers and the manufacturers. Messrs. Rabbethge and Giesecke say that they have been rearing beetroot seed for 30 years, and that their plan is to select the mother-seed beetroots, by special methods, from the different families. In 1889-90, for instance, they tested 2,782,300 beetroots, from which they selected 3,043 roots, or equal to 0·1 per cent., for rearing purposes. It is claimed for the original Klein Wanzleben roots that they give the largest percentage of sugar per acre. I will give here the table published, and furnished to me, by Messrs. Otto Licht and Co., of the experiments of Professor Dr. Maercker, in Emmersleben, near Halberstadt, showing the comparative results of different kinds of seed for sugar beetroot.

Messrs. Otto Licht and Co. published figures in 1886 showing the results of experiments made by Professor Dr. Maercker in Emmersleben, near Halberstadt, showing strikingly the importance of the proper choice of seed.

Name.	Crop of Sugar Beetroot per Acre.	Sugar in the Beetroot.
	Tons. Cwt.	Per Cent.
Vilmorin original ...	11 5	16·3
Heine	13 2	17·0
Dippe	10 12	17·3
Schreiber	10 6	16·0
Wanzleben original ..	15 0	15·2
Heine	16 2	16·0
Dippe	14 2	16·3
Schreiber	15 12	14·9

His elaborate calculations, which take into account all costs, including the manufacture and farming, &c., show a net profit per acre for that year ranging from 6*l.* 12*s.* to 15*l.* 7*s.*, or a difference of 8*l.* 15*s.* In Germany that year 275,000 hectares (= 687,500 acres) were planted with sugar beetroot. Is it not amazing that even among these high class seeds the monetary difference for that Empire between the highest and the lowest would have amounted to 6,000,000*l.*, or for each factory, on a rough average, 15,000*l.*

It is the general custom in Germany that the manufactory supplies the farmers with the seed, and stipulates how they till, plant, and manure, or they put into their beetroot contracts a clause enabling them to refuse acceptance of roots which have a low saccharine strength, and paying higher prices for those that excel in this.

Another report by the same gentleman has been used by Messrs. Rabbethge and Giesecke in compiling a circular, which they have sent me, and where they show without doubt that all the sugar beetroots descending from the Klein Wanzleben root compare very favourably indeed with those descending from those of Mr. Vilmorin's rearing.

	A.—Sugar Beetroot descending from the Vilmorin Variety.	B.—Sugar Beetroot descending from the Klein Wanzleben Variety.
	Ctrs. Tons. Cwts.	Ctrs. Tons. Cwt.
Beetroot, per acre ...	242·37 = 12 2	301·62 = 15 2
Sugar per acre	38·47 = 1 18	15·45 = 2 5
Quantity of sugar in 100 parts of beetroot	Per Cent. 15·80	Per Cent. 15·06

After what has been said of the Klein Wanzleben root and its descendants, you will perhaps be surprised to hear that I am not at all certain that it is really the most suitable one for our English or the Irish climate. This is because it takes a rather longer time to get ripe than, for instance, the Vilmorin root, which has been reared in a cold soil and off cuttings. The difference between the two is almost six weeks; but then even the Vilmorin root can be prevented from ripening by being continually manured during the summer months with nitrate of sodium. This was the experience of a friend of mine who planted beetroot seed last summer in Cheshire, and who used too much artificial and stable manure, and who got small roots with enormous foliage, which yielded the following results on analysis:—

	Geo. Cox, Esq. Grown in his Garden.	
Date of Experiment	9th Sept. 1890.	15th Oct. 1890.
Number of beetroots drawn for experiment	2	1
Average weight with leaves, in grms.	1,247	..
Average weight without leaves, in grms.	269	..
Largest root with leaves in grms.	1,757	2,270
Largest root without leaves in grms.	340	620
Smallest root with leaves in grms.	737	..
Smallest root without leaves in grms.	198	..
Specific gravity of juice	..	1·044
Degrees by Brix saccharometer	..	..
Quantity of sugar in 100 parts ... Small	5·8	..
Quantity of sugar in 100 parts ... Large	6·0	6
Quantity of non-sugar in 100 parts	..	..
Quotient of purity	..	..

This is a very singular property of nitrate that it keeps the roots from ripening, and, as I have said before, lime, phosphoric acid, and nitrate are very useful and essential manures for the beetroot, but they must neither be applied in too large quantities nor at the wrong time.

Some friends of mine, who are great authorities on this question, wrote to me last year after the publication of my paper that they thought I had recommended a too great proportion of phosphoric acid, and that they thought that one of phosphoric acid to one of nitrate would be nearer the mark. Whereas my proportions were two parts of phosphoric acid to one of nitrate.

Here I may as well mention how the beetroots are chosen for rearing purposes. Every well-shaped and proper sized root is tapped with a narrow scoop similar to that used in taking a sample of cheese. The piece drawn is put in a glass filled with a salt solution of a density of from 16 to 18° by Brix saccharometer. If the piece sinks, the root is deemed worthy of further trials, if not it is placed along with others that are to go through the ordinary processes of manufacture. Before being chosen for planting out again in the following summer, two more pieces are bored out, and one water and one alcohol extraction and the usual polarisation made. With reference to my experiments last year I must premise that Mr. Licht recommended me to try—without, of course, discarding the roots with which I had been so successful on previous occasions—Vilmorin Nachzucht, and to compare the results with Vilmorin original, using each in equal proportions, to the extent of 30 lb. per acre. I am going to follow his advice, and have written to Messrs. Vilmorin, Andrieux, and Co., for seed, which they most generously furnished me with gratuitously and also wrote the letter which I have already partly read to you. This Vilmorin Nachzucht was reared by planting Klein Wanzleben and Vilmorin beetroot for seed rearing purposes side by side, and then after fructuation had taken place pulling the Vilmorin beetroots out.

Now I beg to lay before you the results of this year's experiments, and to say of the results I obtained that, as regards any comparison with Licht's reports, his roots were ripe while mine were not. The point to be determined is which root will ripen soonest, and it is with reference to this that the improved Vilmorin root must be considered.

Result of this Year's Experiments.

	F. O. Licht.	Wavertree, Grown at Dunbabin Farm. (Marquis of Salisbury's Estate) by Mr. Jno. Gibbons.				Mr. H. J. Mirehouse Bristol.
Date of experiment	18th Sept. 1890.	18th Sept. 1890.				18th Sept. 1890.
		No. 1 Seed.	No. 2 Seed.	No. 3 Seed.	No. 4 Seed.	
		Rich Clay Loam on Red Sandstone.				
Number of beetroots drawn for experiment	108	10	10	10	10	2
Average weight with leaves, in grms.	854	1,224	1,377	1,102	1,150	1,260
Average weight without leaves, in grms.	461	492	534	482	538	855
Largest root, with leaves, in grms.	1,600	1,800	1,820	1,550	1,800	1,610
Largest root, without leaves, in grms.	1,050	800	750	750	840	1,100
Smallest root, with leaves, in grms.	420	900	1,050	700	900	910
Smallest root, without leaves, in grms.	180	270	350	200	270	610
Specific gravity of juice	1·0719	1·059	1·056	1·0563	1·0552	..
Degrees by Brix saccharometer	18·1	14·7	13·7	13·9	13·4	17·2
Quantity of sugar in 100 parts	15·23	11·8	10·3	10·5	10·1	14·7
Quantity of non-sugar in 100 parts	2·87	2·9	3·4	3·4	3·3	2·5
Quotient of purity	84·1	80·3	75·2	75·5	75·3	85·5

This year my experiments were less satisfactory as far as saccharine strength was concerned in consequence of the dampness and coldness of the weather, but in weight you see I beat Mr. Licht's figures, as I did in saccharine strength last year.

I got a heavier root several degrees less in saccharine strength than Licht's. In roots drawn on the 9th of October he got 16·47 per cent. of saccharine strength when I got only about from 13·0 to 14·06 per cent., and on the 24th of October, the last day I tested the root only contained 15·02 per cent. The average weight, in Licht's case, was 842 grms. with leaves and 478 grms. without, while mine were from over 1,000 and as high as 1,795 grms., with leaves, and without, 942 grms. In Ireland, on Mr.

RESULT OF THIS YEAR'S EXPERIMENTS—*continued*.

	F.C. Licht.	Wavertree, Grown at Dunbabin Farm (Marquis of Salisbury's Estate) by Mr. Jno. Gibbons.				The Rathdown Union Workhouse, Loughlinstown, co. Dublin, Mr. Jno. Conway.			
Date of experiment	25th Sept. 1890.	25th Sept. 1890.				25th Sept. 1890.			
		No. 1 Seed.	No. 2 Seed.	No. 3 Seed.	No. 4 Seed.	No. 1 Seed.	No. 2 Seed.	No. 3 Seed.	No. 4 Seed.
		Rich Clay Loam on Red Sandstone.				Clay Loam, Yellow Clay Subsoil.			
Number of beetroots drawn for experiment	94	10	11	10	10	10	11	10	10
Average weight with leaves, in grms.	851	1,160	1,120	1,177	1,186	..	..	..	..
Average weight without leaves, in grms.	466	412	437	426	471	832	693	1,069	1,010
Largest root with leaves, in grms.	1,670	1,650	1,620	1,720	1,500	..	..	..	..
Largest root without leaves, in grms.	1,060	540	610	510	760	1,070	1,100	1·720	1,570
Smallest root with leaves, in grms.	430	750	810	880	720	..	..	..	..
Smallest root without leaves, in grms.	190	300	310	330	280	500	380	540	570
Specific gravity of juice	1·0789	1·06388	1·06144	1·06576	1·06596	1·06261	1·059	1·0544	1·0498
Degrees by Brix saccharometer	19·0	14·9	15·1	14·2	14·9	15·5	14·5	13·2	12·4
Quantity of sugar in 100 parts	16·04	12·4	12·7	11·8	12·2	12·5	11·0	9·7	8·8
Quantity of non-sugar in 100 parts	2·96	2·5	2·4	2·4	2·7	3·0	3·5	3·5	3·6
Quotient of purity	84·4	83·2	84·1	83·1	81·9	80·6	75·8	73·4	71·0

	Mr. R. P. Gray, Spring Lodge, Athy, co. Kildare.	Mr. Ennis, Springwood, Ballynatty, Wexford.	Mr. J. G. McNaught, Modreeny House, Cloughjordan, co. Tipperary.	Mr. W. Smith, Dodsboro' Lucan, co. Dublin.
Date of experiment	25th Sept. 1890.	25th Sept. 1890.	25th Sept. 1890.	25th Sept. 1890.
	No. 4 Seed.	Nos. 1, 2, 3, and 4 Seed mixed.	No. 4 Seed.	No. 3 Seed.
	Light Loam Soil.	Reddish Shingley Soil.	Clayey Loam, Limestone Concrete Subsoil.	Rich Soil.
Number of beetroots drawn for experiment	10	10	10	8
Average weight with leaves, in grms.	1,488	1,662	1,260	468
Average weight without leaves, in grms.	564	961	723	214
Largest root with leaves, in grms.	2,300	2,170	1,700	670
Largest root without leaves, in grms.	730	1,430	830	280
Smallest root with leaves, in grms.	970	1,000	920	240
Smallest root without leaves, in grms.	260	760	580	130
Specific gravity of juice	1·0602	1·0563	1·0558	1·0585
Degrees by Brix saccharometer	14·8	14·0	13·8	14·6
Quantity of sugar in 100 parts	11·8	11·0	10·6	11·7
Quantity of non-sugar in 100 parts	3·0	3·0	3·2	2·9
Quotient of purity	80·0	78·5	76·8	80·1

Byrne's estate, Ballyknock, Ballymitty, co. Wexford, we got a quotient of purity, in spite of the big root, above that of Licht at the same date.

The process of manufacture is as follows: The beetroots of which the tops have been cut off are brought to the yard of the factory where they are thrown into a trough in which water is running, through which they are propelled by an endless screw towards the factory. This is for the purpose of removing the dirt which is sometimes fully as much as one-third of the actual weight of the beetroot, and even as high as 40 to 50 per cent. Having reached the factory the root is cut up by special machinery called beetroot-slicers. The pieces, cork-screw like in form, are then brought into one of the vessels of the diffusion battery where the sugar is extracted gradually by more or less concentrated solutions of luke-warm liquor from the other vessels of the battery, which generally consists of 12 vessels. The slices which have been thus treated, and which are then supposed to be

RESULT OF THIS YEAR'S EXPERIMENTS—*continued*.

	Mr. J. Costello, Graigue Lodge, Tuam, co. Galway.		Mr. Jas. Watson, Rose Cottage, Portaferry, co. Down.	Mr. J. C. Mayler, Harristown, Ballymitty, co. Wexford.
Date of experiment	25th Sept. 1890.		25th Sept. 1890.	25th Sept. 1890.
	No. 2 Seed.	No. 2 Seed.	No. 1 Seed.	Nos. 1, 2, 3, and 4 Seeds mixed.
	Good Light Warm Soil, Sandy Subsoil.	Good Clay Soil, Heavy Subsoil.	Light Gravelly Soil.	Light Soil.
Number of beetroots drawn for experiment	5	5	10	10
Average weight with leaves, in grms.	1,134	1,092	1,590	1,516
Average weight without leaves, in grms.	428	407	743	1,100
Largest root with leaves, in grms.	1,850	1,620	1,950	2,070
Largest root without leaves, in grms.	840	620	900	1,640
Smallest root with leaves, in grms.	450	230	1,260	1,250
Smallest root without leaves, in grms.	160	65	510	820
Specific gravity of juice	1·0518	1·0577	1·0663	1·067
Degrees by Brix saccharometer	12·7	14·1	16·3	16·5
Quantity of sugar in 100 parts	9·5	11·2	13·3	13·5
Quantity of non-sugar in 100 parts	3·2	2·9	3·0	3·0
Quotient of purity	74·8	79·4	81·6	81·8

	Mr. H. Halix, From a Field at Henley, Surrey.	Mr. Gibbon's Farm, Bickerstaffe, Lancashire.			
Date of experiment	30th Sept. 1890.	3rd Oct. 1890.			
	Probably "Vilmorin" Seed.	No. 1 Seed.	No. 2 Seed.	No. 3 Seed.	No. 4 Seed.
		Sandy Loam with a Clay Subsoil.			
Number of beetroots drawn for experiment	3	11	12	12	12
Average weight with leaves, in grms.	.. .. ..	1,195	1,130	1,093	1,111
Average weight without leaves, in grms.	810	433	534	523	496
Largest root with leaves, in grms.	.. .. ..	1,860	1,650	1,600	1,900
Largest root without leaves, in grms.	1,000	620	880	760	1,000
Smallest root with leaves, in grms.	.. .. ..	800	650	680	760
Smallest root without leaves, in grms.	620	340	340	290	290
Specific gravity of juice	1·0562	1·0678	1·0641	1·06572	1·0636
Degrees by Brix saccharometer	13·9	16·5	15·7	16·2	15·6
Quantity of sugar in 100 parts	11·0	13·8	13·1	13·2	13·0
Quantity of non-sugar in 100 parts	2·9	2·7	2·6	3·0	2·6
Quotient of purity	79·1	83·6	83·4	81·5	83·3

free from sugar, are squeezed through a conical-shaped patent press to extract the remaining moisture, and the residue is either fermented in the silos or dried by one of the numerous patent drying apparatus to make food for cattle. The saccharine extract is treated three times, twice with lime and carbonic acid and once with lime and sulphurous acid in order to remove both salts and colouring matter. In the present day animal charcoal is scarcely used at all in a beetroot manufactory. The products of these three treatments are gathered through filter presses and the clear bright juice which is the final result of the process is boiled in a common vacuum pan to the point of crystallisation, which takes place in small wrought iron movable tanks, with the result of getting as a first product as much as 11·7 per cent. of the weight of the beetroot according to the figures furnished me from Klein Wanzleben. The crystallisation takes places in small square tanks larger at the top than the bottom and from these the centrifugal hydro-

RESULT OF THIS YEAR'S EXPERIMENTS—*continued.*

	F.O. Light.	Wavertree. Grown at Dunbabin Farm by Mr. Jno. Gibbons.				The Rathdown Union Workhouse, Loughlinstown, co. Dublin. Mr. Jno. Conway.			
Date of experiment	9th Oct. 1890.	9th October 1890.				9th October 1890.			
		No. 1 Seed.	No. 2 Seed.	No. 3 Seed.	No. 4 Seed.	No. 1 Seed.	No. 2 Seed.	No. 3 Seed.	No. 4 Seed.
		Rich Clay Loam on Red Sandstone.				Clay Loam, Yellow Clay Subsoil.			
Number of beetroots drawn for experiment.	106	10	10	10	10	10	10	10	10
Average weight with leaves, in grms.	842	1,268	969	1,098	1,061	1,276	1,502	1,447	1,261
Average weight without leaves, in grms.	478	511	400	503	381	579	849	836	710
Largest root with leaves, in grms.	1,680	2,900	1,250	1,400	1,400	1,900	2,010	1,980	1,550
Largest root without leaves, in grms.	1,150	1,170	560	650	600	790	1,290	1,250	1,090
Smallest root with leaves, in grms.	450	800	730	550	700	850	950	1,060	840
Smallest root without leaves, in grms.	200	300	300	270	230	330	550	430	370
Specific gravity of juice	1·0811	1·0668	1·0639	1·0617	1·0649	1·0654	1·0561	1·0582	1·06508
Degrees by Brix saccharometer	19·5	16·2	15·5	15·0	15·9	16·0	13·8	14·3	15·9
Quantity of sugar in 100 parts	16·47	13·0	13·3	12·8	13·7	13·0	10·0	11·2	12·2
Quantity of non-sugar in 100 parts	3·03	3·2	2·2	2·2	2·2	3·0	3·8	3·1	3·7
Quotient of purity	84·5	80·3	85·8	85·3	86·2	81·3	72·5	78·3	76·7

	Mr. R. P. Gray, Spring Lodge, Athy, co. Kildare.	Mr. J. G. McNaught Modreeny House, Cloughjordan, co. Tipperary.	Mr. Jas. Kehoe, Moortown, Ballymitty, Wexford.	Mr. Ennis, Springwood, Ballymitty, Wexford.
Date of experiment	9th October 1890.	9th October 1890.	9th October 1890.	9th October 1890.
	No. 1 Seed.	No. 4 Seed.	——	Nos. 1, 2, 3, and 4 Seeds, Mixed.
	Light Loam Soil.	Clayey Loam, Limestone Concrete Subsoil.	Loose Marshy Soil.	Reddish Shingley Soil.
Number of beetroots drawn for experiment.	11	10	10	10
Average weight with leaves, in grms.	1,305	1,364	1,605	1,334
Average weight without leaves, in grms.	575	809	861	741
Largest root with leaves, in grms.	1,730	1,620	2,700	1,920
Largest root without leaves, in grms.	770	920	1,480	1,000
Smallest root with leaves, in grms.	830	1,080	740	350
Smallest root without leaves, in grms.	340	630	410	180
Specific gravity of juice	1·0648	1·0593	1·0547	1·05892
Degrees by Brix saccharometer	16·0	14·5	13·5	14·5
Quantity of sugar in 100 parts	13·0	11·9	10·2	11·4
Quantity of non-sugar in 100 parts	3·0	2·9	3·3	3·1
Quotient of purity	81·3	82·1	75·6	78·6

extractors turn out the sugar ready for the market. The process, as you see, is a very simple one, and the expenses connected with it are very small indeed.

Of general interest will be the comparative cost of 1 cwt. of sugar made in Germany and in France in 1889–90, a statement I found in Mr. Herbertz's excellent paper "Die Deutsche Zuckerindustrie," No. 2, 1891, and I recommend those who want full particulars to look them up there. He assumes in both cases that 1 m. 10 pf. is paid per cwt. of beetroot.—

	In Germany.		In France.	
		M. pf.		M. pf.
Cost of beetroot	(1 m. 10 pf. × 7·95) =	8 74	(1 m. 10 pf. × 8·56) =	9 41
Cost of fuel	=	1 52	=	1 41
Cost of labour	=	0 58	=	0 81
		10 84		11 63

RESULTS OF THIS YEAR'S EXPERIMENTS—*continued.*

	Mr. M. Byrne, Ballyknock, Wexford.	Miss Richards, Ballymitty, Wexford.	Mr. W. Smith, Dodsboro', Lucan, co. Dublin.	Mr. Francis Keane, Listernan Farm, co. Mayo.	Mr. J. Jack, Steward Pakenham Hall, Castlepollard, co. Westmeath.
Date of experiment	9th Oct. 1890.	9th Oct. 1890.	9th Oct. 1890.	9th Oct. 1890.	9th Oct. 1890.
	—	—	No. 3 Seed.	—	No. 2 Seed.
	Deep free Soil.	—	Rich Soil.	Peaty Gravelly Soil	Newly reclaimed Moor or Waste Land Four Years ago.
Number of beetroots drawn for experiment	10	10	12	10	10
Average weight with leaves, in grms.	1,349	1,795	333	.. ..	1,960
Average weight without leaves, in grms.	718	962	158	182	878
Largest root with leaves, in grms.	2,150	2,300	530	.. .	2,600
Largest root without leaves, in grms.	1,350	1,380	310	700	1,550
Smallest root with leaves, in grms.	450	1,400	240	.. ..	1,280
Smallest root without leaves, in grms.	180	590	90	320	520
Specific gravity of juice	1·07064	1·0648	1·0613	1·0627	1·0501
Degrees by Brix saccharometer	17·2	15·9	15·1	15·3	12·4
Quantity of sugar in 100 parts	14·6	13·2	12·4	12·8	8·2
Quantity of non-sugar in 100 parts	2·6	2·7	2·7	3·5	4·2
Quotient of purity	84·9	83·0	82·1	83·7	66·1

	Mr. Mark White, Castletown, Wexford.	Mr. Jno. Gibbons, Dunlabbie Farm, Waverfree.				Mr. Thos. Grant, Ballyteigue Castle, Kilmore Quay, co. Wexford.	Mr. Thomson Aikman, jun., Glasgow.		
Date of experiment	9th October 1890.	24th October 1890.				6th November 1890.	—		
		No. 1 Seed.	No. 2 Seed.	No. 3 Seed.	No. 4 Seed				
	Medium, rather Light Soil.	Rich Clay Loam on Red Sandstone.				Analysed by Newlands Brothers.			
Number of beetroots drawn for experiment	10	10	10	11	10	4	4	2	2
Average weight with leaves, in grms.	2,130	935	790	704	785	1,155	..	..	..
Average weight without leaves, in grms.	1,005	137	386	385	121	838	183	125	340
Largest root with leaves, in grms.	4,020	1,250	1,110	1,490	1,200	1,110	..	..	..
Largest root without leaves, in grms.	1,710	590	560	900	740	1,030	690	610	460
Smallest root with leaves, in grms.	920	700	580	490	540	1,000	..	..	..
Smallest root without leaves, in grms.	390	330	240	290	320	714	125	240	160
Specific gravity of juice	1·0652	1·0757	1·0678	1·0664	1·0658	1·0715	..	..	..
Degrees by Brix saccharometer	15·8	18·2	16·3	16·2	16·0	18·02	14·0	..	..
Quantity of sugar in 100 parts	12·3	15·2	14·0	13·9	13·6	14·64	11·2	11·7	13·3
Quantity of non-sugar in 100 parts	3·5	3·0	2·3	2·3	2·4	3·38	2·8	..	..
Quotient of purity	77·8	83·5	85·9	85·8	85·0	81·24	80·0	..	..

Or an advantage to Germany of 79 pf. or 9*d.* per cwt. of sugar.

According to calculations I have made the cost of a beetroot sugar factory in this country, including the purchase of site, cost of buildings and machinery, allowing for contingencies, and providing working capital, would be in round numbers about 58,000*l.* The gross annual profits for 70 working days on 30,000 tons of roots would be 43,734*l.*, and the net profit would be 4,495*l.*, or $7\frac{3}{4}$ per cent. on the capital of 58,000*l.* This $7\frac{3}{4}$ per cent., which is a very low estimate indeed, for I have valued the first product at 12*s.*, the second and third product at 10*s.*, and the molasses at 3*s.* per cwt., is the profit of making sugar out of beetroot, and the profit I mentioned in my paper last year, that is, 5*l.* 15*s.* 6*d.* per acre, and which, according to Professor Dr. Maercker and Messrs. Rabbethge and Giesecke's figures was from 6*l.* 12*s.* up to 15*l.* 7*s.* per acre is quite separate. Here I may point out that in Germany

the sugar beetroot industry has had most beneficial results for the agricultural interest. Ten million marks are paid every year to South Bavaria for yoke oxen, and the residue of a hundred million roots is feeding over half a million head of cattle. The raw and finished products make nearly a million waggon loads, which of course is in itself a most important source of employment for unskilled labour. During the winter months 97,000 men find work in this industry, while in the early summer about a quarter of a million adults are occupied in the cultivation of the root. Nor is the benefit confined to labour, for machine manufacturers, coal miners, lime quarries, and brick works all feel the beneficial influence of improved business. Some people seem to be under the impression that this is an enterprise for large city capitalists, and not for the farmer, but the sooner they disabuse their minds of this idea the more likely is the project to assume a tangible and practical shape. The matter is one of national importance, especially to agriculture, and ought to be taken up in the first instance by landed proprietors, who would no doubt find ready co-operation among capitalists. On the Continent, and particularly in Germany and Austria, most of the factories are erected by landowners who, in many cases, allow the small farmers to participate in the undertaking by taking shares of various amounts, sometimes very small, but at the same time contracting to deliver roots for a series of years at a fixed price. This principle of co-operation seems to have worked marvellously well, for if on one side, owing to unforeseen circumstances, the farmer may not get such remunerative rates for his roots as he has been looking forward to, he may on the other side recoup himself from the results of the factory, and I recommend the same principle to the farmers of Great Britain and Ireland. In conclusion, I am desirous of impressing upon you as strongly as possible that this proposed industry is no delusive dream of over-speculative minds, but a practical business-like matter of the utmost national importance. I am anxious, therefore, to urge upon you the necessity of our all joining hands to create a new industry which will not only raise the English agricultural world from its present state of depression, but will likewise keep English money at home instead of enriching the foreigner. Let me repeat again and with all possible emphasis the moral of what I have said on this and previous occasions, that we can in this country produce beetroot sugar quite as well as they can on the Continent, and at rates remunerative enough to enable us to carry on a successful competition with the foreigner.

Discussion.

The Chairman remarked that the importance of the subject could not well be over-rated. The introduction into this country of the manufacture of beetroot sugar produced on our own soil must be of very great value, not only as a matter of chemical industry, but of political economy. The apathy of the farmer could, however, only be got over by showing him that he could from a certain amount of soil obtain, in the shape of beet, something that would be at least equal to, if not better than, the product he was at present raising. He thought that the Society might bring its influence to bear in encouraging experiments and possibly by acting in concert with the Royal Agricultural Society so that experiments might be put on such a footing that the results obtained may have greater weight and induce agriculturists and manufacturers to take up the growth and treatment of the beet with vigour.

Professor Campbell Brown remarked that he learned a great deal from Dr. Schaek-Sommer's paper. The question of manuring was a very important one, and he was much struck by the great weight of roots obtained in Ireland. He would like to know whether the crop was an exhausting one, and what weight of manure per acre it required to keep the soil from running down. Unless the soil was kept supplied, the crop could not continue to be grown, and it was important to know what crop they continue to get from the farm year after year, rather than what they could get in the first year.

Dr. Hurter said that the Society owed a debt of gratitude to Dr. Schaek Sommer for his papers on the sugar industry. He had spoken of the apathy of the farmers, with whom he could, to some extent, sympathise. Before 58,000*l.* could be spent on capital for sugar works, they wanted to be sure of the other half of this industry, that was the beetroot growing, and farmers had to make the experiment. If the farmer were to make experiments what would be the return to him per acre for his outlay in the absence of sugar works? If the farmer could see his way to make the experiment pay, the apathy would not be so great.

Mr. Powell thought that, interesting as the subject was from a chemist's or scientist's point of view, scarcely sufficient stress had been laid upon the commercial aspect of the matter. The facts marshalled by Dr. Schaek-Sommer, and the results obtained under his direction were of so momentous a kind, that they affected the prosperity and social welfare of the largest industrial class in the kingdom, namely, the agricultural class.

It had been shown that even under what might be deemed amateur farming, so far as sugar-beets were concerned, England, and especially Ireland, could excel Germany and France both in weight of roots and richness of saccharine.

A new industry awaits the modern farmer, and he deserves neither sympathy nor help if he remains indifferent to the new conditions which Dr. Schaek-Sommer's efforts have revealed to him as being within his reach. The moderate amount stated as being required to start a factory would be forthcoming if the farmers of any district evince a desire to adopt sugar-beet growing as a permanent industry. No effort should be spared to bring this subject before all classes of the people, and awaken the Government to a sense of its importance. The best thanks of the community were due to Dr. Schaek-Sommer.

Mr. Rhodes wished to ask Dr. Schaek-Sommer, seeing the apathy of the English farmers, whether the Royal Agricultural Society and other similar societies would not be the persons to undertake experiments of this kind? It seemed to him that the question would want going into experimentally in a society like theirs, and it would be well to inquire whether other societies were doing anything in the matter. They knew that a certain amount of money had been voted for agricultural education in England, and he thought the experimental growth of beetroots for the production of sugar presented a suitable opportunity for expending some of that money in promoting a new agricultural industry.

Col. J. Pilkington called their attention to Dr. Schaek-Sommer's reference to the apathy of farmers, and pointed out that they must be led to see that they can venture out of their beaten track. He thought that if it could be shown that the farmer could have any means of disposing of those roots while he was experimenting as to the suitability of our own soil for cultivation, it would be well to go on with the matter. He would like to see a syndicate formed to take the matter in hand and to erect a small experimental factory, to show the public that the thing could be made to pay.

They all thanked Dr. Schaek-Sommer for having taken a great interest in the matter, and for benefiting the industries of this country. They must have large sections of ground suitable to beetroot culture; from what he had heard it could be grown anywhere, and it was an impossibility to starve it. It could be cultivated when other cereals could not thrive, and his strong impression was that it would be a very good thing for the farmer if he took that into consideration. Prof. Campbell Brown had inquired whether the ground would bear crops for a long time. It would to a considerable extent. Every three years it was desirable to have some little change in the cultivation. The amount of manure required would not be great.

Mr. Crosfield thought that the magnitude of the interests at stake had possibly been somewhat overlooked. He stated that the consumption of sugar in the United Kingdom amounted to over 1,000,000 tons per annum, probably it was not less than 1,200,000, the money value of which was upwards of 15,000,000*l.*, a sum of money which the British nation had to pay exclusively to foreigners. As British colonial sugar had now almost ceased to be imported, although at one time it formed a large part of the sugar

supply of great Britain, he thought that if the fact was recognised that a portion at least of this sum could be retained in England, a considerable stimulus would be given to the suggested industry.

Mr. Beck remarked that the subject had been interesting, in so far as they had before them facts which were the first ground on which to work. Climatic influences were no impediment so far as the growing was concerned. If the farmer and factory would co-operate, antipathy would soon be overcome. One great advantage, apart from the commercial and monetary value, would be that every factory would form a school of agricultural education and science for the whole class of farmers, which would exert a beneficial influence on the knowledge of farmers for growing all kinds of crops.

Dr. Schack-Sommer, after being questioned whether the Royal Agricultural Society would be disposed to do anything in the matter, said that at a meeting in June last, just before he read his paper in London, it was proposed by some members of the committee that a deputation should attend the lecture to represent the Royal Agricultural Society. The proposition was not accepted at the meeting. It was strongly recommended that members of the committee should attend the meeting to hear what he had to say, but they would not be officially represented.

In the subsequent issue of the Journal of Royal Agricultural Society, a treatise appeared which embodied all the experiments which he had made up to that date. If the Royal Agricultural Society did not wish to be officially represented, there was not much hope of help from that quarter. In reply to Dr. Hurter as to what the farmer could do with the beetroot if he had planted it, the lecturer stated that Mr. Gibbons had found that as cattle food it was a very valuable product, and Messrs. Peter Lawson and Son, Limited, seed growers and merchants in Edinburgh, had sent him yellow and red coloured sugar beetroots which they had grown there and some which were grown in Denmark for the sole purpose of feeding cattle. They said in their circular that on the Continent, and especially in Denmark, the valuable properties of beetroot for cattle feeding are thoroughly understood, and consequently this root is extensively grown for the use of milch cows, those kinds containing the largest percentage of saccharine matter—their most valuable feeding property—being the best for the production of milk and butter.

In fact it is well known that lately the lower qualities of sugar beetroot, that is, those which give large roots and do not contain so high a percentage of sugar, have been cultivated entirely for cattle-feeding purposes, as it has been proved that their feeding properties are about proportional to their saccharine strength.

Dr. Schack-Sommer in conclusion, while thanking the meeting very heartily for the kind reception they had given to his paper, replied to a question of Professor Campbell Brown to the effect that continental experience has demonstrated conclusively that beetroot is not an exhausting crop; that, on the contrary, it increases the fertility of the soil if a proper rotation of crops is observed. In fact, it cannot be too fully impressed upon the agriculturist that the extraction of sugar removes from the beetroot scarcely anything else than what the plant has acquired from the atmosphere, that is, the carbonaceous material; thence it follows that all the material which the plant took from the soil is practically available for stock-feeding purposes on the farm, in the refuse from the sugar factory, and is consequently returned to the soil. This would also furnish an answer to the objection that might be raised in favour of the mangel crop as compared with the beet crop, to the effect that the former may sometimes be sold off the land as profitably as the beet crop. It must be remembered that in the case of the mangel there is no return to the soil, whilst practically all the ingredients that the beet takes from the land is returned to the farm in the factory refuse.

THE APPLICATION OF ELECTROLYSIS TO QUALITATIVE ANALYSIS.

BY CHARLES A. KOHN, B.Sc., PH.D.,

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The first application of electrolysis to chemical analysis was made by Gaultier de Claubry, in 1850, who employed the electric current for the detection of metals when in solution. Other early workers followed in this direction, and in 1861 Bloxam published two papers (J. Chem. Soc. **13**, 12 and 338) on "The application of electrolysis to the detection of poisonous metals in mixtures containing organic matters." In these papers a description is given of means for detecting small quantities of arsenic and of antimony by subjecting their acidulated solutions to electrolysis. The arsenic was evolved as hydride and recognised by the usual reactions, whilst the antimony was mainly deposited as metal upon the cathode. This electrolytic method for the detection of arsenic in which all fear of contamination from impure zinc is overcome, has since been elaborated by Wolff, who has succeeded in detecting as little as 0·00001 grm. of arsenious oxide by this means (this Journal 1887, 147).

In a somewhat different manner the voltaic current is made use of in ordinary qualitative analysis for the detection of tin, antimony, silver, lead, arsenic, &c. by employing a more electro-positive metal to precipitate a less electro-positive one from its solution.

The quantitative electrolytic methods of analysis, some of which I had the honour of bringing before the notice of the Society some time back (this Journal, 1889, 256), have placed a number of methods of determination and separation of metals in the hands of chemists which can be employed with advantage in qualitative analysis, especially in cases of medical and medico-legal inquiry. These methods are not supposed to supersede in any way the ordinary methods of qualitative analysis, but to serve as a final and crucial means of identification, and thus to render it possible to detect very small quantities of the substances in question with very great certainty. As such they fulfil the required conditions admirably, being readily carried out, comparatively free from contamination with impure reagents, and capable of being rendered quantitative whenever desired.

In conjunction with Mr. E. V. Ellis, B.Sc., I have examined the applicability of the electrolytic methods for the detection of the chief mineral poisons (with the exception of arsenic, an electrolytic process for the detection of which has already been devised, as described), viz., antimony, mercury, lead, and copper.

Antimony.—The method employed in the case of antimony is that adopted in its quantitative estimation by means of electrolysis, a method which ensures a complete separation from those metals with which it is precipitated in the ordinary course of analysis, arsenic and tin. This fact is of considerable importance in reference to the special objects for which these methods have been worked out.

The precipitated sulphide is dissolved in potassium sulphide and the resulting solution, after warming with a little hydrogen peroxide to decolourise any polysulphides that may be present, electrolysed with a current of 1·5—2 cc. of electrolytic gas per minute (10·436 cc. at 0° and 760 mm. = 1 ampère) when the antimony is deposited as metal upon the negative electrode. One part of antimony (as metal) in 1,500,000 parts of solution may be thus detected, a reaction 30 times more delicate than the deposition by means of zinc and potassium. The stain on the cathode, which latter is best used in the form of a piece of platinum foil about 1 sq. cm. in diameter, is distinct even with a solution containing $\frac{1}{20}$ mgrm. of antimony, and by carefully evaporating a little ammonium sulphide on the foil, or by dissolving the stain in hot hydrochloric acid and then passing a few bubbles of sulphuretted hydrogen gas into the solution, the orange-coloured sulphide is obtained as a satisfactory confirmatory test. The detection of 0·0001 grm. of metal can be fully relied on under all conditions, and one hour is sufficient to completely precipitate such small quantities.

Mercury.—Mercury is best separated from its nitric acid solution on a small closely-wound spiral of platinum wire. The solution to be tested is acidified with nitric acid and electrolysed with a current of 4—5 cc. (cc. refer to cc. of electrolytic gas per minute). The deposition is effected in half an hour. The deposited metal is removed from the spiral by heating the latter gently in a test-tube, when the mercury forms in characteristic globules on the upper portion of the tube. As a confirmatory and very characteristic test, a crystal of iodine is dropped into the tube, and the whole allowed to stand for a short time, when the presence of mercury is indicated by the formation of the red iodide. 0·0001 grm. of mercury in 150 cc. of solution can be clearly detected.

Wolff has applied this test under similar conditions, using a special form of apparatus and a silver-coated iron anode (this Journal, 1888, 454).

Lead.—Lead is precipitated either as PbO_2 at the anode from a nitric acid solution or as metal at the cathode from an ammonium oxalate solution. In both cases a current of 2—3 cc. suffices to effect the deposition in one hour.

Here again, 0·0001 grms. of metal in 150 cc. of solution can be easily detected. With both solutions this amount gives a distinct discoloration to the platinum spiral on which the deposition is best effected. As a confirmatory test the deposited metal is dissolved in nitric acid and tested with sulphuretted hydrogen, or the spiral may be placed in a test tube and warmed with a crystal of iodine, when the yellow iodide is formed. This latter reaction is very distinct, especially in the case of the peroxide.

Of the above two methods, that in which an ammonium oxalate solution is used is the more delicate, although it cannot be employed quantitatively owing to the oxidation of the metal that takes place.

An addition of 1 grm. of ammonium oxalate to the suspected solution is sufficient.

Copper.—0·00005 grm. of copper can be very readily detected by electrolysing an acid solution in the usual way. A spiral of platinum wire is employed as the cathode, and the presence of the metal confirmed for by dissolving it in a little nitric acid, diluting with water and adding potassium ferrocyanide.

To detect these metals in cases of poisoning, the organic matter with which they are associated must first be destroyed in the usual way by means of hydrochloric acid and potassium chlorate, and the precipitates obtained in the ordinary course of analysis then subjected, at suitable stages, to electrolysis. As the solutions thus obtained will be still contaminated by some organic matter, it is necessary to pass the current for a longer time than indicated above. On the other hand, *urine* can be tested directly for these poisons.

The presence of mercury or of copper may be detected by acidifying the urine with 2—3 cc. of nitric acid (conc.), and electrolysing as described. 0·0001 grm. of metal in 30 cc. of urine can be detected thus, or 1 part in 300,000 of urine.

Lead does not separate well as peroxide from urine, but if ammonium oxalate be added, and the lead deposited as metal, the reaction is quite as delicate as in aqueous solution, and 0·0001 grm. of lead can be thus detected.

With antimony it is advisable to precipitate it first as sulphide, but it can be detected directly, though not so satisfactorily, by acidifying the urine with 2–3 cc. of sulphuric acid (dil.), and electrolysing with a current of 1—5 to 2 cc. In this case also it is precipitated as metal upon the cathode (cp. Chittenden, Proceedings Connecticut Acad. Science, Vol. 8).

In the presence of urine it is advisable to continue the passage of the current for about twice the time required in the case of aqueous solutions.

That an approximately quantitative result can be obtained under the above conditions was shown in several cases in which the deposition of 0·001 grm. of metal was confirmed with considerable accuracy, the spiral or foil being weighed before and after the experiment.

A comparison of the delicacy of these tests with the ordinary qualitative tests for antimony, mercury, lead, and copper by means of sulphuretted hydrogen, showed that the two were equally delicate in the case of antimony and of copper, but that in that of mercury and of lead the electrolytic test was at least eight times the more delicate. These comparisons were made in aqueous solutions. In testing urine the value of the electrolytic method is still more evident, for here the colour of the liquid interferes materially with the reliability of the ordinary qualitative tests when only very small quantities of the metals referred to are present.

Beyond the detection of mineral poisons, qualitative electrolysis can only offer attraction to analysts in special cases, and the data on the subject are to be found in the many electrolytic methods already published. Beyond testing for gold and silver in this manner, I have not therefore examined the applicability of these methods further.

The detection of small quantities of gold and silver is of considerable importance, and advantage can be taken of the ease with which they are separated from potassium cyanide solution by the electric current for this purpose.

Silver.—Silver is obtained as chloride in the course of analysis. To confirm for the metal electrolytically, this precipitate is dissolved in potassium cyanide and the resulting solution electrolysed with a current of 1—1·5 cc. A spiral of platinum wire is employed as the anode, from which the silver may be dissolved by means of nitric acid, and tested for by hydrochloric acid or by sulphuretted hydrogen. 0·0001 grm. of silver in 150 cc. of solution can be detected thus, and one hour is sufficient for the deposition.

Gold.—Gold is deposited under similar conditions to silver from cyanide solutions. The deposit, which is rather dark coloured, can be dissolved in aqua regia and confirmed for by the Cassius' purple test. Here again 0·0001 grm. of metal in 150 cc. of solution can be detected without any difficulty.

As gold and silver are both extracted from quartziferous ores by treatment with potassium cyanide solution according to the MacArthur-Forrest process of gold extraction (this Journal, 1890, 267), this electrolytic method should prove very useful. By electrolysing the resulting solution a mixture of gold and silver will be deposited upon the cathode, which can then be parted by nitric acid and tested for as described.

Discussion.

The Chairman said that there was little doubt but that further investigation into electrolytic methods of chemical analysis would give even more valuable results than those already obtained. Systematic investigations of the subject, such as have been given by Dr. Kohn, would go far to prove the adaptability of this method as a substitute for or aid in ordinary qualitative examinations. The remarks of Dr. Kohn respecting quantitative examinations were very interesting, and well worth following up by other practical work.

Professor Campbell Brown said that Dr. Kohn had shown that electricity brought the same kind of elegance, neatness, and simplicity into analysis that it did into lighting and silver-plating.

In its applications to the detection of poisons, he understood Dr. Kohn to say that the poisons must first be extracted by chemical means. That would not be sufficient, and he had no doubt that if the subject was pursued farther they would have a paper from him (Dr. Kohn) some day indicating that he had obtained arsenic and such poisons without the previous separation of the metal from organic matter. It was a very great desideratum to have a method for detecting arsenic and separating it from the contents of the stomach and food directly without previous destruction of the organic matter, and he hoped Dr. Kohn would pursue his work in that direction.

Dr. Hurter said he was about to construct a new laboratory, and he would assure them that one of its arrangements would be the installation of electricity, by which to carry out researches similar to those described. He was very glad to learn that the presence of arsenic, &c. could be readily proved by means of electrolysis.

Dr. Kohn, in reply, stated that he considered it would be a very difficult matter to effect the separation of the mineral poisons from organic matter electrolytically without the previous removal of the latter. The oxidation of the organic matter by the electric current was a slow process, and he did not think it was likely to be more complete or more effective than the means usually adopted. From experiments made with urine the decomposition of the organic matter present was fairly complete in a reasonable time, and this fact might be taken advantage of in the analysis of that product. But apart therefrom, he considered the methods worthy of some attention, as being a means of adding to the certainty with which very small quantities of the mineral poisons might be detected.

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There is no change in the composition of this Committee.

Meeting held Friday, April 3rd, 1891.

DR. BOWMAN IN THE CHAIR.

A SIMPLE AND RAPID METHOD OF GRAVIMETRIC ANALYSIS.

BY G. H. BAILEY, D.Sc., PH.D., AND J. C. CAIN.

The method is practically that by which the specific gravity of a solid would be taken, viz.:—by means of weighing in suspension in liquid. Although in this way the weight of the solid suspended in a liquid is frequently made use of as a means of determining its specific gravity, we are not aware that conversely the specific gravity (known or determined once for all) has ever been made use of for ascertaining the actual *weight* of a precipitate directly and without it being separated by filtration from the liquid. Some time ago Dr. J. Grossmann, a member of our Society, made some preliminary investigations in the direction indicated, but these were not published.

Description of Apparatus.

An ordinary specific gravity bottle might be used for the determinations, or even a 100 cc. flask. Indeed, the first part of our work was carried out with such a flask. The former, however, had its inconveniences, and the latter was too wide in the neck to admit of sufficiently accurate measurement. We therefore constructed a form of flask and fittings thereto which should overcome these difficulties. The 100 cc. flask is made in two parts, as shown in Fig. 1, the neck being in a separate piece and accurately ground into

Fig. 1.

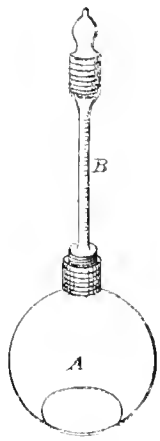
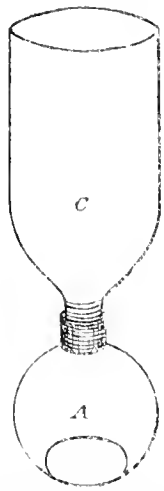


Fig. 2.



the body of the flask. It is desirable, indeed, to make the neck almost capillary for the purposes of accurate reading, so that to facilitate the introduction of the liquid (and suspended matter) into the flask, it is necessary to make this capillary neck removable. With the arrangement shown in Fig. 2 it is easy first to fill the flask A with the liquid and precipitate and then fit in the capillary neck B, and add a little more liquid until a given mark on the stem was reached. The stem is furnished with graduations in millimetres. These serve not only to adjust accurately 100 cc. of liquid at 4° C., but also (the capacity of the stem being once for all determined) enabled us to get rid of the troublesome cooling (or warming) process used in specific gravity determinations where all weighings are made with the liquid at a given temperature. For instance, if the liquid at 4° C. (point of maximum density for water) stood at division 6 for 100 cc. liquid, and at 10° C. it stood at division 9, it is evident that when working at 10° C. the flask must be filled up to division 9 to represent 100 cc. of liquid at the point of maximum density of water. In order to further facilitate the introduction of the liquid containing the precipitate into the body of the flask, especially as 150 or 200 cc. of clear supernatant liquor had to be decanted off for another purpose, the cup-shaped vessel C, also ground so as to fit into the flask, is used.

Method of Working.

First, the specific gravity of the substance precipitated is carefully determined by ascertaining (*a*) weight of flask and air, and then deducting from this the weight of 100 cc. of air; (*b*) weight of flask and 100 cc. of water at 4° C.; (*c*) weight of flask filled to 100 cc. mark with water and the substance whose specific gravity was to be determined. The following values were obtained:—

Silver chloride precipitated in the hot.....	5·298
Silver chloride precipitated in the cold.....	5·287
Copper oxide precipitated in the hot	6·514
Ferric hydrate precipitated in the hot.....	2·583
Barium sulphate precipitated in the hot.....	4·451
Barium sulphate precipitated in the cold...	4·442

Each of these values is the mean of several determinations which closely agreed amongst themselves. It will be seen that, as might be expected, the density of the product varies somewhat according to the circumstances under which the precipitation is effected. The determinations made in the hot were boiled for some time, as in the ordinary course of analysis, and the values were practically uninfluenced, as far as our experience goes, by prolonging

the period of boiling, or by the state of dilution when the precipitation is effected, at any rate within such limits as occurred in actual practice. In order, however, to make use of these numbers in the inverse manner for ascertaining the weight of a given precipitate, it is not necessary to replace the supernatant liquor by water, for, by using two similar flasks, 100 cc. of the clear supernatant liquor may be run off into one flask, leaving the precipitate and supernatant liquor occupying 100 cc. in the other flask. Some of the supernatant liquid may also be transferred to a small wash-bottle for convenience of washing down any precipitate which remains attached to the sides of the cup-shaped vessel. The actual determination of the weight of the precipitate W now takes this form:—

$$W = \frac{(w' - w)Vs}{Vs - W}$$

Where

w' = weight of supernatant liquid and precipitate.
w = weight of known volume (say 100 cc.) liquid.
s = specific gravity of precipitate.
V = volume of the flask (say 100 cc.).

As an instance of the weighings to be made, we give the following numbers, obtained in determining the amount of chlorine (as silver chloride) in a solution of common salt:—

Flask and liquid with silver chloride.....	123·551
Flask only (determined once for all).....	20·972
w =	102·579
Flask and liquid.....	122·341
Flask only (determined once for all).....	21·724
w =	100·617

$$W = \frac{1·962 \times 529·8}{529·8 - 100·617} = 2·422 \text{ grms.}$$

Two weighings only are therefore required. The following numbers obtained by this method will show the extent of the variation which may be expected with careful working. The silver chloride determined gravimetrically was found to be 2·422 grms.

	Grms.
Experiment 1 gave.....	2·422
Experiment 2 gave.....	2·426
Experiment 3 gave.....	2·420
Experiment 4 gave.....	2·424

That is to say, the error in a chlorine determination, taking the value which shows the greatest divergence, will amount to less than one-twentieth per cent. It is not, of course, contended that the method is to be preferred to the ordinary gravimetric determination on the score of accuracy, but rather that it effects a saving of time, especially where a number of similar determinations have to be made from day to day, and where the amount of material is sufficient to yield a precipitate of 2 or 3 grms. As a matter of fact, a determination may be made, after the precipitation has been effected, in half an hour, and a dozen similar determinations done simultaneously in a dozen flasks would occupy very little more additional time than that required to make the necessary weighings. Of course the analysis of a substance involving several determinations—such as the iron, copper, and sulphur in a cupreous pyrites—can be made quite as readily. A determination of iron and sulphuric acid in a solution of ferrous ammonium sulphate gave the following results:—

	Found.	Calculated.
Fe.....	0·8342	0·8233
SO_4.....	2·783	2·758

The following observations have suggested themselves in the course of working out the details of this method of analysis:—(1). Where the precipitate forms a double salt with any of the substances existing along with it in the solution, regard must be paid to this (as it must also in the gravimetric method) and precautions taken. Some soluble salts (the alkalis, for instance, by barium sulphate) are readily carried down with the precipitate where the solution is a concentrated one, and must be washed out with hot water. It is best, however, to precipitate with the precautions usually observed, using dilute solutions. (2.) The method can only be recommended where a sufficiently large quantity of precipitate is obtainable—say 2 grms. Of course it is possible to work with small quantities, but then the experimental error becomes large, unless greater care is exercised than is to be expected in routine determinations. (3.) For determinations where the precipitate can not be washed free from the other liquor without loss, this method may be recommended as preferable to the gravimetric method. Such are the determinations of fluorides, borates, phosphates, and several of the more troublesome sulphides. In the latter case the precipitation can be effected by passing the sulphuretted hydrogen directly into the flask, and thus all fear of alteration by oxidation, &c. is avoided.

NOTES ON EFFLUENT WATER ANALYSES AND ON METHODS FOR DETERMINING THE VALUE OF RIVAL PROCESSES FOR THE PURIFICATION OF SEWAGE.

BY WILLIAM THOMSON, F.R.S.E.D., F.I.C., ETC.

Having lately been engaged in the study of these questions, I have been asked to bring the matter before the Section for discussion this evening.

The subject is one which at the moment is of special interest to the people of Manchester, Salford, and to the residents near the streams which will in future go to supply the Manchester Ship Canal. It is also of great importance to the whole of the country as the statutes with regard to the pollution of rivers are every day being more stringently enforced, and attempts must be made to find the best practical process for sewage treatment.

The refuse matters which at present find their way into rivers and sewers may be classed under two heads:—(*a*) the ordinary household sewage; and (*b*) refuse from manufactures.

The first can be estimated at so much per head of the population, and is that with which the people of England, generally speaking, are more particularly concerned. The second differs very greatly both in qualitity and quantity, and in this the manufacturers are chiefly interested. Ordinary town sewage consists of organic and mineral matters in suspension and in solution, and the problem which the chemist and engineer is called upon to solve is to find the most efficient method at the smallest cost of removing the suspended matter (both organic and inorganic) on the one hand, and as much of the organic matter in solution as possible on the other. It is not so material to remove the mineral matter in solution because that would not be a matter of much importance so far at least as the Manchester Ship Canal is concerned.

The treatment of sewage by sewage processes aims at the more rapid precipitation of the suspended matters, both organic and inorganic, by the addition of something to it, or by a similar operation to bring the suspended matter into a condition in which it might easily be removed by filtration, as town's sewage usually contains somewhat slimy matters in suspension which are liable to block the filters.

The second thing which is demanded of the sewage process is that it shall as far as possible remove organic matters from solution, because if all the objectionable suspended matter be removed the organic matter left in solution would in warm weather undergo putrefaction and emit very objectionable smells.

In comparing rival processes for producing the results above mentioned, one thing is of the very first importance, and that is that each process shall be made to act upon sewage of precisely the same quality. Sewage as it flows through the sewers differ in quality every few minutes, and it is evident that an average sample could not be obtained by taking samples every minute, although samples have usually been collected by those making such investigations every 5, 10, or 15 minutes, and in recent experiments which were made, the results of which were printed but not circulated, the samples of raw sewage were taken every half-hour and mixed together to give an average sample: that this did not give average samples is abundantly proved by looking at the figures obtained by the analysis of the crude or raw sewage in comparison with the figures obtained for the effluents. In some cases the raw sewage appears to be actually purer than the effluent produced after treatment.

There are two and only two methods for finding the relative value of sewage processes. The first is to have a tank say about five yards square fitted with agitators such as those used for keeping flour and water mixed for the preparation of size for warp sizing. The rival processes should then be arranged on each side of this tank; when the tank has been filled with the sewage and thoroughly mixed, a good sample should be taken to be reserved for analysis and experiment, as compared with the same sewage after treatment by the different processes. One analysis of raw sewage would therefore be sufficient for all the processes.

The tank should be provided with taps or sluices on each side so that the same quantity of sewage should be delivered at the same time to each of the different systems at the same rate, say 2,000 to 3,000 gallons per hour, each rival apparatus being made on a scale to treat such an amount.

First comes the determination of the relative values of the different processes as regards their respective influences in aiding the separation of the suspended matter. Assuming four processes are to be tested, five calico or woollen bags of the same size should be taken, and say one or two gallons of the thoroughly mixed raw sewage poured into one, and the same quantity of the same sewage, immediately after treatment by each of the different processes (also well stirred up), should be poured into each of the other four bags, and the time required for each to filter through accurately noted, and the quality of the filtrate in each observed as to clearness or turbidity.

These filtrates might then be analysed to find—

(*a.*) Total solid matter in solution, together with any impalpable sediment which might be left in suspension after passing through the filter.

(*b.*) Loss on ignition of the above after drying at 220° F.

(*c.*) Free and albuminoid ammonia.

(*d.*) Permanganate of potash required to oxidise organic matter, &c., acting during say 15 minutes, and after acting during say three hours, at a temperature of 90° F.

(*e.*) The combined chlorine.

(*f.*) The combined sulphuric acid.

(*g.*) The quantity of iron or alumina in solution, if any.

(*h.*) The condition of the filtrates as regards acidity or alkalinity, the amount of acidity or alkalinity being determined, using laemoid as indicator with $\frac{N}{50}$ sulphuric acid or $\frac{N}{50}$ soda.

(*i.*) Two 10-oz. stoppered bottles (as duplicates) about two-thirds full of each filtrate might then be put aside and examined every day to find how long each remains, under the same conditions, without emitting a putrid odour.

(*k.*) Five large glass cylinders of similar dimensions, each holding, say, one to two gallons, might be filled, one with the stirred raw sewage, and one with sewage from each of the processes after treatment, but before being allowed to settle.

These might each be provided with a glass rod, and after all had been thoroughly agitated, the time required for settlement or subsidence so as to leave a clear supernatant liquor observed. After a certain time a portion of each might be syphoned off from the same depth, and the suspended matter still left in it estimated.

These operations would give the effect of the precipitant used in each process, both from a chemical and from a mechanical point of view.

The next process would be to weigh the sludge or matter left in the filter. This might conveniently be done by having each bag carefully dried and weighed in a tared beaker covered with a glass plate or india-rubber cap before and after filtration; the difference would be the sediment or sludge produced by each process.

(*l.*) These sediments might then be analysed to find specially what percentage of iron and alumina was contained in them. This would give a good idea of the quantity of iron and alumina, or both, used for precipitation, and especially in the electrical process, where the quantity of iron used up was determined by weighing before and after using, a large quantity of heavy cast-iron plates.

The quantity of lime or other precipitant employed might also thus be determined in the sludge filtered off.

The above, however, does not show the value of each of the processes. In the electrical, and in Barry's and Spence's, the process, after treatment, is complete with the exception of the required settlement and filtration. The international process, however, is at this stage said only to be half finished, and the patentees claim that a filter which they possess has the power of still further oxidising and removing the organic matters from solution. It is evident, therefore, that for the completion of the tests, the effluent from each process must be analysed in the same manner as the filtrate above mentioned.

The figures thus obtained would give a very good idea of the value of each process, as the raw sewage dealt with would be absolutely the same for each.

All these experiments should be made in strict comparison with the raw sewage, because I observed in the printed results I have mentioned of trials of four sewage processes made recently in Salford that the raw sewage is first analysed, and the difference between it and the effluent is credited to the process through which it has passed, whereas if the raw sewage had been simply left to subside and then filtered through sand, there might be really very little difference between it and that obtained by any given process.

It might be contended, however, that it is no practical test of any sewage process to try the effect of each on, say, 2,000 or 3,000 gallons, because it might be suggested that the quantity of electricity used in the electrical process might be greater for the small quantity of sewage employed than it could be for larger quantities, or that the filters which oxidise might become clogged or lose their effect by continued use. If it be desired, then, to work for some time continuously each process, then the *second arrangement* might be employed. This would consist of a large tank provided with stirrers, into the centre of which should fall the sewage to be tested, the stirrers being kept constantly at work, and the sewage being supplied from the bottom of the different sides of such tank, one opening being also arranged for allowing the untreated sewage to flow out into a tank similar to those in use for treating the sewage; this to give a raw sewage standard for comparison, so that at any time samples of the effluent from each process might be taken and compared with a sample of the raw sewage, which at any time would as nearly as possible represent a true sample of the sewage which would be treated by all the different processes.

By such a method as this an almost mathematically correct comparison could be obtained of the action of the different processes on sewage. It would of course go without saying that the analysis of all the samples should be made immediately after being taken, before any subsequent change could take place in them.

No such method as either of those above mentioned were carried out by the committee of chemists and engineers in the tests which were recently made of the four different processes tested with the Salford sewage. In these experiments each process was worked on the sewage separately, the one after the other, samples of the sewage supplied being taken as it flowed to the treating tanks or vessels every half-hour, and the whole mixed together and a sample taken from it as representative of the sewage which was treated.

Here, for instance, are some of the results given, which shows the importance of knowing the exact composition of the sewage actually treated.

	Parts per 100,000. Albuminoid Ammonia.
Sample No. 1: Raw sewage (before treatment)	0·50
Sample No. 2: Same sewage in tank (after treatment)	0·80

This is an example in which the albuminoid substances are greater after than before treatment, which could presumably only be accounted for by the fact that the sample of raw sewage taken, did not represent that which was treated. Here is another of the same kind :—

	Ammonia. Free.	Ammonia. Albuminoid.	Oxygen taken up in Three Hours.	Mineral and Organic Matter in Suspension.	Mineral and Organic Matter in Solution.
Sample 41: Raw sewage (before treatment).	1·73	0·30	1·0	25·0	1·56
Sample 42: Sewage (after treatment).	1·75	0·70	3·0	35·2	1·64

The interpretation of the results of the analyses has led to a curious misapprehension on the part of the engineers as to the meaning of the figures given by the analysts. Thus, the loss on ignition is described as "organic matter." Most chemists write "organic matter, &c." the loss being as a rule principally the "et cetera"; in other words combined water, ammonia salts, chlorine from chloride of magnesium, and perhaps some volatilised common salt. Now, on treatment by any of the processes in which iron or alumina are employed, some hydrated oxide of iron, sulphate of lime, or other compound is added or formed which contains a large percentage of combined water, and thus it comes that "organic matter" is represented as contained in greater quantity in the effluents than in the raw sewage.

Now comes the engineers' report, and they take the chemist's figures for organic matter which is not organic matter at all, but chiefly "et cetera," and they cite these results as follows :—

	Parts per 100,000 Organic Matter in Solution.
International process. One example. Raw sewage	13·5
Effluent after filtration	5·0
Another example. Raw sewage	2·2
Effluent after filtration	1·6
Electrical process. One example. Raw sewage	11·4
Effluent after filtration	1·7
Another example. Raw sewage	11·4
Effluent after filtration	2·8

It is interesting to see how the engineers explain these results. They say in their report: "In none of the cases, however, can the results be considered entirely satisfactory in respect to the solids remaining (more especially the organic solids) in solution, and it is somewhat remarkable that these were increased instead of diminished. The precipitants, added to the volume of sewage, may partially account for this, and impurities existing in the filtering material may possibly account for the remainder."

One of the chemists, in epitomising his results, takes account of this loss on ignition as organic matter. Thus, he shows in the four processes the following figures :—

	Mean Percentage of Purification. Loss on Ignition, "Organic Matter in Solution."
International	− 9·5
Electrical	− 11·65
Spence's	+ 16·45
Barry's	+ 26·95

The minus sign means that the loss on ignition from the soluble matters in the mean of the effluents were less than that contained in the mean of the sewages employed. The + sign means that the loss on ignition in the effluents was greater than it was in the filtered raw sewages. As far as I can make out, the first figure in this table is a serious mistake in calculation from the figures given in the body of the report: the figures should be much higher.

Citing from the figures of the report further, I give as follows "percentages of purification," as shown by free and albuminoid ammonia, and "oxygen taken up in three hours."

	"Percentages of Purification." Ammonia. Free.	Ammonia. Albuminoid.	Oxygen taken up in Three Hours.
International	83·47	− 79·51	− 82·45
Electrical	− 26·75	− 60·00	− 73·72
Spence's	+ 56·44	− 17·38	− 29·48
Barry's	+ 28·37	− 33·75	Could not be determined.

Putting aside the figures obtained as "loss on ignition," called "organic matter," as of no value, we come to the free and albuminoid ammonia and oxygen required to oxidise the organic matters, and we observe that the international process shows, by his figures, a much higher percentage of purification than the electrical process, and in this view it is difficult to reconcile his remarks, which I give as follows :—

"After studying closely the results of my analysis . . . . and the results of some laboratory experiments, also taking into consideration the uniformity of its working, I am of opinion, as the final result of my investigation, that the most reliable process is that of the 'Electrical Purification Association (Limited).'"

It appears as if Mr. Carter Bell and the other chemists employed had not compared results before printing, but Mr. Bell's figures confirm the referee chemist in showing that a greater amount of purification was effected by the international than by the electrical process, but he has wisely abstained from deciding between these two processes from the figures he obtained, considering the unsatisfactory and unscientific conditions under which both appear to have been compelled to work. The net result of the whole of the work done in this investigation to find the relative values of the different processes is that it is practically valueless.

Newcastle Section.

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Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

The name in italics is that of a Member of Committee who retires at the end of the present Session. Mr. John Watson has been elected to fill the vacancy thus created.

Meeting held in the College of Science, Thursday, April 9th, 1890.

MR. JOHN PATTINSON IN THE CHAIR.

ON THE DETERMINATION OF MANGANESE IN ITS ORES AND ALLOYS.

BY JOHN PATTINSON, F.I.C., AND H. SALVIN PATTINSON, PH.D., F.I.C.

Owing to the large quantity of manganese in the form of spiegeleisen and ferromanganese, now used in the manufacture of steel, the accurate estimation of this metal in its above-mentioned alloys and in the ores from which these alloys are made, is of considerable industrial importance.

The gravimetric methods of estimating manganese usually adopted may be classed under three heads: 1. Those in which the manganese is calculated from the manganoso-manganic oxide (Mn_3O_4) obtained by igniting the carbonate or the hydrated dioxide in air; 2. Those in which the manganese is weighed as pyrophosphate; 3. Those in which it is weighed as sulphide.

In all these methods the solution of manganese before precipitation of the manganese is freed from iron and aluminium by some one of the various ways in which this can be done, but the process now usually adopted is to precipitate the iron and aluminium by ammonium acetate. The filtrate from this precipitate then contains the manganese and any copper, nickel, cobalt, or zinc, together with a small quantity of iron that has escaped separation. In the case of manganese ores and manganiferous iron ores, the solution also usually contains calcium, magnesium, and alkalis. If the manganese be now precipitated with bromine and ammonia, the precipitate of hydrated manganese dioxide carries down with it, as is now well known, portions of all these substances, which must afterwards be separated from it and their weight deducted from the total weight of the precipitate. Or the iron, zinc, copper, nickel, and cobalt may be separated before the manganese is precipitated, by rendering the solution slightly acid with acetic acid and saturating it with sulphuretted hydrogen. We would point out that although, no doubt, the greater part of these substances may be separated in this way, nevertheless it is most difficult to ensure their complete separation from a relatively large quantity of manganese. In fact, unless the solution is so very slightly acid that a portion of the manganese itself is precipitated, we find that there is incomplete precipitation of the other substances. In the case of ores the calcium, magnesium, and alkalis still remain in solution with the manganese after the removal of the other substances by sulphuretted hydrogen, and the separation of these is very troublesome, necessitating the precipitation of the manganese as sulphide, or the dissolving out of the calcium, &c. from the precipitated manganese oxide by nitric acid, and these processes are but imperfectly successful.

When the manganese is weighed as pyrophosphate, the same objection obtains, for it is usual to first precipitate as hydrated dioxide and, after redissolving this precipitate, to reprecipitate the manganese as phosphate. Unless the calcium and magnesium have been separated, these of course are precipitated as phosphates with the manganese.

H. Rose has suggested the weighing of the manganese as manganese sulphide formed by igniting the oxide with sulphur in an atmosphere of hydrogen. This method is still open to the objection that it depends in the first place upon the formation of the hydrated dioxide, and the tedious separation of all other substances carried down with the dioxide precipitate, is not avoided.

No doubt fairly accurate results may be obtained by the gravimetric process when the manganese is weighed as pyrophosphate or as sulphide, provided of course that due care has been taken to separate all impurities from these substances; the methods are both very tedious and require very experienced manipulation to give anything like good results. But when the manganese is weighed as manganoso-manganic oxide (Mn_3O_4) a still further risk of error is incurred.

We refer to the fact, first pointed out by Wright and Luff (Journal Chem. Soc. Trans. 1878, 525), that when manganese carbonate, or the higher or lower oxides of manganese are ignited in air, a product is obtained which invariably contains more oxygen than Mn_3O_4, and that only by long continued heating over a powerful blast lamp can a product approximating closely to Mn_3O_4 be obtained. Pickering (Chem. News, **43**, 225) found that when hydrated manganese dioxide was heated in a platinum dish over an ordinary Bunsen burner, the composition of the resulting oxide varied with the temperature, approximating when heated during the day, with a low gas passure, to Mn_3O_4, and at night, with a better gas supply, to Mn_3O_4, but that the variation in composition at the higher temperature was from 70·35 per cent. to 74·99 per cent. of manganese, pure Mn_3O_4 containing 72·05 per cent. of manganese.

Dittmar, in 1864 (Jour. Chem. Soc. 1864, 295), had already shown that when manganese dioxide was heated to dull redness in air or even in an atmosphere of nitrogen, the resulting oxide approximated to the composition of the sesquioxide Mn_2O_3, and not to that of the protosesquioxide Mn_3O_4.

Notwithstanding these well-known facts we believe that it is still not an uncommon practice among chemists to estimate manganese by precipitating it as hydrated dioxide, and after ignition of this precipitate at a red heat until a constant weight is obtained, calculating the percentage of manganese on the assumption that the product of ignition has the composition Mn_3O_4, and without making any correction for the oxygen it contains in excess of that required to form manganese protoxide, MnO.

We have had occasion during the last two years to repeat, to a partial extent, the investigations of Wright and Luff and of Pickering, on the products obtained by heating hydrated manganese dioxide in air, and whilst we confirm the work of these chemists on this subject, we think our results are of sufficient interest to warrant our publishing them, especially as they have an important bearing upon the determination of manganese.

Our experiments were made with manganoso-manganic oxide of known composition, prepared either from crystallised manganese sulphate or from ferromanganese containing about 82 per cent. of manganese.

The manganese sulphate was recrystallised, and after solution in water the manganese was precipitated with ammonium sulphide; the precipitate was thoroughly washed to remove a small quantity of lime that was present in the manganese sulphate, and it was then dissolved in hydrochloric acid, the solution filtered from separated sulphur, and evaporated to dryness to expel the excess of acid. The residue was dissolved in water, boiled, and the manganese precipitated as carbonate with ammonium carbonate. After

washing the precipitate free from chlorides the manganous carbonate was dried, separated carefully from the filter paper, and ignited in a platinum dish in a gas muffle, for several hours at a very bright red heat, approaching a white heat, until the weight of the dish and its contents was constant. The resulting oxide was then carefully examined and found to be free from any impurity, and the oxygen in in excess of that required to form manganous oxide, determined.

It was found to contain —

	Per Cent.	
MnO	93·03 = 72·065	Mn.
Available oxygen	6·97	
	100·00	

Pure Mn_3O_4 contains 72·05 per cent. of manganese and 6·99 per cent. of available oxygen.

There being some difficulty in obtaining manganese sulphate sufficiently free from aluminium and calcium, and small quantities of the latter being especially difficult to separate from manganese, we made another batch of Mn_3O_4 from ferromanganese containing about 82 per cent. of manganese. In this substance all the impurities carried down with the precipitate of hydrated manganese dioxide, by precipitation with bromine and ammonia, were such as could be removed or estimated by precipitating them as sulphides in acetic acid solution.

The ferromanganese was finely pounded and then dissolved in hydrochloric acid, and the solution filtered from the separated carbon and silica. The clear solution was then evaporated to dryness in a platinum dish, and dried in an air-bath at about 130° C. for three hours. The residue was transferred to a beaker and dissolved in water and a little hydrochloric acid, and the solution filtered from a trace of silica. The filtrate was then boiled and the iron oxidised with nitric acid. The iron was next removed as basic ferric acetate by precipitating it with ammonium acetate, and the filtrate from the iron precipitate was made very nearly neutral by adding ammonia until the solution barely showed any acidity when tested with litmus paper. The liquid was then boiled and saturated whilst hot with sulphuretted hydrogen. Some of the manganese was carried down with the precipitate of sulphides of iron, copper, and nickel which formed, but it was found that unless the solution was so nearly neutral that some small part of the manganese was also precipitated, there was a very imperfect separation of the other substances. The sulphuretted hydrogen precipitate was filtered off, the filtrate boiled to expel the sulphuretted hydrogen, and the manganese was then precipitated as carbonate with ammonium carbonate. After thoroughly washing the carbonate, it was dried and calcined in a gas muffle at almost a white heat until the weight was constant. Before a constant weight was obtained it was found necessary to grind the oxide in an agate mortar and to stir it frequently during the calcination. The resulting oxide was carefully examined and found to contain—

	Per Cent.	
MnO	92·92 = 71·98	% Mn.
Available oxygen	7·01	
Ferric oxide and traces of copper and nickel oxides	0·07	
	100·00	

Pure Mn_3O_4 contains, as already stated, 72·05 per cent. of manganese and 6·99 per cent. of available oxygen.

The behaviour of manganese carbonate, formed as above described, when heated at various temperatures in a gas muffle furnace was examined as follows :—

About 115 grains of the dried manganese carbonate were placed in a tared platinum crucible, and first of all heated for 1½ hours at a dull red heat, the crucible being placed in the mouth of the muffle. At the end of this time it weighed 72·985 grains. The upper layer of the substance was then found to be black, whilst the underneath layer next the crucible was of a red-brown colour. It was then crushed up and stirred by a flat-ended glass rod, and again heated at a dull red heat for one hour, when it was found to have *gained* 0·75 grains, and now weighed 73·735 grains. At the end of this second period of heating, its colour throughout appeared uniformly black, but on grinding the contents of the crucible up in an agate mortar it was seen that there were still small particles which although black outside were red-brown inside.

Some of the black oxide prepared in this way in a previous experiment was found to closely approximate to the composition of $Mn_3O_{4\cdot 6}$.

After grinding in an agate mortar the quantity of substance returned to the crucible was first weighed, and, owing to some loss during the grinding, it weighed 73·41 grains. The heating was then continued as shown below.

Table I.

No. of Heating.	Duration of successive Periods of Heating.	Manner of Heating.	Weight in Grams after Heating.	Gain in Grams on previous Heating.	Loss in Grams on previous Heating.	Colour, &c.
	Minutes.					
3	15	Gas muffle, dull red heat	73·83	0·42	..	Uniformly black.
4	5	Bunsen burner, very dull red heat	73·93	0·10	..	Do.
5	5	Do. do.	73·93	..	..	Do.
6	15	Gas muffle, very dull red heat	71·93	0·10	..	Do.
7	15	Do. do.	74·03	..	..	Do.
8	10	Gas muffle, bright red heat	71·69	..	2·34	Red-brown, very little black left.
9	10	Do. rather better	71·65	..	0·04	Do.
10	20	Do. do.	71·65	..	..	Do.
11	90	Do. dull red heat	72·07	0·42	..	Colour slightly blacker in parts.
12	30	Do. do.	72·71	0·64	..	Do.
13	10	Bunsen burner, dull red heat	72·71	..	..	Colour not changed.
14	30	Gas muffle, bright red heat	71·59	..	1·12	Red-brown.
15	60	Do. dull red heat	71·61	0·02	..	Do.
16	120	Do. do.	72·13	0·52	..	Do.

TABLE I.—*continued.*

No. of Heating.	Duration of successive Periods of Heating.	Manner of Heating.	Weight in Grains after Heating.	Gain in Grains on previous Heating.	Loss in Grains on previous Heating.	Colour, &c.
	Minutes.					
17	60	Gas muffle, bright red heat	71·58	..	0·55	Red brown.
18	60	Do. dull red heat	71·59	0·01	..	Do.
19	60	Do. rather cooler than last heating .	71·70	0·11	..	Do.
20	60	Do. same temperature as last heating	71·92	0·22	..	Do.
21	60	Do. very bright red heat, almost white heat.	71·53	..	0·39	Do.
22	120	Do. very dull red heat	71·53	..	..	Do.

The available oxygen was now determined in this prodnet, and found to be 7·035 per cent.; pure Mn_3O_4 contains 6·99 per cent. of available oxygen.

On examining this table it will be seen that when heated at a dull red heat in a gas muffle, manganous carbonate, after parting with its carbonic acid, absorbs oxygen until it attains the composition of Mn_2O_3. The available oxygen in the final product, 7·03 per cent., shows that after the sixth and seventh heating the substance contained 10·17 per cent. available oxygen, as compared with 10·13 per cent. required by Mn_2O_3.

It will be remembered that in the Dunlop manganese recovery process, when the manganese carbonate is heated at a much lower temperature than a dull red heat (about 600° F.) in the presence of water vapour, a still higher oxide than the sesquioxide is formed.

It is further seen that after alternately heating strongly and then at a dull red heat, the substance after each exposure to a high temperature absorbs less oxygen on exposure to a low temperature than it had done on the last exposure to a low temperature, until finally a molecular condition is reached in which it ceases to absorb or to lose oxygen, and that its composition in this condition, by making the higher temperature sufficiently intense, may be made closely to approximate to Mn_3O_4.

Twenty grains of the manganoso-manganic oxide made from manganese sulphate were dissolved in hydrochloric acid, the solution diluted and saturated with bromine. Ammonia was then added and the precipitate of hydrated manganese dioxide filtered off on a Schleicher's filter paper, and washed until free from chlorides, and dried. The precipitate was separated from the filter paper, which was burnt off in a tared platinum crucible, and the precipitate was then placed in the crucible and heated for successive periods as shown in the following table.

TABLE II.

Duration of Successive periods of Heating.	Manner of Heating.	Weight in Grains after Heating.	Loss in Weight in Grains on previous Heating.
Minutes.			
5	In gas muffle at bright red heat.	20·57	..
15	Do.	20·22	0·35
15	Do.	20·05	0·17
15	Do.	20·03	0·02
15	Do.	20·03	..
30	Do.	20·01	0·02
30	Gas muffle nearly white heat.	20·00	0·01
5	Over gas blow-pipe in clay jacket.	20·00	..
5	Do.	20·00	..

The available oxygen in this substance was then determined and found to be 6·98 per cent. The theoretical yield of available oxygen from Mn_3O_4 is 6·99 per cent., and the manganoso-manganic oxide used in the experiment yielded 6·97 per cent. of available oxygen.

It will be seen that after heating at a bright red heat for about an hour an a half the substance was reduced to the composition of Mn_3O_4. But had the weight been taken after heating for 20 minutes at a bright red heat and the assumption made that the substance was Mn_3O_4 an error of about 0·8 per cent. of manganese would have been made.

Another portion of 20 grains of pure manganoso-manganic oxide, containing 6·97 per cent. of available oxygen, as against 6·99 per cent. required by theory, made by heating the carbonate as already described, was heated in a platinum crucible in the following way.

TABLE III.

Duration of successive periods of Heating.	Manner of Heating.	Weight in Grains after Heating.	Loss in Weight in Grains on previous Heating.	Gain in Weight in Grains on previous Heating.
Minutes.				
5	Over gas blow-pipe in clay jacket.	19·98	0·02	..
5	Do.	19·96	0·02	..
10	Do.	19·85	0·11	..
8	Do., gas pressure greater and temperature very high	18·93	0·92	..
¾	Gas muffle at bright red heat.	19·91	..	0·98
30	Gas muffle dull red heat.	19·95	..	0·04
30	Do.	19·97	..	0·02
30	Do.	19·97	..	..

The platinum crucible in which the substance was heated was not a thin one, but on the contrary one with stouter sides and bottom than those that are usually made. It will be seen, however, that there was a considerable loss of oxygen caused by heating over the blow-pipe in a clay jacket, equivalent to as much as 3·85 per cent. of manganese if the weight 18·93 grains be taken as Mn_3O_4. On examining the substance in the crucible when it weighed 18·93 grains, it was found that the underneath part, next the heated metal of the crucible, was of a green colour, no doubt owing to reduction of the manganoso-manganic oxide to manganous oxide, probably, as suggested by Pickering, owing to reducing gas permeating the heated platinum. On placing the crucible with its lid off in a gas muffle furnace for about three-quarters of a minute, at a bright red heat, that part of the substance which was green began to glow and continued

to do so for about half a minute. After the glow had ceased, the crucible was taken out and weighed and found to have gained in weight 0·98 grains, and after heating for an hour longer it ultimately nearly acquired the original weight of the manganoso-manganic oxide used. This experiment shows that there is a risk in heating manganoso-manganic oxide strongly over a gas blow-pipe of obtaining an oxide containing less oxygen than Mn_3O_4. We have also found that sometimes reducing gases enter the mouth of the crucible even if closed by a good fitting lid, when a gas blow-pipe and clay jacket are used. This corresponds with an observation of Wright and Luff (Jour. Chem. Soc. Trans. 1878, 534) when endeavouring to obtain cobalt monoxide by heating a higher oxide in an atmosphere of carbon dioxide over a gas blow-pipe.

The following experiment shows that the precipitate of hydrated manganese dioxide formed by bromine and ammonia behaves in the same way as the oxide derived from manganous carbonate when heated alternately at high and low temperatures, absorbing oxygen at the lower temperatures and parting with it at the higher temperatures, but in this experiment the substance was exposed to the heat of a blast-lamp and the final product contained an amount of oxygen less than that required to form Mn_3O_4. The experiment also shows the tendency of the precipitate of hydrated manganese dioxide to carry down with it calcium from solution.

Twenty grains of manganoso-manganic oxide, containing 6·97 per cent. of available oxygen and 93·03 per cent. of MnO, were mixed with 3·57 grains of calcium carbonate = 2 grains CaO, and after solution in hydrochloric acid and dilution with water, the manganese was precipitated with bromine and ammonia, and the precipitate filtered of, washed free from chlorides, dried and heated in a platinum crucible as follows:—

TABLE IV.

No.	Duration of successive Periods of Heating.	Manner of Heating.	Weight in Grams after Heating.	Loss in Grams after Heating.	Gain in Grams after Heating.	Colour of Substance.
	Minutes.					
1	15	Large Bunsen burner	20·15	..	..	Light brown.
2	30	Gas muffle, red heat	20·13	0·02	..	Do.
3	5	Blow-pipe in clay jacket	20·26	0·17	..	Purplish-brown next metal, the rest light brown.
4	7	Do. do.	20·19	0·05	..	....
5	7	Do. do.	20·01	0·18	..	Nearly all purple-brown, but rather lighter brown next crucible.
6	15	Large Bunsen.....	20·20	..	0·19	....
7	60	Gas muffle, moderate red heat ...	20·23	..	0·03	....
8	20	Do. dull red heat.....	20·21	..	0·01	....
9	20	Do. bright red heat.....	20·21	0·03	..	....
10	10	Blow-pipe in clay jacket	19·96	0·25	..	Colour next crucible rather light brown, one piece green.
11	2	Bunsen burner	20·01	..	0·05	....

After the last heating the available oxygen was determined in the product. To do this it was finely ground in an agate mortar and 19·92 grains of it weighed off and dissolved in a solution of ferrous sulphate in sulphuric acid, and the excess of ferrous salt titrated with standard potassium dichromate solution.

19·92 grains of the substance yielded 1·2017 grains of oxygen; therefore 20·04 grains, *i.e.*, the whole of the substance, would yield 1·248 grains of oxygen. Deducting 1·248 from 20·04 we have left 18·792, which is the weight of MnO and CaO in the 20·04 grains of the precipitate. But the actual amount of MnO taken for the experiment was only 18·606 grains (20 grains of the orginal Mn_3O_4 containing 93·03 per cent. MnO), therefore the quantity of lime present in the precipitate is

18·792 − 18·606 = 0·186 grains,

and the composition of the precipitate is—

	Grains.	Per Cent.
MnO	18·606	92·84
Available oxygen	1·248	6·23
CaO	0·186	0·93
	20·040	100·00

Had the weight after heating for 15 minutes on the Bunsen burner and then for 30 minutes at a bright red heat in the gas muffle, been taken as representing the weight of Mn_3O_4 found in the analysis of a substance, an error of as much as 1·6 per cent. of manganese would have been made.

These experiments, and a number of others of the same character that we have made in relation to the influence of temperature, and of the different modes of heating mentioned in this paper, upon the precipitate of hydrated manganese dioxide formed by bromine and ammonia from solutions of manganous salts and upon manganous carbonate, show—

1. That Mn_3O_4 is only formed from these substances by ignition for about an hour at almost a white heat in a gas muffle furnace, or other apparatus in which the Mn_3O_4 is protected from reducing gases.

2. That an ordinary red heat, such as is obtained over a Bunsen burner, is not sufficient to reduce the oxide to the state of Mn_3O_4, and that an error of $\frac{1}{2}$ per cent. of manganese too much may be made in this way if the percentage of manganese is calculated on the assumption that the product obtained is Mn_3O_4.

3. That there is a risk in all cases when the oxides are heated over a gas blow-pipe of obtaining an oxide containing less oxygen than Mn_3O_4, probably due to the action of reducing gas permeating the heated platinum or entering the crucible under the lid, and that an error of as much as $3\frac{1}{4}$ per cent. of manganese too little may be made in this way.

4. Finally, that all determinations of manganese made by weighing the product, yielded by igniting manganous carbonate or hydrated manganese dioxide in air, are unreliable unless the available oxygen in the product is also determined and taken into consideration.

Our investigations and experience have led us to the conclusion, that just as in the case of the estimation of iron, the volumetrical methods of estimating manganese are far superior to the gravimetrical methods, both as regards accuracy and ease of execution.

The volumetrical method described by one of us in 1879 (Jour. Chem. Soc. Trans. 1879, 365) with some modifications of detail, is still used by us. This method depends upon the whole of the manganese being precipitated as hydrated dioxide by calcium carbonate when chlorine or bromine is added to a solution of manganous salt containing also a persalt of iron or a salt of zinc, and under certain conditions of temperature, &c. We have reason to believe that this method is now adopted by many chemists both in private laboratories and in the laboratories of steel works, and we therefore think that the following description of it in its slightly modified form as we now use it for determining manganese in manganiferous iron ores, manganese ores, spiegeleisen, ferromanganese, &c., will not be out of place.

A quantity of the sample to be analysed, containing not more than about 4 grains (0·25 grm.) of manganese, is dissolved in hydrochloric acid. In the case of spiegeleisen and ferromanganese, about 50 grains (3—4 cc.) of nitric acid are afterwards added to oxidise the iron. In the case of manganese ores, ferromanganese, and manganese slags, which do not contain about as much iron as manganese, we add to the solution as much iron, in the form of ferric chloride, as will make the quantities of iron and manganese in the solution about equal. An excess of iron is no drawback, except that a larger precipitate has afterwards to be filtered and washed.

The excess of acid in the solution is then neutralised by the addition of calcium carbonate, which is added until a slight reddening of the solution is produced. The solution is then rendered very slightly acid by dropping into it just enough hydrochloric acid to remove the red colour.

We then add in all cases 1 oz. (30 cc.) of a solution of zinc chloride containing about 7 grains (0·5 grm.) of metallic zinc per ounce. The liquid is then brought to the boiling point, and diluted with boiling water to about 10 oz. (300 cc.).

Two oz. (60 cc.) of a solution of calcium hypochlorite, made by dissolving 1,500 grains of 35 per cent. bleaching powder in 100 oz. of water (about 33 grms. of bleaching powder per litre) and filtering, are then poured into the manganese solution; but we add to the hypochlorite solution, before pouring it into the manganese solution, just enough hydrochloric acid to give it a faint permanent greenish-yellow colour after gentle agitation.

The object of this addition of acid is to prevent a precipitate forming when the hypochlorite is added, due to the alkalinity of this solution. When hydrochloric acid is added in this way to the solution of calcium hypochlorite, the manganese solution remains clear on the addition of the calcium hypochlorite, and any possible local precipitation of manganese in a lower state of oxidation than MnO_2 is obviated.

Finally, we add to the manganese solution about 45 grains (3 grms.) of calcium carbonate diffused in about half an ounce (15 cc.) of boiling water. After the first evolution of carbonic acid has ceased, during which time the cover is kept on the beaker, the precipitate is stirred to make it collect together, and half a drachm (2 cc.) of methylated spirits of wine are added and it is again stirred.

The precipitate is then thrown upon a large filter of English filtering paper and washed, at first with cold water until the greater part of the chlorine is removed, and afterwards, to make the washing more rapid, with warm water at about 150° F. (65° C.). It is washed until, after draining, a drop shaken down straight from the precipitate, by gently jolting the funnel, shows no indication of chlorine when tested with a strip of iodised starch paper. As a matter of practice we always give two or three washings after there has ceased to be any indication of chlorine.

1,000 grains of an acidified solution of ferrous sulphate, containing about 10 grains of iron per 1,000 grains of the solution, and made by dissolving crystallised ferrous sulphate in a mixture of one part of monohydrated sulphuric acid and three parts of water, are then accurately measured off by a pipette and run into the beaker in which the precipitation was made. The precipitate, together with the filter paper, are then removed from the funnel and placed in the solution of ferrous sulphate in the beaker. The precipitate readily dissolves even in the cold (sometimes it may be necessary to add a little more acid to dissolve the ferric hydrate completely), the manganese dioxide converting its equivalent of ferrous sulphate into ferric sulphate. A sufficient quantity of cold water is now added and the ferrous sulphate still remaining is titrated with a standard solution of potassium dichromate.

The exact amount of ferrous sulphate in 1,000 grains of the ferrous sulphate solution is determined by measuring off into a clean beaker another portion of 1,000 grains, and titrating with standard dichromate solution. The difference between the amounts of dichromate solution required gives the quantity of ferrous sulphate oxidised by the manganese dioxide, and from this the percentage of manganese in the sample can be calculated.

The ferrous sulphate solution should be standardised from day to day, as it undergoes slow oxidation on exposure to air.

By carrying out the process in the manner here described, the temperature of the liquid, immediately after the precipitation is complete, is about 170° F. (77° C.), and we find that the best and most constant results are obtained when the temperature after precipitation is near this point.

We have also tried the effect of precipitating the manganese with zinc oxide or calcined magnesia instead of calcium carbonate.

There are two objections to the use of zinc oxide. One of them is, that the presence of zinc in solution (due to the solution of the excess of zinc oxide in the acid of the ferrous solution) interferes with the titration of the excess of ferrous sulphate, by rendering the finishing point of the titration very indefinite. It has the property of delaying the formation of the blue colour that a ferrous salt gives with potassium ferricyanide, and the titration seems to be finished before the whole of the ferrous salt has been oxidised. Towards the end of the titration, whilst there is still some ferrous salt unoxidised, the drops taken out for testing show no colouration with the indicator until they have been mixed with it for several minutes, and unless patience and care are exercised it is quite easy to make an error of 1 per cent. too much manganese.

Another objection to the use of zinc oxide, and one that also applies to calcined magnesia, is that some oxidising chlorine compound is formed with these substances, which is very difficult to remove by washing, and which is retained in the precipitate after the washings have ceased to give any indications of chlorine with iodised starch paper. In one instance the zinc oxide method indicated 103 per cent. of manganese, and the magnesia method 100·75 per cent.

A solution of bromine in water may of course be used instead of the hypochlorite solution, in which case no acid is added to the bromine solution. When using bromine a solution containing about 10 grains of bromine per ounce (about 22 grms. per litre) should be used, and 3 oz. of this solution (90 cc.) used for precipitating about 4 grains of manganese.

The unpleasantness of working with bromine may be mitigated, to some extent, by adding to the bromine solution before pouring it into the liquid containing the manganese, a few drops of a solution of sodium hydrate until nearly all, but not quite all, the bromine is taken up. If an excess of sodium hydrate were added to the bromine it would produce a precipitate on pouring it into the manganese solution, and this is to be avoided.

We prefer to have both zinc and iron in solution with the manganese. When working with either of these alone we obtain all the manganese in the form of dioxide, but with iron alone there is a greater tendency to the formation of permanganate, than when zinc is also present. This point was also noticed by Wright and Menke (Jour. Chem. Soc. Trans. 1880, 43). When zinc alone is present we have found that the precipitation of the dioxide does not take place so rapidly as when iron is also present. When both iron and zinc are used, there is very seldom any permanganate formed, if care is taken not to use an unnecessarily large excess of chlorine or bromine, but occasionally there is a small quantity formed, especially if the precipitate is left to stand some considerable time before filtering. We have found that the addition of a very small quantity of alcohol immediately after the precipitation of the manganese

is complete, entirely prevents the formation of permanganate even when a large excess of chlorine has been used, and for this reason we make a practice of adding it.

It is known that the oxide precipitated by alcohol from a solution of potassium permanganate in water, is in a lower state of oxidation than MnO_2, but by a long series of duplicate tests in which, to one portion of the sample, alcohol was added after precipitation, but before any permanganate had formed, whilst the second portion was, after precipitation, at once plunged into cold water and stirred until cold, thus effectually preventing any formation of permanganate, we established the fact that the alcohol had not the slighest reducing action upon the precipitate of manganese dioxide—in every case the duplicate tests were alike.

We find that when filtering paper has been wetted with the solution containing free chlorine or bromine and afterwards washed clean it has no reducing action either upon potassium dichromate or upon ferric sulphate. The addition of the filter together with the precipitate to the solution of ferrous sulphate therefore does not influence the result.

We must point out that the presence of lead, copper, nickel, cobalt, and chromium in the substances under examination interferes with the accuracy of this method of testing manganese. To what extent these substances respectively do so is seen from the following experiments, which were made with manganoso-manganic oxide of known composition. In each experiment the method of estimating manganese that we have just described was carried out, and the quantity of ferrous sulphate oxidised in each case was calculated into its equivalent of manganese. In the following table the results are given as parts of manganese indicated for every 100 parts of manganese actually present in the test.

Proportions taken.	Parts of Manganese indicated, per 100 Parts of Manganese taken.
100 parts Mn_3O_4 to 1 part Pb	100·23
100 parts Mn_3O_4 to 1 part Cu	100·23
100 parts Mn_3O_4 to 1 part Ni	100·23
100 parts Mn_3O_4 to 1 part Co	100·64
100 parts Mn_3O_4 to 1 part Cr	101·60

It will be seen that so large a proportion as 1 per cent. of lead, copper, and nickel has not greatly interfered with the test, but the interference of cobalt and, especially of chromium, is serious. All these substances, except chromium, form, under the conditions of the test, higher oxides insoluble in water, which are precipitated with the manganese dioxide, and which oxidise ferrous sulphate to ferric sulphate; whilst chromium forms some insoluble chromate which goes down with the manganese dioxide.

Fortunately these metals rarely, if ever, occur in the ores of manganese or in spiegeleisen and ferromanganese in sufficient quantity to effect the practical accuracy of this test.

This volumetric method cannot, however, be applied to the determination of manganese in alloys of these metals, such as ferro-chrome or in ores containing these metals, without previously separating them from the solution containing the manganese.

We have repeatedly tested this method of analysis with manganoso-manganic oxide of known composition, prepared as already described, and we have invariably obtained by it results indicating 100 per cent. of the manganese used in the test.

Mr. Pattinson exhibited and demonstrated Lux's gas balance.

THE NOXIOUS VAPOURS OF MANURE WORKS.

BY JOHN MORRISON.

Before the envelopment of chemical manure works within the powerful embrace of the "Alkali Works, &c. Act, 1881," the manufacture of superphosphates was carried on for the most part under simply dreadful conditions. Scarcely any serious attempt whatever was in many districts made to render matters agreeable either to the employés within or to the neighbourhood without the works, and had the dissolving process been continuous instead of intermittent, it is difficult to imagine how the men immediately engaged in it could long have survived its physically disastrous effects.

Some manufacturers, too, I am afraid, argued that inasmuch as the extra wages of the process workers liberally recognised the unwholesome nature of the occupation, they at least had no substantial cause of complaint. Also that as in most cases the towns had gravitated towards the works, rather than the works to the towns, the townspeople had little real grievance either.

Fortunately for humanity, however, the 1881 Act ushered in the longed-for dawn of a better day. Manufacturers unable or unwilling to conform to reasonable requirements judiciously and temperately enforced were gradually metamorphosed into merchants at probably little sacrifice beyond their own personal feelings; while of the rest, a notable proportion have readily constructed apparatus, not just barely sufficient to satisfy inspectorial requirements, but to thoroughly and completely prevent the discharge into the atmosphere of almost every particle of their acid vapour production.

The rapid development of the superphosphate industry, and the consequent increase of its nuisances, rendered of course the legislation of ten years back all the more imperative, for whereas with a trifling output, restricted to the close of each working day during the winter months, it was possible to carry on the process in hand tanks, and to utilise without serious inconvenience the entire works overnight as depositing chambers for the noxious exhalations, it is quite evident that the advent of large operations, mechanical mixers, closed dens, and gas draughting to the chimney, at once constituted the works enormous watering pots, from the spouts or chimney stalks of which the adjacent country was freely deluged with unwholesome vapours.

The noxious vapours, however, of the registered manure works, which are under the charge of and can be quantitatively determined by the Government inspectors, must be clearly distinguished from the powerfully offensive and searching stinks peculiar to the boiling of bones and treatment of blood, fish and flesh offal, &c. &c. in non-registered premises. These are wholly under the care of the local sanitary authorities, and with them I have at present of course nothing to do.

The stifling fumes evolved during the treatment of mineral phosphates with sulphuric acid consist chiefly of fluoric, carbonic, and sulphuric acids, intermingled with silicic tetrafluoride and much steam, and when these raw phosphates are treated in conjunction with animal matters various oily vapours of more or less unpleasant character are likewise produced.

There is no difficulty whatever about the arrest of these acid vapours, of which the fluoric acid is the chief. With sufficient time and space to react upon themselves, they will peacefully subside of their own accord. The sole difficulty lies in their arrest within reasonable space and limited time.

As calcic fluoride (CaF_2), fluorine occurs in most mineral phosphates, but in some, and those singularly the phosphates in largest present use, much more plentifully than in others. As hydrofluoric acid, the addition of sulphuric acid sets this fluorine free. Without silica at hand, the hydrofluoric acid escapes into the air. With silica present, fuming silicic tetrafluoride is formed. This also passes into the atmosphere, but only to be decomposed in presence of water into gelatinous silica and hydrofluosilicic acid.

1. $CaF_2 + H_2SO_4 = 2HF + CaSO_4$
2. $4HF + SiO_2 = 2H_2O + SiF_4$
3. $3SiF_4 + 2H_2O = SiO_2 + 2(HFSiF_4)$

The average in CaF_2 (or fluorspar) of South Carolina "River" phosphate and 40—45 per cent. Belgian phosphate, (which are phosphates very commonly employed for the production of the ordinary grades of mineral "supers,") may be taken as not less than 3 to 3½ per cent., or, say, 70 lb. per ton; and as in the larger works 25 to 50 tons of phosphate are treated with sulphuric acid daily, it may be safely assumed that from 8 to 16 cwts. of hydrofluoric acid are regularly evolved during the very few hours out of the 24 which the dissolving operation each day usually occupies.

This implies that on the Tyne alone, in default of condensing plant, four or five tons of hydrofluoric acid would be discharged into the atmosphere every week. Such a fact was, in all conscience, sufficiently serious to demand the most earnest consideration, and the surprising thing was that it escaped legislative supervision so long.

I have given from time to time, since the passing of the Alkali, &c. Works Improvement Act, 1881, some little attention to the arrest of manure works vapours, having designed most of the apparatus in use for its accomplishment throughout the North of England. It may possibly, therefore, interest the members present to have the leading principles of the apparatus roughly described.

There is, however, no such appliance in existence as a "Morrison" tower, any more than a "Morrison" chimney or a "Morrison" sulphuric acid chamber, and my name has by various friendly writers been attached to apparatus for which I have been chiefly responsible, more, I assume, for convenience of reference than for any imagined originality either of principle or design.

There can be no doubt that the manure mixer fumes possess within themselves every element needed for their speedy destruction, and but a single element (heat) to in any way retard it. For this reason I am opposed to the introduction of steam advocated by many manufacturers, for it must be borne in mind that with every ton of superphosphate produced, at least 1 cwt. of water in the form of steam is evolved; and as such a quantity is quite sufficient to saturate the effluent gases, to introduce more is to provide what costs money and can be profitably dispensed with. Doubtless a steam jet will aid the draught, augment the agitation of the gases, and quickly purify up to a certain point an atmosphere thickly laden with noxious vapours; but it appears demonstrable that to the extent of the heat liberated in its own condensation, it must of necessity retard the perfect filtration of the residual vapours, and my impression is that any benefit accruing from its introduction is in any case wholly disproportionate either to its quantity or its expense.

The first desideratum is to cool the gases by draughtage into chambers or flues of sufficient area or length, and where this can economically be managed, little more is required; the fume will quietly subside of itself. But unfortunately it is too generally needful to accomplish a maximum of condensing work within a minimum of space, and where this necessity prevails, the only desirable alternative is to submit the gases to a sort of dry scrubbing process, so as to hasten the deposition of the fluorine compounds. I have managed this in such various ways as the special circumstances in each particular case permitted; but my invariable aim has been to provide, within a suitable flue, a sufficient number of impinging or baffling diaphragms by means of which the motion of the gases could be momentarily arrested and then diverted into another direction, for I have found that at such eddying points or contractions the greatest deposition of silica, &c. has taken place.

In this, then, the first stage of the process, the great bulk (say 90 per cent.) of the solid matter is arrested, so that the residual vapours chiefly now remain to be dealt with. These, therefore, I cause to traverse in an upward direction one or more water towers or wet scrubbers simply packed with wood spars, and after this treatment the gases are allowed to pass away to the chimney.

The necessary draught is created by means of an exhaust fan of special construction. This I find a convenient arrangement, for a well-balanced fan takes little power to drive, is noiseless, and is easily actuated by the mixer engine. It is best fixed between the towers and the chimney, and its power is controlled by a damper just sufficiently to secure a slight "pull in" at the mixer mouth. The den doors are, of course, made as tight as possible, to avoid unnecessary dilution of the gases and interference with the efficiency of the fan.

Gas dilution means reduced condensing efficiency. For as beyond a certain point it is exceedingly difficult to scrub out the acid vapours, the augmentation by dilution with atmospheric air of gas bulks, increases of necessity the total acid escapes. It is the arrest of the last half per cent. which tries the mettle of the apparatus.

This is so exceedingly elementary as to be scarcely worth recipitulating. Yet there have been lots of failures, due to a total misapprehension of the necessities of the case and to the impracticable construction or wholly insufficient capacity of the condensing plant. For in the erection of the latter, two things have to be constantly borne in mind: one, that the evolution of the gas is spasmodic, and (especially in the case of hot vitriol) extremely violent when the spasm is on; and the other, that every chokable part of the apparatus must admit of the readiest possible access. To provide for the first of these, therefore, the plant has to be of ample dimensions, and unless the second be remembered, the most annoying failures at most inconvenient seasons are absolutely certain to ensue.

Where such failures involve stoppages and intervals of working discomfort, they are perfectly fatal to every semblance of manufacturing economy. For every unnecessary reduction in the day's dissolving tonnage, at a time so unremunerative as the present, is simply to add so many pence or shillings per ton to the manufacturing costs, and to sweep away, in all probability, every vestige of profit.

The wet scrubbers, as I have just said, are packed with wood spars. This is for two reasons: firstly, because (unlike coke packing) spars exert no thrust on the tower sides, and so save the necessity of tie-rods. And secondly, because they seem to afford a maximum of interstitial or scrubbing surface to a minimum of solidity. The firebrick packing sometimes adopted is, in my opinion, less economical, for not only does it largely augment the dead weight of the towers, but by its pigeon-hole overlap the ratio of useful surface to solid material is decreased.

I have been in the habit of making the spars of wedged section, as I think this shape delays the choking of the towers, both by affording extra space for the deposit of silica, and by facilitating its detachment and conveyance to the tower base by the action of the water. Silica deposited on the sides of square-sectioned spars clogs the tower by reducing the packing spaces. But on wedged-section spars a considerable deposit can take place without affecting the packing mesh at all.

I usually advocate—where economy of water is an object—one tall tower, in preference to two or three shorter ones. But the prevailing arrangement is a tower of moderate height, divided into two packed upcasts, with a downcast flue between.

These arrangements, of course, do not specifically deal with the arrest of organic matter, which, in the early days of the 1881 Act, the Government inspectors urged manufacturers to destroy by passage of the final gases over a boiler fire. But there is no need for any such complication, as in a properly equipped apparatus the great bulk of the organic matter is carried away in the scrubbing water, and the effluent gases even discharged (instead of through the usual chimney) directly into the atmosphere, exert no appreciable nuisance.

Besides, what is the good of a passage over a boiler fire? Its only possible effects would be dilution without destruction, and reduction of the boiler efficiency. The destruction of organic matters, in fact, by any such means is a sheer impossibility. You can no more burn them by racing the gases impregnated with them over a fire than you can similarly burn smoke. To talk about burning smoke is, of course—practically speaking—to talk nonsense, and the only sensible talk relates to its prevention. Once produced, it, of necessity, goes to the chimney.

To successfully burn the organic matters in manure gases, the entire volume of the latter would have to be raised to the ignition point of the former. And this would involve combustion by passage through a fire: a special and an

expensive arrangement. Of course, the fire requisite for such ignition and destruction might be utilised for the creation of the draught required for the exhaustion of the gases through the scrubbing apparatus, but such an arrangement would be so incomparably more troublesome, inefficient, and costly than a fan, as to be utterly unworthy of the serious attention of any practical man.

But in speaking of the organic matters of chemical manure works, I may mention that it always seems to me a pity that they are not properly included in the 1880 Act. At the present moment, I presume, the Government inspectors have merely a sort of complimentary control over other than the acid vapours in dissolving gases, and that they have no power of legal action regarding the discharge into the atmosphere of organic matters from the mixing machine, however offensive; yet in my opinion, if manure manufacturing is to be controlled at all, it ought to be controlled fully and comprehensively. From a manufacturer's point of view I consider it infinitely better to be wholly under a dignified and a scientific Government supervision than to be periodically bullied and browbeaten by the uninformed nuisance-inspecting Bumbles of the sanitary authorities; and, so far as I can see, there is nothing to prevent the incorporation within the 1881 Act of every process, whether chemical or mechanical, dealing with products used in agriculture, and the enforcement in connexion therewith of the use of the best possible means to obviate nuisance.

It may, of course, be argued that it is rather difficult to define a nuisance which cannot be dealt with quantitatively by any ordinary analytical methods; that what may to one man be a delightful perfume, may to another be a disgusting stench; and that where odours are chiefly of an empyreumatic character, it is not easy to discriminate between what is positively injurious to health and what is merely offensive to the nostrils of a super-sensitive "British public." Still there is a large margin which might safely be legislated upon; and, while the transfer to and storage in non-manufacturing premises might safely continue in the hands of the local sanitary authorities, I for one hope that both the storage and treatment within registered manure works, of every kind of animal or fish offal liable to putrefaction, may speedily be placed under the immediate control of Mr. Fletcher and his assistants.

Discussion.

In answer to a question Mr. Morrison said that the length of flue between the mixers and the scrubbers was dependent on circumstances, but that he preferred a length of 200 feet. The dimensions also would vary with the amount of work done; for a decomposition of 20 to 30 tons per week, a diameter of 18 inches would be about sufficient.

Mr. W. S. Corder referred to the destruction of noxious matters of animal origin. He had had to deal with the products of decomposition of fish, and thought he had completely got over the difficulty. His plan was to draw the gases from closed vessels by a fan, which then drives them up a tower where they are exposed to a shower of water, and down a second tower. They are then brought under the fears of the boiler fire, through which they pass to the chimney. At the top of the chimney no odour can be detected.

ON THE DETERMINATION OF CHROMIUM IN STEEL.

By T. W. Hogg.

Although chrome steel has been known since 1820, it is only within the last few years that it has attracted much attention. When chromium is added to steel to the extent of from 0·5 per cent. to 4 per cent., the alloy is found to possess a greatly increased tensile strength, and such steels may be so treated that extreme hardness is produced without the great tendency to fracture which exists in other hard steels; and it is considered by many metallurgists that the addition of even small quantities of chromium improves the ordinary and better classes of carbon steels.

It is however most likely due to the fact that the preparation and methods of using these steels demand so much more than ordinary care and skill that they have not been more largely introduced.

The principal object of this short paper is to describe a simple method for determining the chromium in these alloys, but as it is of great importance that the analyst should be in the possession of both accurate and rapid methods, perhaps the few following remarks upon the two methods now in use may be of interest.

Galbraith's process (Chem. News, 1877) is the only rapid one we have; it consists in dissolving a weighed portion of the steel in dilute sulphuric acid (1 to 6), and then an excess of permanganate of potassium is added, either in solution or crystals, and then the liquid is boiled until all the manganese is precipitated; the liquid is now filtered and the chromic acid in the filtrate ascertained by adding an excess of ammonio-ferrous sulphate and titrating with standard bichromate.

It has been objected that the whole of the chromium is not dissolved by the sulphuric acid; this objection most likely has arisen from insufficient boiling with the strength of acid originally given; only the merest traces of chromium escape solution if a stronger acid is used, namely, 1 to 3, and if boiling is kept up vigorously for a few minutes after all decomposition has apparently taken place. Another probable source of error arises from filtering the liquid through filter paper; if this is done a small quantity of chromic acid will be reduced, and if the solution is concentrated and hot, and the filtration at all slow, which sometimes happens, the error from this cause alone may become serious; for this purpose an asbestos filter only should be used.

Again, in order that the precipitation of the manganese be effected as rapidly as possible, the liquid should not be diluted any more than can be helped; the crystals, or better still, the finely-powdered permanganate, should therefore be used and not the solution. If very prolonged boiling is ever necessary to precipitate the manganese, the results are sure to be too low.

With these precautions reliable results may be obtained, and if duplicate determinations be made, using different quantities of the steel, there is not much fear of going astray.

With regard to the gravimetric method, it has been variously recommended to precipitate the mixed metals after the steel has been decomposed either as sulphides, oxides, or carbonates, with subsequent filtering and drying; a better method is to evaporate the solution of the steel in hydrochloric acid down to dryness, as recommended by F. O. Arnold (Chem. News, 1880); after mixing and igniting gently with an excess of sodium carbonate, potassium hydrate is added and heat applied. As soon as the mass is in a state of fusion, potassic nitrate is gradually introduced in small portions at a time until the decomposition is judged to be complete; this operation is best conducted in a capacious nickel crucible. The presence of the potassic hydrate enables the operation to be conducted at a much lower temperature; in fact, the crucible may be heated quite sufficiently upon a gauze. Nickel crucibles answer well for this work; moreover the direct contact of the flame is not needed, they do not get such an abundant carbonaceous deposit upon them. The

fusion is then treated with water, and if any manganese is suspected to have passed into solution a drop or two of alcohol is added, and the liquid allowed to stand for a while before filtering. The filtrate is concentrated somewhat and acidified with hydrochloric acid. As a rule there is sufficient potassic nitrite present to ensure the complete reduction of the chromic acid, but in case there is any doubt a little more acid is added, and then two or three drops of pure alcohol. After warming gently, dilute ammonia is added in slight excess as soon as the liquid has attained the right colour. Prolonged boiling before adding the ammonia often produces some change in the condition of the chromium whereby its complete precipitation is rendered very difficult. These chromium chloride solutions are very capricious with regard to their precipitation, and occasionally a pinkish solution is obtained; this as a rule will disappear upon heating gently for some time, or if a few drops of hydrochloric acid be added, again precipitating by ammonia; if the quantity of chromium present is very small, it is best to add ammonium sulphide and allow to stand over night.

I may here mention that nitric acid and alcohol reduces chromic acid solutions much more quickly than hydrochloric or sulphuric acid and alcohol; a very small quantity of alcohol is sufficient for the purpose.

After the precipitate has completely subsided, it is washed thoroughly, ignited, and weighed, then placed in a small beaker, treated with strong nitric acid and chlorate of potash, and warmed very gently; after the residue appears to be free from chromium, water is added and then a slight excess of ammonia. After standing a short time the precipitate is filtered off and washed. A few drops of nitric acid are poured over the filter, which is washed, and ammonia again added to the solution. This is done to separate the little chromic acid which is always carried down by the precipitate. The precipitate is rinsed on to the same filter, washed, ignited and weighed; this weight deducted from the first one gives the weight of pure chromic oxide, if this is only present in small quantity it should be again precipitated from the filtrate and weighed directly. By this treatment there is separated from the impure chromic oxide silica, alumina, and phosphoric acid. It is probable that many determinations of chromium are extremely faulty, especially when this element is only present in small quantities, on account of other impurities than silica. Fresenius states that lime is also occasionally present, but I have never detected any.

This method, of course, cannot be used where the results are wanted in a short time, and no doubt it requires much more patience and skill than the volumetric one.

I will now draw your attention to the following very rapid colorimetric method. Every one who has had experience with chrome steel knows that the solution of the steel in sulphuric acid is highly coloured, the intensity of the colouration being greater as the percentage of chromium increases. Sulphate of iron itself, of course, possesses a green tinge, but the colour intensity of chromium sulphate is so vastly greater than that of ferrous sulphate that the presence of such a small quantity of chromium as 0·1 per cent. is sufficient to give a decided increase to the colour intensity of the solution, and the presence of 0·35 per cent. will almost double it. So far as I have been able to ascertain, this simple fact does not appear to have been applied by anyone for the purpose of determining the quantity of chromium present.

Experiments with chrome steels in which the chromium had been carefully determined by the gravimetric method when compared with the colorimetric one gave very concordant results. I need hardly mention that it is necessary to have accurately-prepared standard chrome steels, the nearer they are to the steels to be examined the better, but a 2 per cent. standard may be used for all steels between 1 and 4 per cent. For steels of lower percentages down to 0·3 per cent. it is necessary to have other standards, but an approximate result useful for many purposes may be obtained from a 1 per cent. standard if careful corrections be applied for the colour value of the iron itself. The method is as follows:—Take 0·2 grm. of the steel of the standard, and also of pure iron, dissolve each in 5 cc. of dilute sulphuric acid (1 to 3), using a rather wider tube than is usual for the Eggertz colour testing, for if the tube is narrow the steel is partially carried up and deposited upon the sides. The decomposition is hastened by placing the tubes upon a hot plate or by heating in a water-bath, they are then boiled over the lamp for a couple of minutes, and then cooled and filtered. The solutions are now compared and their colour intensities adjusted. There are so many different ways of doing this that I need not describe in detail any of them. I myself prefer to use graduated flat-bottomed tubes about half an inch in diameter, comparing the solutions by looking down through them as they are held over a mirror so placed that the light is reflected vertically. The pure iron is also examined and its value in terms of the standard ascertained; once known it need not be done again. From this a table of corrections is prepared, bearing in mind that the quantity to be deducted or added gradually decreases as the steel approaches the standard in value; the quantity to be allowed when these are approximately equal to each other is so small that it may be neglected.

Discussion.

The Chairman referred to Mr. Hogg's remark on the reducing action of the filter paper on chromic acid compounds. He said he had found the same trouble in dealing with compounds of manganese, but had got over it completely by first submitting the filter to the action of a solution containing chlorine, bromine, or bleaching powder, afterwards washing with ammonia. Paper so treated was found to be without reducing action on chromic or manganic compounds.

Glasgow and Scottish Section.

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Hon. Local Secretary:

Dr. G. G. Henderson, Chemical Laboratory, University of Glasgow.

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

The names in italics are those of members of Committee who retire at the end of the current Session. The following have been elected to fill the vacancies, and will take office in July next:—*Committee:* C. J. Ellis, R. A. Inglis, R. Irvine, and J. B. Readman.

SESSION 1890-91.

May 5th (Edinburgh):—

1. Dr. J. B. Readman. "The Manufacture of Phosphorus: Part III."
2. Dr. J. Clark. "The Direct Estimation of Arsenic in Minerals and Metals."
3. Dr. D. B. Dott. "On Methylated Spirits."

May 19th (Edinburgh):—

Mr. J. Laing. "The Destructive Distillation of Mineral Oils, under Pressure and at Atmospheric Pressure, and their Molecular Condition."

June 1st (Glasgow):—

Dr. E. J. Mills. "Destructive Distillation." Part II.

Meeting held at the Societies' Rooms, 207, Bath Street, Glasgow, on Monday, April 6th, 1891.

MR. F. C. C. STANFORD IN THE CHAIR.

THE DETERMINATION OF IMPURITIES IN PARAFFIN SCALE, &c.

BY J. STUART THOMSON.

DESPITE several attempts to formulate a uniform scheme for the analysis of paraffin scale, differences between buyer and seller are still of not unfrequent occurrence, and as it is now generally acknowledged that the cause of such differences arises largely, if not indeed entirely, from the use of varying methods of testing, the Scottish Mineral Oil Association (a body composed of representatives of the mineral oil companies in Scotland), with a view of securing greater uniformity in results, passed the following resolution at a meeting held on 11th June 1890:—

"DETERMINATION OF IMPURITIES IN SCALE AND FLASHING POINT OF HEAVY MINERAL OIL."

"Mr. Fyfe referred to correspondence he had had with Mr. Calderwood (Price's Company) on this subject, and suggested that the chief chemist of each company should meet together, and consider the questions at issue, with a view of formulating a mode of determination which would be applicable to all. Mr. Thomson (Young's Company) to be convener. This was unanimously agreed to."

The committee thus appointed consisted of the following members.—

Mr. E. M. Bailey, Pumpherston Oil Company, Limited.

Mr. Fred. Bishop, Linlithgow Oil Company, Limited.

Mr. R. Dunlop, Stanrig Oil Company.

Mr. John Gray, Clippens Oil Company, Limited.

Mr. J. Moffat Johnston, Oakbank Oil Company, Limited.

Mr. T. R. Sandeman, West Lothian Oil Company, Limited.

Mr. J. Spencer, Burntisland Oil Company, Limited.

Mr. D. R. Stewart, Broxburn Oil Company, Limited.

Mr. W. R. Syme, Young's Oil Company, Limited (Addiewell).

Mr. J. S. Thomson, Young's Oil Company, Limited (Uphall).

who after holding several meetings and making a large number of experiments, ultimately drew up a scheme, giving a description of what they considered to be the best means for determining the impurities in paraffin scale, &c. This scheme was then submitted to Mr Calderwood and Mr. Boverton Redwood, as representing certain of the buyers, and after correspondence regarding some points on which there was a difference of opinion, it was finally adjusted, and has been accepted as the recognised method for the analysis of scale, &c.

It was thought that not only should such a scheme be made as widely known as possible, but also that some explanation and reason should be given, as to the grounds which led to the adoption of the particular processes. As convener of the committee, I was asked by the members to do this, by means of a communication to be laid before this Society. In carrying out this request, I have dealt with each paragraph, in the order given in the scheme, which appears as an appendix to this paper. As this point it may be convenient to point out that the literature on the subject of scale-testing is extremely meagre, nearly all published facts of importance being found in one or other of the following papers:—

Boverton Redwood.—Jour. Soc. Chem. Ind., Vol. III., page 430.

Boverton Redwood.—Jour. Soc. Arts, 1886, Cantor Lectures, page 56.

D. A. Sutherland.—Jour. Soc. Chem. Ind., Vol. VI., pages 123 and 271.

I. SCALE ANALYSIS.

"Scale," it may be explained, is the trade term for crude solid paraffin; it receives this name from the fact that it consists principally of masses of flat crystalline plates or "scales" of the higher members of the paraffin series (C_nH_{2n+2}) of hydrocarbons. In commercial scale there is present, in addition to the solid hydrocarbons, varying quantities of oil, water, and mechanical impurity or dirt, and as these if present in excess are valueless, if not indeed deleterious, it is necessary to estimate their amount. It should be pointed out that there is no sharp line of demarcation between the solid hydrocarbons and the oil, these passing gradually through "soft" or low melting paraffins into each other, and there is no doubt but that a portion at least of such soft paraffins are expressed along with the oil and estimated as such. It will thus be seen that the test for oil is a purely arbitrary one, and consequently the most careful attention must be given to the specified details when carrying it out. In "hard" scale the normal amount of impurities accepted by the trade is 6 per cent., made up of 4 per cent. oil and 2 per cent. water and dirt, everything in excess of these being deducted from the gross weight of the scale.

1. *Sampling Scale.*

Experience has shown that unless great care be taken in the sampling of scale very discordant results may be obtained; by the use, however, of a conical metallic tube such as is described in the schedule, a perfectly representative sample of the cask, waggon, or bing may be readily obtained.

2. *Preservation of the Sample.*

It was found by Mr. McArthur (Price's Company), as well as by members of the committee, that unless precautions were taken, samples of scale rapidly lost water when exposed to the atmosphere, consequently the directions given in paragraph 2 were inserted to prevent this so far as possible. Further, unless the bottles are completely filled, the water present is liable to separate and condense in the upper part, thus tending to render the sample non-homogeneous. In fact the analysis of a scale should be proceeded with as soon as possible after sampling.

3. *Determination of Oil in Scale.*

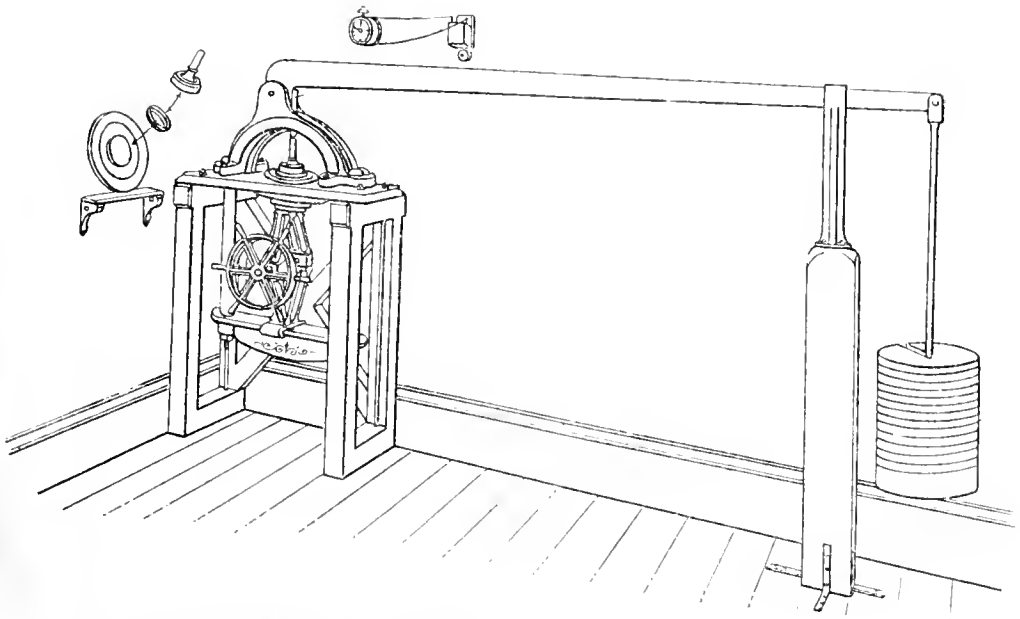
Before dealing with the sub-clauses of this section it may be explained that the principle on which the determination of oil in scale is based is to subject a given quantity of the scale, suitably prepared, to a definite pressure, for a given time, at a specified temperature, and observe the loss in weight which it sustains.

(*a.*) *Description of Press to be used.*—The first form of press used for this purpose, in Scotland at least, consisted of a simple powerful screw, operated by a long lever; this was and is still known as the "Walls" press, and its only drawback is that it was not furnished with any means for indicating the pressure applied, which is perhaps the most important requirement in a press for treating scale. Of presses capable of indicating the pressure, several forms were brought under the notice of the committee, a short description of which may not be without interest.

1st. Those, in which the pressure is applied by means of weights hung at the end of either a single long lever or a system of multiplying levers; the pressure being calculated from the length of the lever or levers, and the weights

applied. Such a form of process is thus similar in principle to the machines used for testing the strength of metals, cement, &c. A press of this type is used by Mr. Boverton Redwood. (Fig. 1.)

Fig. 1.



2nd. Those, in which the power is obtained by means of a screw and long lever, the pressure being indicated by the amount of compression of a powerful spiral steel spring. This form, which is in use in several of the Scottish oil works, was designed by Mr. Wm. McCutcheon, by whose name it is frequently known. (Fig. 2.)

Fig. 2.—Plan.

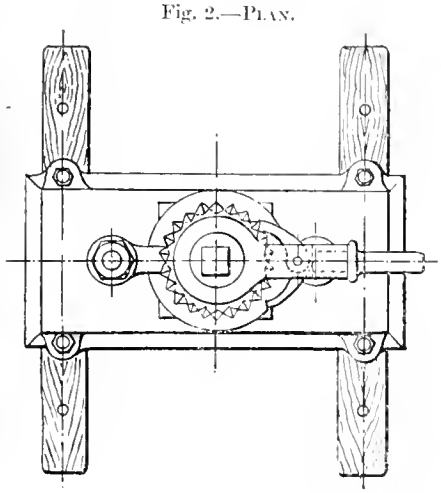


Fig. 2.—Elevation.

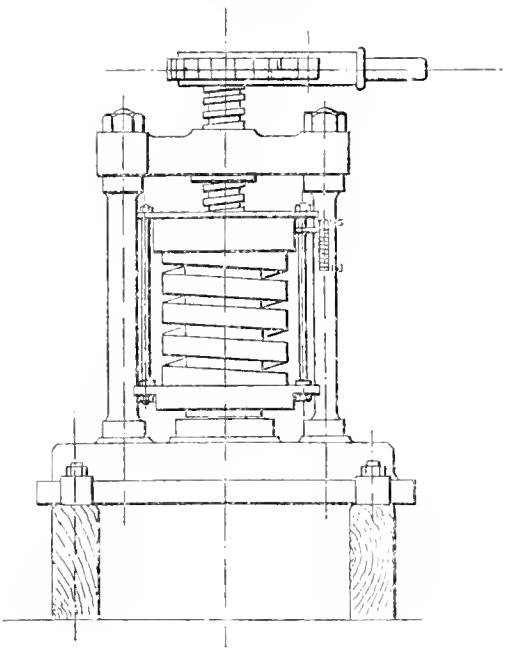
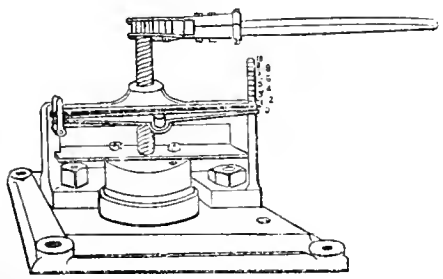


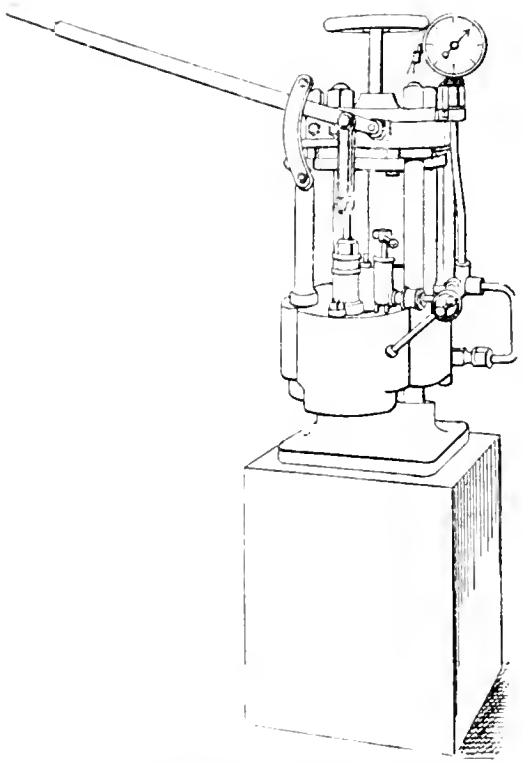
Fig. 3.



3rd. Those, in which the power is also obtained by means of a screw and lever, but the amount of pressure applied is indicated by the deflection of a powerful flat steel spring, which constitutes the cross-head of the press; the slight deflection of the spring being magnified by a lever indicator. This form of press is also made use of by Mr. Boverton Redwood. (Fig. 3.)

4th. Those, which are in reality miniature hydraulic presses; the pressure being indicated by means of an ordinary

Fig. 4.



Bourdon gauge. Messrs. Clarkson and Beckitt, engineers, Maryhill, Glasgow, some years ago introduced a very neat press of this description, which has been highly spoken of.

The question of what form of press should be recommended was one which was very fully considered by the committee; ultimately, however, they agreed that any form of press which had an arrangement for indicating the pressure might be employed provided the cup in which the scale was placed had an area of 20 square inches.

(*b.*) *Preparation of the Sample.*—This is a most important detail, and one which must be most carefully attended to. The first step is to free a portion of the sample from the water and dirt present; this is done by melting at a gentle heat and subsidence, the reason for so doing being that if the water were allowed to remain a varying proportion of it would be expressed along with the oil, when the sample was subjected to pressure. The melted scale is then allowed to cool slowly overnight to a temperature of 60° F., the object of the slow cooling being to allow of the scale crystallising in as large crystals as possible, it having been found that the result of suddenly cooling scale is a mass which is amorphous or nearly so, and which does not part with its oil so readily as scale which has been slowly cooled. The most preferable means of cooling scale is to float the basin or vessel containing the melted scale on the surface of a comparatively large volume of hot water, thus ensuring that the solidification takes place as slowly as possible. After cooling, the sample is ground to a fine powder, either in a mortar or by means of a small mincing machine, when it is ready for use. At one time it was not unusual to mould the scale into a thin round cake of about the required weight, and use this without further preparation for the determination of the oil. Such a procedure is now, however, entirely given up, as it was found to be not only more troublesome, but less accurate, than the method just described, owing to a portion of the oil adhering to the sides of the mould.

(*c.*) *Quantity of Scale to be used.*—At the first meeting of the committee a number of the members were of opinion that 250 grains of scale, the quantity hitherto employed for the determination of oil, was too large; as, especially with scales containing an excess of oil, when this quantity was used, the paraffin was liable to exude beyond the press cloths. This was acknowledged by all, but as doubts were expressed as to the effect of reducing the quantity, it was arranged that Mr. Moffat Johnston and myself should each prepare a sample of scale, portions of which should be sent to each member, who would then experiment thereon, using quantities varying from 150 to 250 grains. Of the two samples, the one contained over 7 per cent. and the other about 3 per cent. of oil. The numerous results thus got were tabulated, and an average taken, from which the following figures are obtained:—

Quantity of Scale employed.	Percentage of Oil found.	
	No. 1 Sample.	No. 2 Sample.
Grains.	Per Cent.	Per Cent.
150	7·78	2·98
250	7·56	2·83

Although these results show that an appreciably greater loss occurs when the smaller quantity is employed, the majority of the members of committee, after considerable discussion, resolved to recommend that the smaller quantity should be adopted. To this, however, the London chemists objected, stating:—

"With hard Scotch scales, using 250 grains we do not experience the difficulty of the paraffin spreading beyond the cloths. With soft scale this sometimes happens."

On this ground, therefore, the original recommendation was modified, so that while 250 grains are still to be used with ordinary "dry" scales, the quantity is to be reduced to 150 grains if the scale contain an excess of oil (over 7 per cent.) or if it be of low melting point (soft scale).

(*d.*) *Temperature at which the Scale is to be Pressed.*—This was fixed at 60° F. as being the temperature in universal use. The important influence which even slight variations of temperature have upon the results, has already been pointed out by Mr. Redwood in the paper referred to, so that it is unnecessary to further direct attention to the importance of this detail.

(*e.*) *Time which the Scale is to Remain under Pressure.*—While some members were of opinion that in some cases at least it might be advisable to press in two stages, applying fresh absorbing papers at each, it was ultimately decided to fix the time at 15 minutes, allowing the sample to remain in the press for the whole period.

(*f.*) *Pressing Cloths and Papers.*—The object in the use of these is the absorption of the oil which exudes from the scale when it is subjected to pressure, and in order that they may do this efficiently, certain small precautions should be carefully attended to.

The cloths between which the scale is placed are cut from fine linen, which should be thoroughly washed previous to use to remove the starch or dressing which is usually present, and which if allowed to remain tends to prevent the free passage of the oil. For the same reason the cloths should be perfectly dry when used.

The papers which act as the principal absorbents of the oil are usually cut out of ordinary blotting or thick filter paper; any fairly thick bibulous paper giving satisfactory results; like the pressing cloths the papers should also be thoroughly dried before being used. In regard to the number of layers of paper necessary to ensure complete absorption of the oil, this varies with the amount of oil present in the scale; never less than six ply of paper on each side of the cloths should, however, be used, and this number will be found to be sufficient with scale containing 4 per cent. of oil. Should the oil exceed this amount, the number of papers must be increased, so that the exterior papers are not soiled by oil, thus ensuring that an excess of absorbent material is present.

In the printed directions no particulars are given as to the manner in which the pressed cake is to be weighed, and on this point it is possible that some little difficulty may arise which will call for future adjustment. In many of the Scotch oil works it is the custom to employ pressing cloths which have been previously saturated with scale, *i.e.*, cloths which have been in use for some time, and to weigh the pressed cake of paraffin along with the cloths. Mr. Redwood, on the contrary, informs me that he is in the habit of using fresh or clean cloths for every test, and of weighing the pressed cake bare or without the cloths. A good deal might be said in favour of each of these methods, and with a view of determining if they had much effect upon the ultimate result, Mr. Moffat Johnston and Mr. Syme have kindly, at my request, made a number of experiments on the two methods; their results, together with those of a similar set of experiments made by myself, are given in the following table:—

TABLE.

EXPERIMENTS on the DETERMINATION of OIL in SCALE, using (1) Fresh cloths for each determination; and (2) cloths which had previously been saturated with scale under the maximum working pressure of nine tons, and weighing the pressed cake both with and without the pressing cloths.

Observer.	Cloths.	Percentage of Oil found.	
		Weighed with Cloths.	Weighed without Cloths.
J. M. J.	Fresh	1·91, 1·88	3·51, 3·65
W. B. S.	Fresh	.. ..	2·74, 2·70, 2·76, 2·77
J. S. T.	Fresh	1·86, 1·98, 2·00	2·84, 2·80, 3·08, 2·88
J. M. J.	Saturated	2·81, 2·87	2·85, 2·70
W. B. S.	Saturated	2·28, 2·31, 2·34	2·35, 2·30, 2·28, 2·34
J. S. T.	Saturated	2·74, 2·80	2·52, 2·64

Note.—Mr. Syme's results are somewhat lower than either Mr. Johnston's or my own, but this is accounted for by the temperature of his press being 57° F. in place of 60°.

These results go to show that, with comparatively dry scales at least, the use of fresh cloths for each test and weighing the pressed cake by itself gives results higher by about 0·5 per cent. than those got when using saturated cloths and weighing the cake along with the cloths. This slightly higher result I attribute to two causes, 1st, the difficulty of completely separating the paraffin from the cloths; and, 2nd, the cloths themselves absorbing a portion of the scale. In the case of a purely arbitrary test such as this is, it is scarcely possible to decide which of the two methods is the more accurate; but seeing that the difference is in reality so small, scarcely indeed exceeding the limits of the error of manipulation, it is perhaps immaterial which process is employed.

I may here add that I have recently adopted a steel punch for cutting out the pressing cloths and papers, as was recommended by Mr. Redwood, and can corroborate his statement as to its usefulness.

(*g*.) *Pressure to be applied.*—The amount fixed is that in almost universal use, and which has been found to give results in conformity with manufacturing operations. Some of the English chemists were inclined to reduce the maximum pressure to 8 ewt. and the working pressure to 7 ewt. per square inch; this was not however pushed and the pressure was allowed to remain at 9 and 10 ewt. respectively. It should be pointed out, that slight variations in pressure have not anything like the effect on the results that small variations of temperature have.

With "soft" or low melting point scales the pressure fixed would be much too high; but as crude soft scales are not, except upon very rare occasions, to be met with in commerce, the committee did not consider it necessary to lay down any regulations regarding the testing of them.

4. Determination of Water in Scale.

Of the various matters which came under the consideration of the committee, there was none which gave rise to a more interesting discussion than this, the determination of water in scale.

The numerous processes which have been proposed for this purpose may be conveniently classed under two heads, viz.:—

1st. The "subsidence" methods, that is those where a given quantity of scale is melted, and the quantity of water which settles down to the bottom of the vessel measured or weighed.

2nd. The "evaporation" methods, that is those in which the water is driven off from the scale by heat, the amount being determined either by condensing and measuring, or by the loss in weight which the sample sustains.

A full description of the "subsidence" methods being found in Mr. Sutherland's paper, it is unnecessary to refer again to them here.

Of the "evaporation" methods, three modifications, viz., distillation from a copper flask, Price's Company's method, and distillation from a small Erlenmeyer flask, were brought under the notice of the members; the first two of these are described in detail in the Appendix, the following being a description of the third:—

Distillation from a small Erlenmeyer Flask.—From 300 to 500 grains of the scale are placed in a small tared Erlenmeyer or conical glass flask, about 5 inches in height, to which a short glass conductor tube, bent at a slight angle, is attached by means of a well-fitting cork. It is then placed on a small shallow sand-bath, covered with a suitable conical tin shield and the whole slowly heated. On heating the water is volatilised, the greater portion being condensed in the conductor tube, at the end of which it is advisable to place a small porcelain basin. In about 15 to 20 minutes practically all the water will have distilled over, this being known by the cessation of "crackling;" the cork is now removed and the flask placed in a steam-bath for a few minutes to allow of any small traces of moisture adhering to the neck of the flask to evaporate; it is then allowed to cool and again weighed, the loss in weight being taken as water.

Regarding these various processes, it may be pointed out that when employing the first method, that with scales containing but a very small percentage of water, it is sometimes difficult to remove the last traces of water from the condenser tube, and consequently in such cases the results are liable to be slightly (about 0·3 per cent.) too low. The reason for the insertion of the last clause in the description of the second method was that it had been found that a certain quantity of oil was volatilised along with the water, and the second experiment with scale freed of water is made with a view of determining the amount so lost. The London chemists were of opinion that such an experiment was unnecessary in every case, and that all that was requisite was to determine the loss once for all for a given class of scale. With the third method the results are liable to be slightly in excess of the actual amount of water present, owing to small quantities of solid paraffin and light oil being volatilised along with the water, but if thought necessary a correction can be applied in a similar way to that described under the second method.

The members of committee were unanimously of opinion that none of the "subsidence" methods were sufficiently accurate to warrant their adoption, and in this the English chemists were at one with them. They were thus left with the three "evaporation" methods, and in order to decide as to the relative merits of each, it was arranged that the members should carry out experiments on the samples of scale prepared by Mr. Johnston and myself. Owing to the fact that, when these samples were distributed, the rapidity with which scale lost water unless most carefully packed, was not thoroughly realised, the results of the various observers are unfortunately not comparable with each other. However, the results obtained by each member showed that in point of accuracy all the three processes were on a par. This being so, the committee decided to select two of them, the result being that the first and second methods were adopted.

The majority of the members of the committee appeared to prefer the distillation from a copper flask; it has, however, the disadvantage of requiring at least 1 lb. of scale to operate on, and this quantity is not available in every instance. At the same time the method is a most convenient one for the regular testing of the daily make of scale in the works, as it practically requires no attention after being once started. Mr. Calderwood and Mr. Redwood, while acknowledging that both processes were equally accurate, expressed a preference for the second method, considering it to be the one most easily manipulated. There is, however, but little doubt but that the preference in each case arises largely from custom and habit.

5. *Determination of Dirt in Scale.*

Regarding this, it is merely necessary to state that in ordinary Scotch scale the percentage of dirt rarely exceeds 0·2 per cent., and it consists chiefly of vegetable fibre derived from the cloths in which the crude scale is pressed, and of oxide of iron from the condenser worms, &c.

6. *Calculation of the Results of the Analysis of Scale.*

No remarks appear to be called for upon this point.

7. *Determination of the Melting (Setting) Point of Solid Paraffin.*

The method specified was not under the consideration of the present committee, it having been adopted some time previously by representatives of the buyers and sellers; it was, however, thought advisable to incorporate it in the present set of directions.

Commercial scale, as already stated, consists of a mixture of the higher numbers of the paraffin series, and it has been found that the "English" test gives more certain results with such a mixture than the capillary tube. The point taken as the "melting" point is, more correctly speaking, the "setting" or "solidifying" point, in the case of paraffin, the real or actual melting point being some 2° to 3° F. higher.

II.—Flashing Points of Heavy Mineral Oils.

8. *Determination of the Flashing Point of Heavy Mineral Oils.*

The use of the covered oil cup of the "Abel" or Government flash-point apparatus for burning oils has gradually become general for the purpose of determining the flash-point of heavy or lubricating oils as well. Its use for this purpose is, however, attended with one rather serious drawback, which is, that when used for high temperatures there is no arrangement for regulating the rate at which the oil is heated. When the Abel cup is used for heavy oils, it is usually heated by means of a small naked flame or on a sand bath, and with a view of making the rate of heating as regular and uniform as possible, the committee specified that not less than 15 minutes should be taken in raising the temperature of the oil to 300° F.; when this is done, fairly concordant results are obtainable.

When the committee first met, Mr. Calderwood brought under their notice a German apparatus, designed by Pensky and Marten,* which he reported as yielding most satisfactory results, both in Mr. Redwood's hands and his own. A short description of this apparatus is to be found in this Journal, **8**, 734, and the principal feature which distinguishes it from the Abel arrangement is, that it is provided with a stirrer, which ensures not only a thorough agitation of the oil, but also of the air or vapour above the oil.

Experiments showed that the discrepancies which frequently occurred with the old method, arose from local overheating of the oil as much as anything else, and that when a stirring arrangement is attached to the oil cup to prevent this, the rate of heating within wide limits was practically without effect upon the result. In these circumstances it was, therefore, specified that in the event of a dispute arising as to the correct flashing-point of a heavy mineral oil, it was to be decided by means of the Pensky-Marten apparatus.

III.—Viscosity of Mineral Oil.

9. *Determination of the Viscosity of Mineral Oil.*

The whole question of the determination of the viscosity of mineral and other oils has already been so fully dealt with by Mr. Boverton Redwood (this Journal, **5**, 121), that it is unnecessary to add anything further here; in fact, the method now adopted is practically identical with that which is therein recommended.

IV.—Setting Point of Mineral Oil.

10. *Determination of the Setting Point of Mineral Oil.*

The setting point of a mineral oil is unfortunately a term to which the most diverse definitions have been applied, some taking the setting point as the temperature at which a given volume of the oil ceases to be fluid, while others again consider the setting point to be the temperature at which an oil just commences to deposit solid matter (paraffin). The latter definition is the one most generally understood among buyers and sellers of Scotch mineral oils, but even here, owing to slight variations in the manner of manipulation, differences of several degrees (Fahrenheit) are not uncommon. In these circumstances the committee framed the directions given in paragraph 10 of the schedule, believing that if the various details be carefully followed, concordant results will be readily obtained by different observers.

When this description of the method for determining setting points was submitted to Mr. Redwood, he took exception to it, stating "This is a method which is only applicable in the case of certain oils and is therefore unsuitable for general adoption," and on making further inquiry as to what oils he had found the process unsuitable for, he again wrote: "According to my experience, the test you propose cannot be advantageously applied in the case of some pale American oils of high viscosity, the solid hydrocarbons in which more nearly resemble vaseline than paraffin."

In addition to such American oils, the proposed process is also inapplicable to Russian heavy oils, which have no true setting point. As however the present rules only apply to Scotch mineral oils, the directions were allowed to stand as originally drafted.

In bringing this paper to a conclusion, I have on behalf of my colleagues and myself to express our thanks to Mr. Calderwood and Mr. Boverton Redwood for much valuable information and assistance, and to Mr. McArthur, chemist to Price's Company, for numerous analyses and tests, and also for their kindness in granting permission to make use of the same in the drawing up this paper.

APPENDIX.

Methods of Determination as to Scotch Scale and Heavy Mineral Oils, agreed upon by the chief Chemists of the Scottish Mineral Oil Association, and certain Representative Purchasers.

I.—Scale Analysis.

1. *Sampling of Hard Scale.*

The sample is to be taken by means of a metal tube, which is made slightly conical; the small end is inserted in the scale, and by means of a handle, which is removable, it is forced through the scale to be sampled. By this means a cylindrical core of paraffin is obtained.

Care must be taken to see that the tube is of such a length that the sample will represent the whole length or depth of the cask, waggon, or bing.

* To be obtained from Sommer and Runge, Wilhelm Strasse 122, Berlin.

2. Preservation of Samples of Scale.

Immediately after the sample has been drawn it is to be thoroughly mixed, placed in suitable wide-mouthed bottles, which may be closed either with glass stoppers or good corks; if the latter are used, they should be covered with paraffin paper or soaked in melted paraffin wax before being inserted. The bottles are then finally sealed in the usual manner. The scale should be tightly packed into the bottles, which should be completely filled.

3. Determination of Oil in Scale.

(*a.*) *Press to be used.*—While no one special form of press is recommended for general adoption, the press used must have some arrangement for indicating the pressure applied. The cup, in which the scale is placed during the application of pressure to have an area of 20 square inches.

(*b.*) *Preparation of the Sample.*—A quantity of the scale, after having been freed from water and dirt, by melting and subsidence, is to be allowed to cool over night to a temperature of 60° F. The solid mass is then ground to a fine powder, a portion of which is used in the determination of the oil.

(*c.*) *Quantity of Scale to be used.*—The quantity of scale to be used in the determination of oil is to be 250 grains, which quantity may, however, be reduced to 150 grains in the event of the scale containing much oil (over 7 per cent.). With "soft" scale the smaller quantity should be taken.

(*d.*) *Temperature at which the Scale is to be pressed.*—The temperature of the scale and the press is to be 60° F.

(*e.*) *Time which the Scale is to remain under pressure.*—The scale is to remain under pressure for 15 minutes.

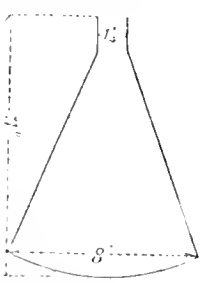
(*f.*) *Pressing Cloths and Papers.*—Fine linen pressing cloths and a number of layers of filter paper, sufficient to absorb all the oil, to be used. The exterior papers must not be soiled by oil.

(*g.*) *Pressure to be applied.*—The maximum pressure is to be 10 cwt. per square inch, and the working pressure 9 cwt. per square inch.

4. Determination of Water in Scale.

The amount of water present in scale may be determined by either of the following processes:—

(*a.*) *Distillation from a Copper Flask.*—From 1 to 2 lb. of the scale are heated in a conical copper flask of about the dimensions shown in the annexed sketch; this is connected to an ordinary Liebig condenser. By means of a powerful Bunsen burner or lamp, the water, accompanied by a small quantity of light oil, is volatilised and condensed. The distillate is received in a narrow graduated measure, so that the volume of water can be readily ascertained. As a little water usually adheres to the sides of the condenser tube, this is to be washed out with hydrated gasoline or naphtha and added to the principal quantity.



(*b.*) *Price's Company's Method.*—500 grains of the scale to be tested are weighed in a tared porcelain basin and heated with constant stirring to 230° F., until bubbles cease to be given off: the loss is then determined.

500 grains of the *same scale*, which has been freed of its water and dirt by melting at a gentle heat and subsidence, are to be heated in the same way, to a similar temperature for the same time, and the loss again determined. The loss in the second instance is now to be deducted from the loss found in the first experiment, and the remainder is then to be taken as the quantity of water present.

5. Determination of Dirt in Scale.

The amount of dirt present in scale is to be determined by melting a weighed quantity of the scale, and after subsidence, pouring off the clear paraffin. The residue is then mixed with naphtha, thrown on a weighed dry filter paper, washed with naphtha or gasoline, dried and weighed. When available, the quantity of scale to be used in the determination of the percentage of dirt should not be less than 7,000 grains.

6. Calculation of the Results of the Analysis of Scale.

As the oil is determined on scale which has been freed from water and dirt, the result must be calculated back to the original scale containing water and dirt.

7. Determination of the Melting (Setting) Point of Solid Paraffin.

This is to be determined by what is known as the "English" test, *i.e.*, a test tube, about 1 in. in diameter, is filled to the depth of about 2 in. with the melted paraffin, a small thermometer is inserted, and the whole steadily stirred, while the test-tube and its contents are allowed to cool slowly. The temperature at which the thermometer remains stationary for a short time is the melting (setting) point.

II.—Flashing-Point of Heavy Mineral Oil.

8. Determination of the Flashing-Point of Heavy Mineral Oil.

The oil cup and cover of the ordinary "Abel" flash-point apparatus is to be employed. The cup is filled with oil in the usual manner, and the rate of heating is to be such that at least 15 minutes are taken in raising the temperature of the oil to 300° F. In the event, however, of a dispute arising as to the correct flashing point of a heavy mineral oil, the question is to be decided by means of the "Pensky-Marten's" apparatus (this Journal, **8**, 734).

III.—Viscosity of Mineral Oil.

9. Determination of the Viscosity of Mineral Oil.

The instrument known as the "Redwood" viscometer, is that which is to be employed in the determination of the viscosity of mineral oils. The instrument is to be standardised according to the directions given by Mr. Boverton Redwood, in this Journal, **5**, 127. Ordinary results are to be expressed, as the time in seconds, which 50 cb. cm. of the oil take to flow through the orifice at a temperature of 70° F.

IV.—Setting Point of Mineral Oil.

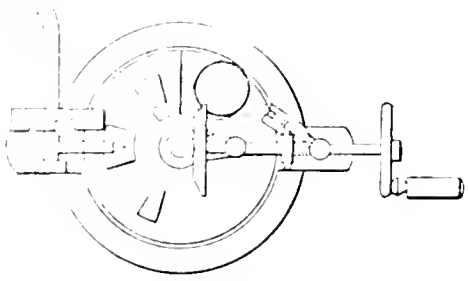
10. Determination of the Setting Point of Mineral Oil.

This is determined in the following manner:—Into a test tube, having a diameter of about one inch and a quarter, the oil to be tested is added to the depth of about two inches, the tube is then immersed in a freezing mixture, the oil being slowly stirred with a thermometer till it is cooled down considerably below the temperature at which solid paraffin first appears; the tube is then removed from the freezing mixture, the oil constantly stirred with the thermometer, and the point carefully watched at which the last trace of solid paraffin disappears. This operation is repeated with the same sample of oil, until two experiments give concordant results, the temperature so found being the setting point.

AN APPARATUS FOR DETERMINING THE FLASH-POINTS OF HEAVY MINERAL OILS.

BY J. GRAY, F.I.C.

The necessity for a speedy and accurate method of determining the flash-points of heavy mineral oils is fully recognised by those who are called upon to make numerous tests, and perhaps no one is more alive to the uncertainty of the methods which are at present employed than the chemists of the Scotch mineral oil works.



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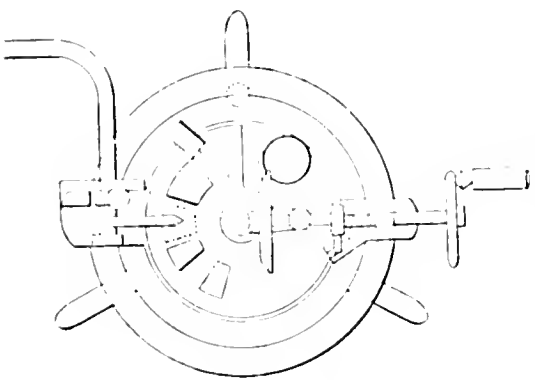

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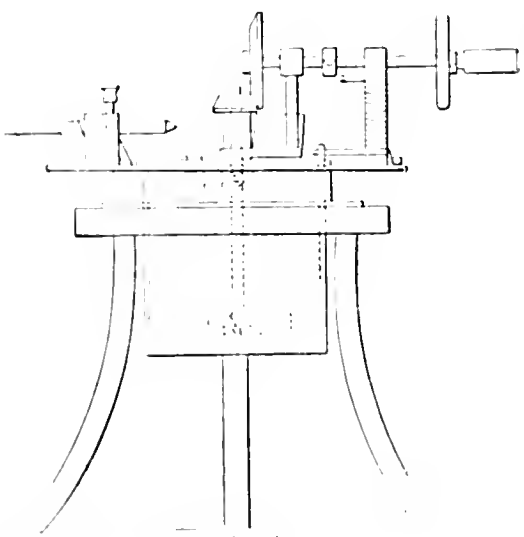

Elevation.

FLASH-POINT APPARATUS.

It is hardly necessary for me to refer to the old method of taking flash-points, known as the "open test," which is well known to give discordant results, even in the hands of the same operator, according to variable and almost uncontrollable conditions under which the test may be carried out. It is still recommended as "sufficiently accurate for many practical purposes." (This Journal, 9, 902.)

The above method, though still employed in some works laboratories is gradually being superseded by the Abel's cup test, in which the oil cup and cover of the well-known petroleum tester are employed. As already mentioned by Mr. Thomson, this method has been adopted by the committee of oil works chemists, provided the time in heating to 300° F. be not less than 15 minutes. I have found that the flash-point of an ordinary Scotch 885° oil will vary as much as 6° F. according as the time of heating varies between 15 and 90 minutes, when the test is carried out with the ordinary Abel's cup. It would therefore be necessary to state the maximum as well as the minimum time of heating, in order to make the results indisputable. With oils having such a wide range of flash-points as those we are dealing with, the fixing of an absolute time is a practical impossibility.

The foregoing method being still unsatisfactory, I was led to design the apparatus I now bring before the Society, with the view of rendering the determination of those flash-points more rapid and accurate. It is an adaptation of the Pensky-Marten slide and stirrer to the Abel cup. Those who now employ the method recommended by the Oil Association chemists, can easily have a stirring arrangement, such as I now show you, fitted to the cup. In working with the Pensky-Marten apparatus, I found the results under varied conditions to be excellent, and was struck with the idea that it could be simplified, and made more suitable for everyday work in the technical laboratory.

The stirrers, consisting of two sets of vanes, one in the oil and the other in the vapour space, are attached to a vertical shaft passing through the cover and terminating at the top in a small bevelled wheel, the bevel of which is milled. A horizontal shaft (carried on two supports) terminates at one end with a bevelled wheel gearing with the one on the stirrer shaft, and at the other end with a disc carrying a small handle with which to rotate the shaft. This shaft also carries a collar with two pins projecting about ¼ in. at diametrically opposite points. By sliding the shaft slightly to the right, the bevel wheels are put out of gear, and the pins projecting from the collar are drawn into position for actuating the testing arrangement. This consists of a sliding cover on the top of the lid proper, so arranged that when the former is moved it depresses the pip light to the proper point, and brings the orifices opposite those on the fixed lid. There are three orifices, one, at which the test light is applied, the other two, situated one at either side of it, being for the admission of air. It will thus be readily seen that the change from stirring to testing and *vice versâ* can be instantly performed.

The results got by this apparatus are identical with those got by the Pensky-Marten. They are not affected by the source of heat, a naked flame giving the same results as the sand-bath. It is immaterial what the rate of heating is, provided it is not too rapid to prevent a correct reading of the thermometer. I prefer to reduce the rate of heating when nearing the point at which the oil is expected to flash. The stirrers do not require to be worked continuously but merely at intervals. I find it advisable to stir more frequently when the rate of heating is fast.

The apparatus is made by, and may be had from Messrs. Baird and Tatlock, Glasgow.

Nottingham Section.

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Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

The names in italics are those of members of Committee who retire at the end of the current Session. The following have been selected to fill the vacancies, and will take office in July next:—

Chairman: L. Archbutt. *Vice-Chairman:* Jno. R. Ashwell. *Treasurer:* J. M. C. Paton. *Committee:* C. H. Field, E. W. Small, C. Taylor, and Sir John Turney.

Obituary.

FRANCIS CLARK BLAKE.

SOMETIME ADJUNCT-PROFESSOR OF CHEMISTRY IN LAFAYETTE COLLEGE AND SUPERINTENDENT WITH THE PENNSYLVANIAN LEAD COMPANY; MEMBER OF THE SOCIETY OF CHEMICAL INDUSTRY.

THE subject of this obituary was born in Cumberland, Maine, February 23rd, 1854, and died in Helena, Montana, February 21st, 1891. His was the son of the Rev. Joseph Blake, late of Andover, Mass. A few years after his birth his family moved to Wells, Maine, where his youth was passed, and his remains now lie.

F. C. Blake, being the minister's eldest son, was obliged to push out into the world at an early age to make a way for himself. He was a hard worker from the beginning, and owed all his successes to his own unaided efforts. The extensive works of Washburn and Moen, of Worcester, Mass., formed the first scene of his labours, and here he learned the trade of machinist. Thereafter he entered the Worcester Polytechnic Institute, and, working his way through the school, graduated in the course of Physics in 1876.

In 1877 he was called to Lafayette College to take the position of Adjunct-Professor of Chemistry, which he filled with honour and ability for two years.

At Easton he later on became acquainted with the daughter of Dr. Ballard, Professor of Moral Philosophy, who became his wife in 1885. In 1879 he accepted the position of Assistant Superintendent with the Pennsylvanian Lead Company, whom he served most faithfully daily until the time of his death. On the resignation of the Superintendent, Mr. E. F. Enrich, in 1881, Mr. Blake was appointed to succeed him. For 10 years he devoted all his energies and talents to the development and improvement of the great refinery entrusted to his care. The works as they stand to-day are a substantial monument to his genius and fertility of resource.

Mr. Blake was a great lover of books, and accumulated in a few years of his business life one of the choicest and most extensive scientific libraries west of the Alleghanies.

In the notice of his life and death contained in the *Eng. and Mining J.*, 1891, 323, from which the foregoing information has been mainly culled, his personal character is thus summed up:—"He was a quiet, strong, earnest, genuine man. But perhaps the most striking characteristic of all was his kindness of heart, and his readiness, nay, eagerness, to help others to bear their burdens."—W. S.

Journal and Patent* Literature.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

PATENTS.

A Composition suitable for Lining Casks and like Vessels, and for Making Screw Stoppers for Bottles. W. Sinclair, Hull, and M. Mackay, London. Eng. Pat. 1177, January 22, 1890. 4*d*.

See under XIII., *page* 375.

Improvements in Lining Boilers or Digesters used in the Manufacture of Paper-Pulp and for similar Purposes. C. Kellner, Vienna, Austria. Eng. Pat. 6951, May 6, 1890. 4*d*.

See under XIX., *page* 381.

II.—FUEL, GAS, AND LIGHT.

Steam Boiler Experiments. Nos. 1, 2, 3, 4 *and* 5. Bryan Donkin, jun., and Professor Kennedy. Engineering, 1890, **50**, 1—2, 59—60, 120—122, 591—593; 1891, **51**, 236—238.

THE authors point out that in all boiler trials hitherto made, different kinds of coal have been used for the different boilers, so that useful economical comparisons of the experiments are difficult. They therefore have undertaken a series of very elaborate experiments on some of the chief types of boilers in general use, employing the same kind of coal in each case. To do this about 100 tons of a good Welsh coal —Nixon's steam navigation—was procured and thoroughly mixed to insure uniformity. The boilers tested included the following types:—

Fires Internal.

(1.) Lancashire boiler with two fires and two tubes. With and without forced draught.
(2.) Railway locomotive or tubular boiler, both fixed and running on rails. With exhaust steam going into chimney.
(3.) Cornish boiler, one fire and one flue. With ordinary chimney draught.
(4.) Cornish multitubular boiler. With ordinary chimney draught.
(5.) Small vertical fire-engine type. With exhaust steam into chimney.
(6.) Vertical tubular. Ordinary chimney draught.
(7.) Tubular locomotive, or agricultural type. With ordinary chimney draught.

One fire.

Fires External.

(8.) Elephant, or French type } With ordinary
(9.) Water tube, or Root type } chimney draught.

* Any of these specifications may be obtained by post, by remitting the cost price, *plus* postage, to Mr. H. Reader Lack Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C. The amount of postage may be calculated as follows:—

If the price does not exceed	8*d*.	½*d*.
Above 8*d*., and not exceeding	1*s*. 6*d*.	1*d*.
„ 1*s*. 6*d*., „ „	2*s*. 4*d*.	1½*d*.
„ 2*s*. 4*d*., „ „	3*s*. 4*d*.	2*d*.

For all the trials a uniform programme was laid down, details of which are fully given in the paper, showing that every possible point was considered, and that the greatest care was taken to ensure exactness in the various measurements. The paper is divided into the following parts:—

I. Description of the standard coal used, its analysis and calorimetric value, amount of ash, moisture, clinker, pure and dry coal, amount of air theoretically required, &c.

II. Methods adopted and instructions followed in the various trials, with particulars and analysis of gases, method of calculating heat balance, graphic representation of results, and tests for radiation.

III. Remarks and notes relating to each experiment.

IV. Tables of results of the standard boiler tests, and the additional tests with other coal.

V. Steam engine trials executed at the same time as the boiler tests.

VI. Comparison of the results, &c.

In Part I. are given complete analyses and calorimetric determinations of the coal, as well as the calculated heat value of 1 lb. independent of the water and the incombustible matter it contained. This last result, which is called "per lb. pure and dry," is 15,560 thermal units (Fahrenheit). From this is calculated the theoretical evaporative value of 1 lb. of the pure and dry coal, which is 16·1 lb. of water from and at 212° F.

In Part II. are given the results of the practical experiments with the various boilers tried. These results, which have appeared from time to time in "Engineering," are not yet exhausted, and up to the present only those of the first seven experiments have been published. These show that most minute precautions were taken to catch and try to account for every thermal unit of the fuel used. Full descriptions, drawings and dimensions of the boilers are given, as well as every detail in connexion with the work. Every factor has been taken into consideration, and the results are given in elaborate tables, as well as being plotted out in the form of curves. A *balance sheet* of the heat evolved and absorbed has been worked out, and is given with each experiment. As the amount of heat evolved is taken as the same in each case (100 per cent., from pure and dry coal), the results of the heat absorbed may be compared in the following table:—

Heat Absorbed Per Cent.

Experiment.	1.	2.	3.	4.	5.	6.	7.
Heating and evaporating water ... (boiler	65·8	79·4	67·6	66·2	56·8	62·5	60·1
Heating and evaporating water ... (economiser	..	..	..	..	..	11·9	11·7
Heating furnace gases	9·4	13·6	16·2	22·5	31·8	13·8	13·3
Evaporating moisture in coal	0·1	0·1	0·1	0·1	0·0	0·1	0·1
Radiation	4·5	7·0	6·0	5·2	9·4	6·5	6·3
Heat in fire drawn	0·1	0·3	0·1	0·2	0·1	..	..
Evaporating water under grate	..	3·1	1·6	..	..	..	..
Lost by imperfect combustion	12·7	0·0	1·2	0·0	0·0	2·1	0·8
Unaccounted for	7·4	4·9	3·6	5·8	1·6	2·8	7·7
	100·0	100·0	100·0	100·0	100·0	100·0	100·0

The type of boiler used in each case was as follows:—

Experiment 1.—Vertical, tubular, internal fire, no economiser; at B. Donkin's works, London (mean steam pressure above atmosphere, 35 lb.).

Experiment 2. Lancashire, with conical tubes in flues, no economiser; at B. Donkin's works, London (mean pressure, 50 lb.).

Experiment 3. The same as experiment 2 (mean pressure, 57 lb.).

Experiment 4. Locomotive, no economiser; at the Engineering Laboratory, University College (worked at atmospheric pressure).

Experiment 5.—The same as experiment 4; at the Engineering Laboratory, University College (under pressure of 85 lb. and reduced area of grate).

Experiment 6.—Water tube, De Naeyer's system; near Liége, in Belgium (mean steam pressure, 86 lb.).

Experiment 7. Same as experiment 6 (steam pressure, 75 lb.).—A. W.

The Valuation of Coal. H. Bunte. J. f. Gasbeleuchtung, **34**, 21–26 and 41–47.

The earliest method in use for the calorific valuation of fuel consisted in employing Dulong's formula, which added together the heat evolved by the combustion of the carbon, sulphur and hydrogen present, subtracting from the latter the amount necessary to form water with the oxygen, as follows:

$$C\,8080 + \left(H - \frac{O}{8}\right) 28{,}800 + S\,2500 = 600\,W$$

W standing for the amount of water existing in the coal.

In the year 1867 Scheurer-Kestner and Meunier (Bull. Soc. Ind. Mulhouse, 1868; Compt. Rend. **69**, 414; **73**, 1061; and **77**, 1587) conducted a series of experiments in a calorimeter resembling that of Favre and Silbermann, which tended to show that the results obtained in the former way were from 10 to 17 per cent. too low, and that from the chemical composition of the fuel only approximate ideas as to its commercial value could be obtained. As these experiments were carried out on small samples of coal (0·3—0·5 grm.) it was felt advisable to repeat them on a larger scale, and the Polytechnische Verein of Munich put up a plant capable of burning from 200 to 300 kilos. at a time.

This apparatus, for a detailed description of which reference must be made to the original article, consists of a calorimeter in which the heat absorbed in boiling water is measured by the rise of temperature of a limited quantity of condensing water, and which is so arranged that samples of the escaping gases can be from time to time collected, and the amount of carbonic acid estimated. Experiments conducted by the author and others in this apparatus, and also by the author in calorimeters devised by Berthelot and Fischer, on a large number of different sorts of coal, show a maximum deviation from Dulong's formula of −3·7 and + 2·8 per cent., and that *so close a connexion exists between the chemical constitution and the heat evolved during the combustion of a coal, that the figures obtained from its ultimate analysis may be confidently employed for calculating its commercial value.* Full particulars of the experiments and analyses on which these conclusions are based, will be found in the paper.

In practice the same coal burnt under different conditions is often found to give widely different results, owing to

the greater or less loss occuring during the process. This loss is dependent on the amount of carbonic acid in the waste gases, being the greater when the carbonic acid is less and the excess of air supplied to the furnace is greater; and the less the higher the percentage of carbonic acid present in the waste gases. Four experiments conducted on coke under precisely similar conditions, excepting as to the amount of air supplied to the furnace, yielded the following results:—

No. of Experiment	In Waste Gases.	
	CO_2	Total Heat Evolved.
	Per Cent.	Per Cent.
1	8·0	22·0
2	10·8	16·0
3	13·8	13·0
4	14·9	10·0

Other experiments on various sorts of coal gave similar results, showing that at a temperature in the flues of 250° when the amount of carbonic acid was 9 per cent., the loss of heat was 20 per cent., while with only 7 per cent. of carbonic acid the loss rose to about 26 per cent.; but owing to the fact that when air is supplied in large excess the temperature of the gases is usually far higher, the loss occurring must be considerably greater than indicated by these figures.

To trace the connexion between the amount of carbonic acid gas in the waste gases and the economy of combustion, the following considerations are submitted. When 0·536 grm. of pure carbon (the weight necessary to form 1 cbm. of CO_2) is burnt in a closed vessel containing 100 cbm. of air at a temperature of 0°, the heat evolved may be calculated to be sufficient to raise the whole to 141°; on doubling the amount of carbon so that the air after combustion contains 2 per cent. of carbonic acid, the temperature will be 281°. In this way a table may be constructed in which the temperature rises approximately 140° for each additional 1 per cent. of carbonic acid. By denoting this temperature by T and the temperature of the waste gases by t, the available heat per cent. may be represented by the expression $\frac{T-t}{T}$.

Thus, with 5 per cent. of carbonic acid and a temperature of 300° above that of the surrounding air, the loss of heat is 43 per cent., and with 10 per cent. of carbonic acid at the same temperature 22 per cent.

To see how far these theoretical considerations apply in practice four experiments were tried on coke in the above-mentioned apparatus and the loss of heat occurring directly estimated:—

	1.	2.	3.	4.
CO_2 in waste gases..per cent.	8·0	10·2	13·8	14·9
Temperature of waste gases (t)	218°	203°	192°	174°
Loss of heat found	21 %	15 „	12 „	10 „
Loss of heat calculated..$\left(\frac{T}{t}\right)$	20	14·3	10·4	8·7

In the case of coal, experiments point to the fact that within certain limits a difference between the theoretical and practical loss of not more than 2—4 per cent. may be expected, with respect to which the author proposes shortly to give further details.—F. H. L.

On the Heat of Combustion of the Commoner Illuminants, and the Contamination of the Air caused by their Use. E. Cramer. J. f. Gasbeleuchtung, **34**, 27—31, 48—50 and 65—68.

The substances examined by the author consisted of candles (made of tallow, paraffin* and stearin), paraffin oil and gas. The tallow candles were moulded, as being more uniform in composition. The paraffin candles were the German standard candles, and the gas was that supplied to the town of Marburg, which, however, differing as it does only slightly from that made in other places, may be said to be of average composition. Both the petroleum and gas were burnt so as to produce a light of about one-candle power. In the following table the "total heat" represents the total amount indicated by the calorimeter, and the "actual heat" the amount rendered latent by the evaporation of the water formed during the combustion subtracted from the total. The weight of substance burnt was in each case one gramme.

Table I.

Substance.	Total Heat.	Latent Heat.	Actual Heat.	Per Cent. of Heat.	
				Latent.	Actual.
Gas.....	12,483	1,150	11,332	9·22	90·78
Petroleum ...	11,033	670	10,363	6·07	93·93
Paraffin.....	10,618	728	9,890	6·86	93·14
Stearin	9,178	626	8,552	6·82	93·18
Tallow	8,720	609	8,111	6·98	93·01

The amount of water formed by the combustion of 1 grm., and also the relative amounts of water and of "actual heat," representing tallow as 100, are shown in Table II.

Table II.

Substance.	Water Formed.	Relative Amounts of	
		Water.	"Actual Heat."
Tallow.....	0·973	100	100
Stearin	1·017	104	104
Petroleum (3 hours)	1·088	112	128
Paraffin.....	1·220	125	122
Petroleum (8 hours)	1·271	131	128
Gas.....	1·867	192	140

The differences in the case of the petroleum lamp when kept burning for three or eight hours are due to the fact that for the first hour or two the combustion is not so perfect as later, carbon being deposited on the wick. On burning the substances so as to obtain a light of 100 candles, the results per hour are given in Table III.

To estimate the amount of carbon incompletely burnt, the original substances were analysed, and from the amount of carbon so found was subtracted that passing away in the waste gases in the form of carbonic acid; this method appearing preferable to the one formerly employed, which consisted in passing a sample of the gases over red-hot copper, and calculating the increase of CO_2. The figures given in Table IV. show the results of burning one gramme of the various substances.

* Throughout this abstract the word "paraffin" signifies the solid used for the manufacture of candles and "petroleum" the "burning oil."

TABLE III.

Substance.	Amount Burnt.	CO_2 Produced.	Water Vapour.	Heat Units.
	Cbm.	Kilos.	Kilos.	
Gas: Siemens' regenerative lamp.	0·35	0·386	0·304	1843
Gas: Argand	0·80	0·882	0·694	4213
Petroleum: Flat burner (5 hours).	Kilos.	1·648	0·653	>6220
Petroleum: Flat burner (8 hours).	0·60	1·876	0·762	
Petroleum: Large round burner (3 hours).	0·20	0·549	0·218	>2073
Petroleum: Large round burner (8 hours).		0·625	0·254	
Paraffin	0·77	2·208	0·911	7615
Stearin	0·92	2·343	0·956	7881
Tallow	1·00	2·681	0·941	8111

TABLE IV.

	Weight of Carbon.			Relative Amounts.	
	By Analysis.	In Waste Gases as CO_2	Incompletely Burnt.	As CO_2	Incompletely Burnt.
Gas	0·653	0·647	0·016	100	320
Tallow	0·740	0·730	0·010	135	200
Stearin	0·763	0·726	0·037	112	740
Paraffin	0·830	0·821	0·018	127	360
Petroleum (3 hours)	0·858	0·751	0·107	116	2,140
Petroleum (8 to 13 hours)	0·878	0·853	0·005	132	100

For a light of 100 candles, these figures become—

	Cbm. CO_2
Siemens' burner	0·39
Argand burner	0·88
Petroleum small and flat flame	1·65
Petroleum large and round flame	0·55
Candles	2·3—2·7

Table V. gives the amount of hydrogen incompletely burnt, the results being obtained by feeding the flame with dry air, and estimating the amount of water in the gases.

TABLE V.

	Weight of Hydrogen.			Relative Amount Incompletely Burnt.
	By Analysis.	In Waste Gases as H_2O.	Incompletely Burnt.	
Tallow	0·118	0·108	0·010	100
Stearin	0·124	0·113	0·011	110
Paraffin	0·152	0·135	0·017	170
Petroleum (3 hours)	0·138	0·121	0·017	170
Petroleum (8 hours)	0·138	0·111	0·027	..
Gas	0·256	0·207	0·049	490

With regard to the loss of heat occurring during the combustion of the various illuminants, Table VI. shows the difference between the total heat registered by the calorimeter and the theoretical amount given off by one gramme. The figures in the case of stearin and tallow are the result of direct analysis, the others being calculated from the probable composition of the substances, the gas being considered to be dry.

TABLE VI.

	Total Heat.		
	Theoretical.	Observed.	Loss.
			Per Cent.
Gas (1 litre)	6,074	5,949	2·6
Stearin	9,745	9,178	6·0
Tallow	9,423	8,720	7·5
Petroleum	12,000	11,036	8·0
Paraffin	12,009	10,618	11·5

The products of the incomplete combustion of the hydrogen and carbon include carbonic oxide, nitrous and nitric, sulphurous and sulphuric acids; the author has only been able to investigate the amount of nitrous acid formed during the burning of stearin candles: his results are 0·126—0·322 mgrms. of HNO_2 per gramme of stearin. The experiments will shortly be continued.

Experiments with guinea pigs prove that healthy animals are able to breathe air contaminated with the products of combustion of stearin candles or a gas burner for days at a time without permanent injury to their health; but in case of human beings, the nose so quickly detects small quantities of "carbonic acid" and nitrous fumes that no one is able to inspire air containing these substances in quantities far below their injurious limits without great inconvenience.—F. H. L.

The Freezing of Gas Mains. J. f. Gasbeleuchtung, **34**, 81.

THE recent severe weather has attracted special attention to the inconvenience caused through the freezing of the water in gas mains, and to the question of the possibility of its avoidance during subsequent winters by the drying of the gas before leaving the works. Seeing, however, that special purifiers of large size would have to be put down, and that to keep the mains dry they would have to be at work all through the year, this plan becomes impracticable, and the only alternative is to lay the mains so deep that they always remain above the freezing point (this Journal, 1889, 949).

—F. H. L.

The Measurement of Natural Gas with the Pitot Tube Gauge. S. W. Robinson. Engineering and Mining J. 1891, 261—262.

THE Pitot tube-gauge is a simple and accurate instrument for measuring the velocity of a current of fluid. This velocity, multiplied by the sectional area of the stream, gives the volume of fluid which passes any cross section of the tube in unit time. An idea of the principle on which the action of the instrument depends may be obtained from Fig. 1, which represents a manometer used for the purpose of measuring the pressure under which natural gas escapes from the mouth of an oil well. Here the external static pressure is that due to the atmosphere acting on the limb F. The limb B is bent down so as to face the issuing gas. The difference in pressure is measured by a column D, E, F of water or mercury: when greater pressures have to be measured, a pressure gauge is used instead, as in Fig. 2. Tables have been prepared giving the velocities corresponding to various differences of pressure.

Fig. 3 shows the actual form of gauge used for measuring the flow of natural gas in pipes. It has been used in pipes where the pressure was above 100 lb. per square inch without inconvenience or detraction from accuracy of results. The tip A, B is seen to have two openings: A is the Pitot tube mouth proper; B is a lateral opening in the smooth uniform side of the tip. B may be at some distance

from A; but it is most convenient to make the double tip so that it can be screwed air-tight into a ⅝-inch hole. The end AB is bent at an angle of 90°, so that A faces the current while B is so placed that the velocity of the gas has no effect, the static pressure alone being transmitted. Thus the pressure exerted at A when the instrument is in use on a pipe line, is equal to the static pressure in the pipe, plus the pressure due to impact, or to the velocity of the current. The figure shows that the pressure at A is transmitted to C, and that at B to D. The difference in pressure is measured by the manometer C D, which consists of a glass tube containing water or mercury. When used for measuring flow from the mouth of gas wells the instrument would be placed just at the mouth, and the pressure transmitted through the side opening would be simply that of the atmosphere; hence the simple manometer shown in Figs. 1 or 2 is all that is required in this case. The complete gauge shown in Fig. 3 is especially designed for measuring the flow of gas in pipe lines. It should be placed so as to receive the normal flow of gas, away from pipe connexions, tees, &c., which cause eddies. The tip should be held at one-fourth of the diameter, or, if at the centre, the apparent volume should be multiplied by 0·97 to correct the so-called velocity curve. The volume (in cubic feet) of gas flowing per hour through the pipe may be found from tables or calculated from the expression—

$$\text{V per hour} = 1690\, d^2 \sqrt{h\left(1 + \frac{p}{15}\right)}$$

where p is the gauge pressure in pounds per square inch, d the inside diameter of the pipe in inches, and h inches of water, the temperature of the flowing gas being taken at 40° F. and that of storage at 50°.

Fig. 1.

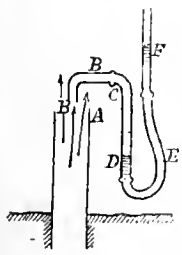


Fig. 3.

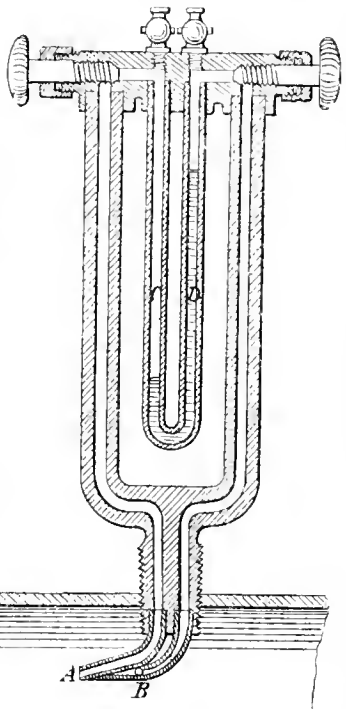
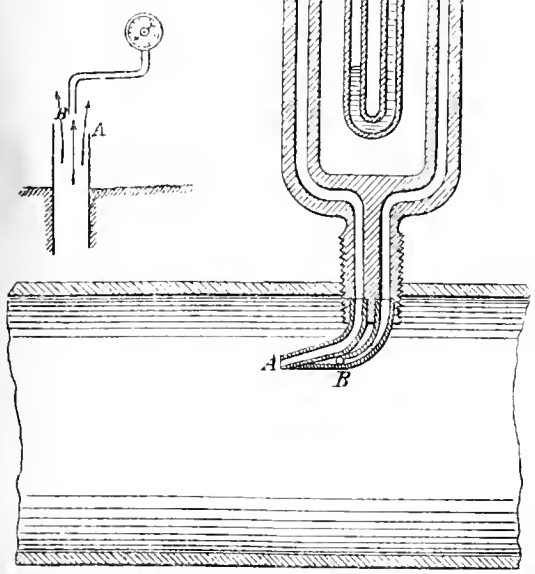


Fig. 2.



Results are given of a series of 21 tests made with a "gas-meter prover," where a known volume of air was forced through a pipe in a measured interval of time; these show that the errors amounted to less than 3 per cent. Tests made with a Westinghouse natural-gas meter gave similar results.—D. E. J.

PATENTS.

Improvements in the Means Employed in Burning Gas or Oil for Lighting or Heating Purposes. W. Potts, Edinburgh. Eng. Pat. 115, January 3, 1890. 8*d*.

In order to effect a slower burning and a more complete combustion of the gas or oil, the products of combustion are discharged along a lateral, instead of a vertical, line of flow; this is effected by having the burner-glass spherical below but funnel-shaped above, and supporting a metal or other reflector on the burner-glass by wires, in such a way that a space of about three-eighths of an inch is left through which the products of combustion may escape; in this way discolouration of ceilings is avoided. The gas is heated by passing through a coil of tube, forming the burner socket, instead of the usual straight passage, and three or more flat flame nibs may be fixed in the socket. An improved form of gas street-lamp and a corrugated form for oil lamp-wicks, to enlarge the burning surface, are also described.

—F. S. K.

Improvements in and Connected with Furnaces for Burning Liquid Fuel. C. A. Sahlström, London, and A. F. Hill, West Brighton. Eng. Pat. 2670, February 8, 1890. 8*d*.

Instead of setting the upper portion of the fire-chamber of a cupola vertically or nearly so above the widened lower portion, the patentees construct it at an angle of 60° or 45°, but varying according to the nature of the material to be melted.

The essential features of the furnace described are:—(1.) The enlarged fire-chamber with a dome-shaped roof combined with an air space and provided with adjustable hydrocarbon burners, and, if necessary, with a fixed or moveable receiver for the molten metal. (2.) The inclined upper portion of the chamber, which is contracted below and provided above with a charging door. (3.) The vertical flue containing superheated steam pipes, which are utilised for the supply of steam to the hydrocarbon burners.

—F. S. K.

Improvements in Apparatus for Utilising Liquid Hydrocarbons for Lighting and Heating. H. H. Doty, London. Eng. Pat. 3242, February 28, 1890. 8*d*.

This patent relates to an improvement on the burner of the apparatus previously described in Eng. Pat. 8697 of 1887.

The burner is constructed with an upper and a lower annular chamber connected with each other by vertical tubes of wrought iron, or other material in which the hydrocarbon is volatilised. The vapour passes through the upper chamber to a burner arranged within the space enclosed by the chambers and tubes; the annular chambers are so constructed that portions of them may be easily removed so as to permit of the vertical tubes being cleaned.

There are two claims and one sheet of drawings.

—F. S. K.

Improvements in Separating Hydrogen Gas and the Light Carburets of Hydrogen, such as Methane, from Water-Gas or Producer-Gas, or from both of them when mixed together. B. C. Sykes and G. Blamires, Cleckheaton. Eng. Pat. 3332, March 3, 1890. 6*d*.

The water- or producer-gas from a gasometer is passed under some pressure through porous tubes suitably arranged in a larger metal tube; the lighter gases, such as hydrogen and methane, which diffuse through the porous tubes more quickly than the heavier gases, are drawn off from the outer and larger tube by an exhauster and passed into a gasometer, whilst the heavier gases pass on and are stored separately. When the lighter gases are required for domestic heating they can be further purified, if necessary, by repeating the process; in this way every vestige of carbonic oxide and nitrogen can be removed.—F. S. K.

Improvements in Incandescent Gas Lamps. A. Wenzel, Czernowitz, Austria. Eng. Pat. 3767, March 10, 1890. *6d.*

The incandescent gas lamp described in this patent is well adapted for use in an inverted position; it consists of a burner formed of two concentric nozzles, and a disc, rod, or grating of magnesia, placed on a suitable support attached to the burner, the whole being enclosed in a suitable perforated glass cover. Illuminating gas is passed through one of the burner tubes, the other being supplied with oxygen, hydrogen, water gas, oxyhydrogen gas or air, either singly or mixed together.

The magnesia disc is prepared by heating magnesium nitrate until the oxides of nitrogen have been driven off, pouring the molten mass on to a plate (covered with paper), and then hardening the cake by heating it again to complete the decomposition.

There are three claims and one sheet of drawings.

—F. S. K.

Improvements in the Manufacture of Artificial Fuel. H. H. Lake, Middlesex. From J. Lundstrom & Co., Stockholm. Eng. Pat. 11,115, September 8, 1890. *4d.*

The blocks of fuel are prepared by mixing the small coal produced in breaking anthracite with an adhesive paste made of finer coal, coal-dust, peat, sawdust, &c., and a solution of silicate of soda; the mixture is then moistened with a solution of common salt containing 5 to 50 per cent. of calcium chloride in order to hasten solidification, pressed or moulded into suitable forms, and dried if necessary.

—F. S. K.

Improvements in Gas Furnaces for use in Glass and other Works. R. J. M. Regnault, St. Denis, France. Eng. Pat. 20,606, December 17, 1890. *6d.*

Gas furnaces employed in glass works have hitherto been provided with two distinct gas-producers and two distinct grates, in order that the supply of gas may be kept up while one or the other is being cleaned out. The patentee describes an arrangement of furnace with a single inclined grate of such dimensions that two (or more) feeding holes can be placed above it, and so constructed that one half of the grate can be charged without in any way interfering with the proper working of the other. This arrangement diminishes the cost of construction and is more economical as regards fuel.—F. S. K.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

The Determination of Impurities in Paraffin Scale, &c. J. Stuart Thomson.

See *pages* 342—347.

The Utilisation of By-products of Mineral Oil Manufacture for Alkali-Making. A. Veith and C. Schestopal. Dingl. Polyt. J. **279**, 21—22.

See *under* VII., *page* 367.

Phenol of Birchwood Tar. M. Ptrenger. Arch. Pharm. **228**, 713—719.

The raw material used, a brownish yellow refractive liquid of acid reaction and sp. gr. 0·956 at 15°, was the *Oleum betulini ætherium rect.* By first washing with sodium carbonate solution and then with water, all acid was removed, subsequent repeated treatment with aqueous potash yielding the *phenoxide*. The phenol was separated from the latter by means of sulphuric acid. It was then taken up with ether, well washed, and then dried with sodium sulphate. The purified phenol was fractionated. At length a fraction boiling between 181° and 191° was obtained, and probably consisted of *cresol* with a little *phenol*.

When heated with zinc-dust, the fraction boiling between 191° and 200° yielded chiefly *toluene* and a little *anisoil*. When heated at 150° C. with methyl iodide and some methyl alcohol, the same fraction yielded *methyl cresyl ether* and a small quantity of *catechol dimethyl ether*. The fraction boiling between 200° and 205° was dissolved in ether and heated to 80° with alcoholic potash; on cooling, dissolving the crystalline product in water, decomposing with hydrochloric acid, and purifying the separated product, *guaiacol* was obtained.

Heated at 150° with methyl iodide, the same fraction yielded mainly *catechol dimethyl ether* and a little *methyl cresyl ether*.

When melted with potash, the fraction distilling between 206° and 211° yielded *hydroxy-isophthalic acid*.

The fraction 218° to 221° behaved with reagents like *creosol*.

Thus the constituents of this birchwood tar creosote are traces of phenol, cresol, guaiacol, 1, 3, 4-xylenol, and 1, 3, 4-creosol. The bulk of the creosote consisted of *guaiacol* and 1, 3, 4-*creosol*.

On the Imperfect Solubility of Mineral Oils in Petroleum Spirit. Bender. Mitt. Konig. tech. Versuchs. 1890, 311—316.

Dark mineral oils, dissolved in benzene, are apt after some time to deposit fine precipitates. The filtration of these precipitates is difficult; good results, however, are obtained by using filter-paper containing asbestos. After having washed the precipitates and dried them at 100°—110° C., it was found, by weighing, that the quantities of the insoluble substances contained in three different mineral oils were 1·8, 2·0, and 1·8 per cent. respectively. The precipitates consisted of a fine powder, resembling dark brown coal, having a slight bituminous smell and a higher specific gravity than water. The melting point is above 110° C., and the powder, if ignited, burns with a smoky flame. It is insoluble in the various kinds of petroleum spirit, slightly soluble in ether, but easily so in heated petroleum. It dissolves easily in carbon bisulphide, benzene, ether, chloroform, and in a mixture of ether and chloroform. These results indicate that the precipitates thus obtained belong to those organic substances which are formed by the oxidation of petroleum, the most important of which is asphaltum. H. S.

PATENT.

An Improved Process for Rendering Tar Oils Soluble in Water and the Production of Disinfectants and other Useful Products therefrom. W. Dammann, Halle, Germany. Eng. Pat. 1017, January 20, 1890. *6d.*

See *under* XVIII. C., *page* 380.

IV.—COLOURING MATTERS AND DYES.

A New Synthesis effected by Diazo-Compounds. R. Hirsch. Ber. **23**, 3705—3710.

Ten grms. of aniline were dissolved in 30 grms. of hydrochloric acid (30 per cent.) and 200 cc. of water, and diazotised by adding a solution of 7·5 grms. of sodium nitrite in 50 cc. of water. The solution was heated to 50° for two hours when the diazo-compound was completely decomposed. The end of the reaction was determined by adding an alkaline solution of β naphthol sulphonic acid,

when no colouration was produced. The solution, after distilling until only traces of phenol remained, was allowed to stand. After 15 hours a few crystals separated. The experiment was repeated with large quantities of material, and the crystalline body was found to be hydroxydiphenyl. The compound is identical with that of Latschinoff obtained by the action of potash on diphenylmonosulphonic acid. The same compound is obtained by diazotising para-amidodiphenyl. The formation of this compound appears to be due to the action of phenol on diazobenzene as follows:— $C_6H_5OH + C_6H_5N_2Cl = C_{12}H_9OH + N_2 + HCl$. To determine this point the following experiment was made. A solution of 50 grms. of aniline in 500 cc. of water was diazotised and shaken repeatedly with a mixture of 100 grms. of phenol with 10 per cent. of water. The product, which contained a considerable quantity of diazobenzene in solution, decomposed energetically, on warming, with evolution of gas. Other solvents, such as benzene, chloroform, ether, anisol, &c., do not extract diazobenzene from an aqueous solution. Since phenol dissolves diazobenzene with an intense orange colour, the author ascribes it to the formation of diazo-oxybenzene, $C_6H_5N:N.O.C_6H_5$. The cresols act similarly.

After decomposing the solution of phenol and diazobenzene on the water-bath, it was distilled in fractions. About 4½ per cent. boiled at 230°—290°, and contained 8 per cent. of phenol and 1 per cent. at 290°—325°, which solidified on cooling. After a second fractionation the product boiling above 200° was dissolved in toluene and shaken up repeatedly with caustic soda solution. The alkaline solution became deep blue and oxygen was evidently absorbed. The toluene separated from the caustic soda and fractionated yielded diphenyl ether and a neutral oil, which was probably $C_6H_5.O.C_6H_5$. The alkaline solution, acidified and shaken up with toluene, yielded a mixture of the two isomers *p*- and *o*-hydroxydiphenyl. The blue colouring matter was not isolated, but was probably similar to the compound obtained by the action of phenol upon nitrosophenol, the leuco-compound of which is *p*-dihydroxydiphenylamine.

The homologues of aniline, benzidine, and naphthylamine react similarly with phenol and with *o*-, *m*-, and *p*-cresol.—J. B. C.

Formation of Quinalizarin from Alizarin. C. Graebe. Ber. **23**, 3739—3740.

It has been shown by René Bohn that bluish-green colouring matters are obtained by warming sulphuric acid with alizarin blue (Germ. Pat. 46,654). The author has found, in conjunction with Muhlert, that these are derivatives, not of dihydroxy- but of tri- and tetrahydroxyanthraquinolinequinone, and that by splitting off the sulpho-groups, a product is obtained consisting chiefly of tetrahydroxyanthraquinolinequinone.

Bohn has extended the reaction to alizarin, the purpurins, anthragallol, &c., and it is found that the product obtained by heating the first named with 100 per cent. sulphuric acid consists of a mixture of tri- and tetrahydroxyanthraquinone. The latter is identical with Liebermann's quinalizarin, and is therefore a 1.1′.2.4′ tetrahydroxy compound. Neither this substance nor the trihydroxy-derivative yield phthalic acid on oxidation.—H. G. C.

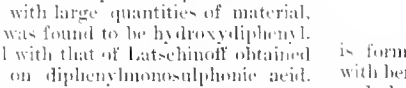
Phenazines. K. Ficker. Ber. **23**, 3803—3810.

O. Fischer and Hepp (this Journal, 1890, 603 and 1028) have described the synthesis of amidonaphthaphenazine, and the author has applied their method to the preparation of other phenazines.

Benzene-azo-α-ethylnaphthylamine separates from a mixture of ether and petroleum spirit in red prismatic crystals, with a bluish reflection, melting at 88°.

Benzene-azo-α-dimethylnaphthylamine is prepared by the action of diazobenzene chloride on α-dimethylnaphthylamine; its hydrochloride forms deep indigo-blue needles, melting at 105°.

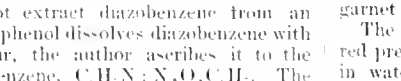
α-Ethyl-amido-α-naphthaphenazine—



is formed when 1 : 2 phenylenediamine (1 mol.) is heated with benzene-azo-ethylnaphthylamine hydrochloride (1 mol.) and alcohol (2 parts), in a sealed tube, for 5—6 hours at 140°. The *hydrochloride* is obtained from the solid portion of the melt after washing it with dilute alcohol, and from the liquid portion by precipitation with water; it is purified by repeated crystallisation from alcohol. The *base* separates from its solution in benzene, on addition of petroleum spirit, as a yellow crystalline powder, which sublimes in woolly needles, undergoing meanwhile partial carbonisation. It is insoluble in water and in alkalis, and sparingly soluble in chloroform, ether, benzene, and cold alcohol; its solutions show a yellow-green fluorescence. The *hydrochloride* forms garnet red and the *nitrate* reddish-brown glistening needles.

The *platinochloride* $(C_{18}H_{15}N_3HCl)_2, PtCl_4$, is a scarlet-red precipitate, consisting of microscopic needles, insoluble in water and sparingly soluble in alcohol, and the *aurochloride*, $C_{18}H_{15}N_3HCl, AuCl_3$, a red micro-crystalline powder, sparingly soluble in alcohol. The *acetyl-derivative*, $C_{20}H_{17}N_3O$, forms small straw yellow rhombic crystals from glacial acetic acid. On heating the *base* with concentrated hydrochloric acid at 175°—180°, the group, $NH.C_2H_5$, is replaced by hydroxyl, ammonia and alcohol being formed (compare O. Fischer and Hepp, loc. cit.).

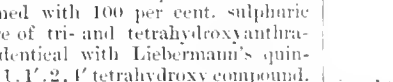
α-Ethyl-amido-α-naphthatolazine—



is prepared from benzene-azo-α-ethylnaphthylamine and tolylenediamine [$CH_3 : NH_2 : NH_2 = 1 : 3 : 4$], under the same conditions as the foregoing compound, which it closely resembles, but is less soluble in the solvents mentioned; it forms yellow stellate groups of needles or plates, melting at 182°. The *hydrochloride* and the *sulphate* crystallise in copper-glistening needles, and the *nitrate* in brown-red needles, having a bronze shimmer. The *platinochloride*, *aurochloride*, and *acetyl-derivative* resemble the corresponding compounds of the foregoing base.

α-phenyl-amido-α-naphthatolazine, $C_{25}H_{17}N_5$, prepared from tolylenediamine [$CH_3 : NH_2 : NH_2 = 1 : 3 : 4$], and benzene-azo-α-phenylnaphthylamine hydrochloride (compare Fischer and Hepp, Annalen **256**, 256) crystallises from alcohol in yellow needles, melting at 214°; it is sparingly soluble in most solvents, and does not sublime readily. The salts are sparingly soluble; the hydrochloride forms small brown-red, and the nitrate brown glistening needles from alcohol. The platinochloride crystallisesin dark red microscopic needles, sparingly soluble in alcohol, insoluble in water, and the aurochloride is a brown-red crystalline powder.

α-Dimethyl-amido-α-naphthaphenazine—



is obtained from 1 : 2 phenylenediamine and benzene α-dimethylnaphthylamine. The melt is evaporated and the resinous residue washed successively with water, dilute hydrochloric acid, and dilute alcohol; it is then dissolved in dilute alcohol containing hydrochloric acid, the *base* precipitated by sodium acetate, and crystallised from alcohol. It forms delicate brownish-yellow needles, melting at 221°, sparingly soluble in ether and petroleum spirit, easier in benzene and cold alcohol; its solutions show a yellow-green fluorescence. It sublimes in woolly needles, and gives, with concentrated hydrochloric or sulphuric acid, a green colour, dissolving, however, in glacial acetic or dilute mineral acids with a cherry red colour. It is isomeric with Witt's dimethylamidonaphthaeurhodine (Ber. **21**, 719). The *hydrochloride* and the *sulphate* form copper-glistening needles and the *nitrate* small bronze-coloured needles. The *platinochloride* and *aurochloride* crystallise in red needles, the former being sparingly soluble in alcohol.

α-Dimethyl-amido-α-naphthatolazine—

$$CH_3.C_6H_3\begin{cases}N.C.C_6H_4\\ \\ N.C.CH\end{cases}>C.N(CH_3)_2$$

prepared from toluylenediamine [$CH_3:NH_2:NH_2 = 1:3:4$], and benzene-azo-dimethylnaphthylamine, resembles the foregoing base, but is somewhat less soluble; it gives the same colour reaction with concentrated sulphuric acid, and forms brownish-yellow needles from boiling alcohol, melting at 230°. It sublimes in woolly needles with partial carbonisation. The *hydrochloride* and the *sulphate* crystallise in garnet-red glistening needles, easily soluble in alcohol, and the *nitrate* separates from alcohol in delicate needles, having a bronze shimmer. The *platinochloride* and the *aurochloride* form brownish-red needles.—A. R. L.

The Tinctorial Properties of the Nitrosohydroxyquinolines. S. v. Kostanecki. Ber. **24**, 150—156.

The author has pointed out (this Journal, 1888, 33 and 838; and 1889, 698) that *ortho*-nitrosophenols (quinoneoximes) are dyestuffs, and he has now extended his experiments to the corresponding quinoline derivatives.

Nitroso-p-hydroxyquinoline, $C_9H_5N(O.NOH)$ (Mathëus, Ber. **21**, 1886), crystallises from alcohol in yellow needles, carbonising at 180°; it dyes green with iron mordants, and brick-red with cobalt mordants. Its most probable constitution is [O:NOH = 3:4].

Nitroso-α-hydroxyquinoline [O:NOH = 1:4] is formed when α-hydroxyquinoline [OH = 1] is dissolved in dilute soda with the addition of the theoretical quantity of sodium nitrite and the mixture poured into cooled dilute acetic acid, or when the hydroxy-derivative is dissolved in dilute hydrochloric acid (2 mols.) and sodium nitrite gradually added (compare Lippmann and Fleissner, Monatsh. **10**, 794). The crude base has tinctorial properties, but this was found to be due to the presence of an isomeric by-product (probably an *ortho*-derivative), which is precipitated as a green lake on adding ferrous sulphate to the solution of the crude base in soda. The pure *base* crystallises from alcohol in thick yellowish needles, darkening below 220° and decomposing with evolution of gas at 245°; it possesses no tinctorial properties.

Amido-α-hydroxyquinoline—

$$C_9H_5N(OH)(NH_2)\quad [OH:NH_2 = 1:4]$$

prepared by reducing the foregoing with tin and hydrochloric acid, is identical with that obtained by Fischer and Renouf (Ber. **17**, 1642); it forms a *sulphate* crystallising in needles, containing 2 mols. of water and melting at 110°. It possesses weak tinctorial properties.

Nitro-α-hydroxyquinoline—

$$C_9H_5N(OH)(NO_2)\quad [OH:NO_2 = 1:4]$$

identical with that obtained by Schmitt and Engelmann (Ber. **20**, 2693), is formed when finely powdered nitroso-α-hydroxyquinoline (1 part) is added to cooled nitric acid sp. gr. 1·38 (4 parts); solid soda is added until the precipitated nitrate redissolves, and the base is thrown down by acetic acid. It dyes with iron mordants green, and with alumina mordants yellow; it also forms a bright green lake with ferrous sulphate.

Dinitroso-α-hydroxyquinoline—

$$C_9H_4N(OH)(NO)_2\quad [OH:(NO)_2 = 1:2:4?]$$

identical with that of Bedall and Fischer (Ber. **14**, 1368) is obtained by treating nitroso-α-hydroxyquinoline with boiling nitric acid; its tinctorial properties are weaker than those of the mononitro-derivative.

The author has learned from Nolting and Trautmann that α-hydroxyquinoline is itself a weak dyestuff. This work proves therefore that *ortho*-quinone-oxime derivatives of quinoline, like those of the aromatic hydrocarbons, possess tinctorial properties, and that the latter can also be brought about by the exchange of that atom of hydrogen in the benzene nucleus of quinoline, adjacent to the nitrogen atom of the pyridine nucleus, for hydroxyl or the isonitroso-group.—A. R. L.

Quinolinedioximes. S. v. Kostanecki and M. Reicher. Ber. **24**, 156—159.

As in certain dyestuffs the hydroxyl of the colour-producing groups may be replaced by the isonitroso-group, without the compound losing its tinctorial properties (compare Kostanecki, Ber. **22**, 1351; this Journal, 1888, 698 and 699), it was to be expected that the dioxime obtained from nitroso-α-hydroxyquinoline (previous abstract) would also retain these properties, and this is found to be so.

Quinolinedioxime, $C_9H_5N(NOH)_2$ [NOH : NOH = 1 : 4], is formed when a solution of hydroxylamine hydrochloride is added to nitroso-α-hydroxyquinoline (previous abstract) mixed into a paste with water. It is boiled with sufficient alcohol to dissolve it, and after distilling off the latter, excess of soda is added, and the dioxime precipitated by acetic acid. It separates from alcohol in microscopic crystals decomposing above 200°. It dyes with iron mordants, in a bath acidified with acetic acid, intensely green to black, and with cobalt mordants faint brownish yellow: the colours are fast. On boiling with acetic anhydride, it yields a diacetyl-derivative, $C_9H_5N(NO.C_2H_3O)_2$, which crystallises in white needles, decomposing at 160°.

Quinolinedioxime [NOH : NOH = 3 : 4] is obtained by adding an aqueous solution of hydroxylamine hydrochloride to finely powdered nitroso-*p*-hydroxyquinoline (previous abstract) suspended in alcohol, and boiling. After distilling off the alcohol, cold soda-lye is added until a clear solution results, from which the dioxime is then precipitated by acetic acid. It crystallises from alcohol in small needles, decomposing at 190°. It dyes faintly brown with iron mordants in a neutral bath, but its tinctorial properties are far less pronounced than those of the 1:4 isomeride. The *anhydride*, $C_9H_5N(N_2O)$, crystallising from alcohol in long needles, melting at 134°, is formed when the dioxime is warmed with alkalis or acetic anhydride.—A. R. L.

Carbazole. G. Mazzara. Ber. **24**, 278—281.

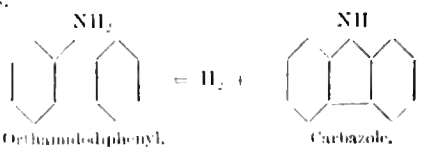
Benzoylcarbazole, $(C_6H_4)_2N.CO.C_6H_5$, is obtained by heating carbazole (1 mol.) and benzoic chloride (1 mol.) for about two hours at 160—170°. The mixture is then warmed with a weak solution of caustic soda, allowed to cool, filtered, and the solid mass purified by repeated recrystallisation from hot alcohol. It forms lustrous needles which melt at 98·5°, and is readily soluble in ether and glacial acetic acid but sparingly soluble in benzene and light petroleum. It is decomposed by alcoholic potash into carbazole and benzoic acid, a reaction which shows that the benzoyl group is attached to the nitrogen atom. As a further proof of the absence of a ketone the base was subjected to the action of hydroxylamine and phenylhydrazine. It is decomposed by the former into carbazole and benzamide whilst phenylhydrazine does not react with it.

Nitrobenzoylcarbazole, $(C_6H_3NO_2.C_6H_4)N.COC_6H_5$, is formed by the action of nitric acid (sp. gr. 1·48) on benzoylcarbazole dissolved in glacial acetic acid. It crystallises in yellow lustrous plates, melting at 181°, dissolves in warm ether and benzene, but only sparingly in alcohol and light petroleum. It is not attacked by potash.

Mononitrocarbazole, $(C_6H_4.C_6H_3.NO_2)NH$, is obtained by boiling benzoylnitrocarbazole with alcoholic potash in a reflux apparatus. It crystallises from alcohol in small scales which melt at 210°, is sparingly soluble in glacial acetic acid, chloroform, and benzene, and almost insoluble in ether and light petroleum.—D. B.

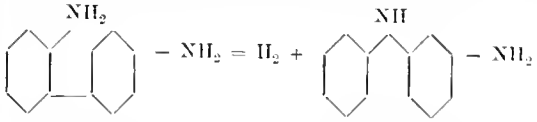
Syntheses of Carbazole. A. Blank. Ber. **24**, 306.

The author has obtained carbazole synthetically by passing the vapour of orthamidodiphenyl over lime heated to dull redness.



Orthamidodiphenyl. Carbazole.

Diphenyline, when similarly treated, gave amidocarbazole, a feeble base, the salts of which are readily decomposed.



Diphenyline. Amidocarbazole.

It crystallises from water in small needles which melt at 238° and resemble benzidine in colour and lustre.—D. B.

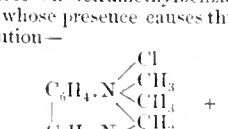
A New Method of Formation of Soluble Indulines. Fischesser. Bull. Soc. Ind. Mulhouse, 1891, 48—51.

The earliest known members of the class of induline dyestuffs are insoluble in water, and have either to be sulphonated to render them soluble, or dissolved in alcohol, ethyl tartrate, or acetin, to enable them to be employed for dyeing or printing. Recently numerous methods have been discovered for the manufacture of indulines soluble in water. The chief of these methods may be summarised as follow: (1) The action of nitramines on the hydrochlorides of other monamines; (2) the action of amidoazobenzene on aniline and aniline hydrochloride, different proportions of these compounds being used from that used in the manufacture of insoluble indulines; the soluble induline obtained in this way has the formula $C_{24}H_{18}N_4$; (3) the use of secondary or tertiary amines in place of the primary amines previously used. The reaction of *p*-phenylenediamine with (4) amidoazo-compounds; (5) azophenine; (6) *p*-phenylenediamine hydrochloride and nitrobenzene in the presence of ferrous chloride; (7) α-amidoazonaphthalene or α-amidonaphthaleneazobenzene; (8) chloranil; (9) diamidoazoxybenzene hydrochloride; (10) pheno- and tolu-safranines; (11) unsymmetrical triamidobenzene; (12) azobenzene or azotoluene; (13) induline, soluble in spirit, of the formula $C_{30}H_{27}N_5$; (14) *p*-diamidoazoxybenzene; (15) induline, soluble in spirit, of the formula $C_{18}H_{15}N_3$; (16) induline, soluble in spirit, obtained by the action of diazotised benzidine on aniline; (17) the substance produced by the combination of diazobenzene with naphthylenediamine. (18) A soluble induline is formed along with other substances by heating together in aqueous solution the hydrochlorides of aniline and amidoazobenzene.

The new method discovered by the author consists in causing primary, secondary, or tertiary aromatic amines to react with the amidoazo-compounds produced by the action of the diazo-derivatives of *o*-, *m*-, or *p*-nitraniline on *o*- or *m*-nitraniline, or with the diazoamido-compounds formed by the combination of the diazo-derivatives of *o*-, *m*-, or *p*-nitraniline with *p*-nitraniline. In practice, these bodies are heated with ferrous and zinc chlorides, and according to the temperature of the reaction and the proportions of materials employed, grey, blue or violet dyes are produced. As an example, 250 parts of diazoamidodinitrobenzene (from *p*-diazonitrobenzene and *p*-nitraniline), 500 parts of aniline hydrochloride, and 575 parts of dimethylaniline hydrochloride, are heated with ferrous and zinc chlorides at 140° to 200° until a sample, on testing, dissolves in dilute hydrochloric acid with the desired shade of colour. The reaction is then interrupted, the mass dissolved in dilute hydrochloric acid, rendered alkaline with lime, and the unchanged bases removed by a current of steam. The free colour-base is washed with water, re-dissolved in dilute hydrochloric acid, and the dye salted out. It forms a black powder which is sparingly soluble in cold water, but freely so in hot, with a violet-blue colour. It yields blue-grey shades on cotton mordanted with tannic acid.—E. B.

Some Derivatives of Dimethylaniline. C. Lauth. Compt. Rend. **111**, 886—888.

The action of lead dioxide on dimethylaniline is essentially different from that of various other oxidising agents; with the latter, one of the methyl-groups is attacked, giving rise to the formation of Methyl violet, but with lead dioxide the phenyl groups are oxidised with the production of tetramethylbenzidine. Several methods have been described for the preparation of tetramethylbenzidine from dimethylaniline, but the process with lead dioxide is distinguished by the rapidity and ease with which it gives an abundant yield of that base. To prepare tetramethylbenzidine by this method, 20 parts of dimethylaniline are dissolved in 120 parts of acetic acid at 8° B. and 160 of water, and 20 to 30 parts of lead dioxide are gradually added whilst the temperature is kept below 30° or 35°. The reaction is complete in 5—10 minutes. The product is filtered, washed with hot water, boiled with water to eliminate all traces of dimethylaniline, dried and purified by repeated crystallisation from light petroleum. The mother-liquors, after removal of the lead by sulphuric acid and neutralisation with ammonia, give a small quantity more of the base. The yield altogether is about 40 per cent. Oxidising agents, such as lead dioxide, ferric chloride, bichromates, atmospheric oxygen, &c., give with mere traces of tetramethylbenzidine an intense green colouration, which is noticeable when preparing that substance by the above method. When prepared by the action of a tolerably strong solution of ferric chloride on tetramethylbenzidine hydrochloride, the compound, whose presence causes this green colouration, has the constitution—



If an excess of a solution of ferric chloride at 45° B. be used, an orange-coloured ferric chloride double-salt is obtained. The zinc double-salt is sparingly soluble in saline solutions. All the salts of this compound are soluble in water; they are also soluble in alcohol and are precipitated by ether from solution in the same. The compound itself is extremely unstable, apparently existing only in the form of salts; it is decomposed by cold, and very rapidly by hot, water, the solutions being decolourised and tetramethylbenzidine regenerated; alkalis form with it tetramethylbenzidine and hydrogen dioxide; it is decomposed by drying in vacuo; it is capable of dyeing, yielding on silk very pure shades of green, which, however, quickly disappear even when protected from air and light.—E. B.

Colour Reactions of Aromatic Amines. C. Lauth. Compt. Rend. **111**, 975—977.

See under XXIII., *page* 389.

PATENTS.

Colouring Matters Obtainable by the Combination of Tetrazoditolyl or Tetrazodixylyl Salts with Alpha- and Beta-Naphthylamine or their Mono- and Disulpho Acids, and Process for the Manufacture of the same. H. J. Haddan, London. From the "Farbenfabriken vormals F. Bayer and Co.," Elberfeld, Germany. Eng. Pat. 3803, March 24, 1885. (Third Edition.) 6*d.*

This specification has already been abstracted (this Journal, 1886, 96).—T. A. L.

The Manufacture of Sulphonated Thionines. S. Pitt, Sutton. From L. Casella and Co., Frankfort-on-the-Maine, Germany. Eng. Pat. 4596, March 24, 1890. 6*d.*

A process for obtaining blue to greenish-blue dyestuffs which dye animal fibres from an acid bath. The following quantities are given for the formation of a colouring matter, which dyes wool the same shade as indigo carmine. 30 kilos. of benzylethyl-*p*-phenylenediamine sulphonic acid are dissolved in 300 litres of water and mixed with a solution containing 30 kilos. of aluminium sulphate and 26 kilos. of sodium thiosulphate. The whole is then oxidised with 10 kilos. of potassium bichromate forming ethylsulphobenzyl-*p*-phenylenediamine thiosulphonic acid, and giving a colourless solution. A dilute solution of

29 kilos. of benzylethylaniline sulphonic acid is then added, and the whole oxidised with 30 kilos. of potassium bichromate, boiled for a short time, and zinc chloride added. The dyestuff forms a dark blue solution, and after filtering is precipitated by salt. The benzylethylaniline sulphonic acid can be replaced by mono- or dimethylaniline or mono- or diethylaniline or α-toluidine with the formation of similar colouring matters.—T. A. L.

Production of Ethyl Ether of Cinnamic Acid. O. Imray, London. From the "Farbwerke vormals Meister, Lucius, und Prüning," Hoechst-on-the-Maine, Germany. Eng. Pat. 4946, March 29, 1890. 4*d*.

The method hitherto employed for obtaining cinnamic and ethyl ether has been the etherification of cinnamic acid. The ether can, however, be obtained directly from benzaldehyde by the action of acetic ether in presence of metallic sodium. 45 kilos. of acetic ether and 1·15 kilos. of sodium (in small pieces) are kept cool by means of iced water, and 10·65 kilos. of benzoic aldehyde allowed to run in slowly. When the whole of the sodium has disappeared acetic acid is added corresponding to the sodium taken, and on dilution with water the ether separates. After drying with calcium chloride the acetic ether is distilled off on the water-bath, and the cinnamic ethyl ether is rectified, distilling at about 260 —275° C.—T. A. L.

Manufacture of Azo Colouring Matters Derived from Azoxyamines. J. Imray, London. From "La Société Anonyme des Matières Colorantes et Produits Chimiques de St. Denis" and A. F. Poirrier and D. A. Rosenstiehl, Paris, France. Eng. Pat. 5736, April 15, 1890. 6*d*.

A NITRO-AMINE is diazotised and combined with a phenol or amine, hydroxy-derivative or sulphonic or carboxylic acid, and the azo compound thus obtained is reduced in an alkaline solution with zinc-dust, glucose, arsenious acid or other reducing agent. Para-nitroaniline is diazotised in an acid solution and combined with naphthol disulphonic acid. This colouring matter dyes wool red, but not cotton. 55 kilos. are dissolved in 2,750 litres of water and 76 litres of caustic soda-lye of 40° B. The solution is heated to 80°, and 17·5 kilos. of glucose in 350 litres are added with constant agitation. At the end of an hour the new colouring matter is precipitated by the addition of salt, and dyes unmordanted cotton blue from an alkaline bath. (See also Eng. Pat. 1579 of 1890; this Journal, 1891, 131.)—T. A. L.

The Preparation of New Sulphonic Acids for the Production of a Blue Colouring Matter for Cotton. S. S. Bromhead, London. From "Die Chemische Fabrik Grunau, Landshoff und Meyer," Grunau, Berlin, Germany. Eng. Pat. 6195, April 23, 1890. 6*d*.

Sodium naphthionate is heated in a current of carbonic acid in a horizontal cylinder provided with an agitator to a temperature of from 220 —240° C. until a test dissolved in water no longer shows a violet blue fluorescence in a dilute solution, when the melt is dissolved in water and precipitated with sulphuric acid. The new α-naphthylamine sulphonic acid formed, gives a diazo compound crystallising in greenish-yellow scales, and is converted on boiling with dilute sulphuric acid into an easily soluble α-naphthol sulphonic acid which yields a dichloronaphthalene melting at 35° C. On sulphonation with four parts of fuming sulphuric acid containing 10 per cent. of anhydride the α-naphthylamine sulphonic acid is converted into a new α-naphthylamine disulphonic acid easily soluble in water, but sparingly so in dilute sulphuric acid. When the sodium salt of this acid is heated in an autoclave with caustic soda and water for 20 hours to about 260° C. a new amidonaphthol sulphonic acid is produced, which on combination with tetrazodiphenyl in an acetic acid or alkaline solution yields a blue colouring matter which dyes unmordanted cotton.—T. A. L.

Manufacture of Nitrated Colouring Matters. J. Imray, London. From "La Société Anonyme des Matières Colorantes et Produits Chimiques de St. Denis," Paris, France. Eng. Pat. 6486, April 28, 1890. 4*d*.

Certain colouring matters such as Fuchsin, Dimethylaniline violet, and Methylene blue, are treated with a mixture of sulphuric and nitric acids. The shades of the dyestuffs produced do not differ greatly from the original colouring matters, but "all these products have the advantage of not colouring the light parts of a design produced by removal of the tannin mordant, and they resist soap and light at least as well as the colouring matters whence they are derived."—T. A. L.

Improvements in the Manufacture of Colouring Matters. C. D. Abel, London. From the "Aetien Gesellschaft für Anilin Fabrikation," Berlin, Germany. Eng. Pat. 6932, May 5, 1890. 6*d*,

By the action of one molecule of tetrazoditolyl on one molecule of α-naphthylamine the following compound is formed—

$$ClN = N - C_7H_6 - C_7H_6 - N = N - C_{10}H_6 - NH_2HCl.$$

This, by treatment with nitrous acid, can be converted into a tetrazo compound and combined with phenols, amines, or their sulphonic or carboxylic acids. The bodies obtained dye unmordanted cotton violet to blue shades which are fast to light. 10·9 kilos. of tolidine are converted into the tetrazo compound and added to a solution of a salt of 7·5 kilos. of α-naphthylamine. After standing some time the mixture is acidulated with hydrochloric acid and diazotised with sodium nitrite. The tetrazo compound thus obtained is combined with 40 kilos. of the sodium salt of α-naphthol disulphonic acid (Eng. Pat. 4625 of 1888; this Journal, 1889, 280). After standing some hours the solution is boiled and the dyestuff precipitated with salt, filter-pressed and dried. It dyes unmordanted cotton bluish-violet. If 17·1 kilos. of dianisidine be substituted for the tolidine a colouring matter is obtained which dyes cotton a bluish-green.—T. A. L.

Production of New Basic Blue Colouring Matters. S. Pitt, Sutton. From L. Casella and Co., Frankfort-on-the-Maine, Germany. Eng. Pat. 6916, May 5, 1890. 4*d*.

Secondary amines of the fatty series, as for instance, dimethylamine and diethylamine, combine with colouring matters of the oxazine class such as New blue, Muscarine, Gallocyanine to form bases which on oxidation give blue colouring matters of purer and greener shades. 32 kilos. of dimethylamidonaphthophenoxazine chloride (New blue R) are mixed with an aqueous solution containing 30—40 per cent. of dimethylamine. A substance is formed sparingly soluble in water, but soluble in dilute hydrochloric acid. This is oxidised by passing air through for several days at 15° C. until the mass has become dry. The oxidation is finished when a test is completely soluble in hot water. The whole is then dissolved in 1,000 litres of water, neutralised with hydrochloric acid, filtered, cooled to 15° C., and precipitated with salt. The colouring matter separates in green needles and dyes cotton mordanted with tannin a greenish-blue fast to soaping and light, and dyes wool a deep blue from a neutral or acid bath.—T. A. L.

Improvements in Treating Alizarin Blue for the Obtainment of New Compounds thereof, and Alizarin Blue S. J. Y. Johnson, London. From the "Badische Anilin und Soda Fabrik," Ludwigshafen-on-the-Rhine, Germany. Eng. Pat. 8363, May 28, 1890. 6*d*.

According to Eng. Pat. 3603 of 1881, Alizarin blue is converted into Alizarin blue S by treatment with an alkaline bisulphite or by passing sulphurous acid gas through an aqueous solution of an alkali containing Alizarin blue in suspension. According to the present invention the alkaline bisulphites are to be replaced by the sulphite of an organic

base such as aniline. It has also been discovered that Alizarin blue itself, when suspended in water and treated with sulphurous acid gas, forms a new compound, Alizarin blue sulphite, which, on treatment with sodium acetate or other suitable alkaline compound, gives Alizarin blue S. The following proportions are given for preparing Alizarin blue S according to the first method. A solution of aniline sulphite of sp. gr. 1·16 is prepared by mixing aniline with water and saturating the mixture with sulphurous acid gas. One hundred parts by weight of this are mixed with 100 parts of Alizarin blue paste containing 20 per cent. of the dry substance. After standing a few days at the ordinary temperature the colour of the paste changes to brownish red. It is then filtered off, dissolved in water, and sodium acetate added, which precipitates Alizarin blue S together with some of the double sulphite which may escape decomposition, but does not interfere with the dyeing properties of the product.
—T. A. L.

Processes for the Manufacture of Colouring Matters. T. Peters, Chemnitz, Germany. Eng. Pat. 21,205, December 30, 1890. 6*d*.

A NUMBER of sulphonated naphthalene derivatives are specified which on heating with aniline and its hydrochloride yield substances which on sulphonation are dyestuffs. The following are some of the derivatives mentioned: Meldola's nitroso-β-naphthol-monosulphonic acid, nitroso-β-naphthol-disulphonic acid R. and G., benzene-azo-β-naphthol-monosulphonic acid, "benzene-azo-naphthalidin-sulphonic acid," &c.—T. A. L.

Manufacture of New Colouring Matters. J. C. L. Durand, D. E. Huguenin, and A. J. J. d'Andiran, of "La Société L. Durand, Huguenin, et Cie.," Bâle, Switzerland. Eng. Pat. 583, January 12, 1891 (Internat. Conv. June 13, 1890.) 4*d*.

AN extension of Eng. Pat. 11,848 of 1889 (this Journal, 1890, 610), and of Eng. Pat. 15,360 of 1889 (this Journal, 1889, 981). The colouring matters obtained according to the previous patents are heated with aniline or its homologues, the naphthylamines, or with *p*- or *m*-phenylenediamine, or with a mixture of these amines, to between 100°—200° C. The colouring matters described in the above-mentioned patents dissolved in sulphuric acid with a blue colour, whereas the new substances dissolve with a cherry-red colour. On sulphonation they yield colouring matters which dye wool and silk blue from an acid bath.
—T. A. L.

V.—TEXTILES: COTTON, WOOL, SILK, Etc.

PATENTS.

Improvements in the Manufacture of Artificial Silk Filaments, and in Apparatus for that Purpose. H. de Chardonnet, Paris, France. Eng. Pat. 1656, January 30, 1890. 11*d*.

THIS invention relates to the process and apparatus for spinning artificial silk from nitro-cellulose, dissolved in a mixture of equal volumes of ether and alcohol, to which is afterwards added some more alcohol (see this Journal, 1887, 139; 1888, 206; 1889, 539 and 611; and 1890, 286). The machine employed has a number of tubes with capillary nozzles, placed in water jackets open at the top, the water being in some cases charged with glutinous matter or with substances which render the fibres less combustible. The solution of nitro-cellulose is supplied to the tubes under considerable pressure, which causes a fine stream of the solution to issue from each of the capillary nozzles. By the influence of the water of the jacket this stream becomes a solid fibre or thread, which is wound on to bobbins, several fibres usually being taken together, thus producing compound fibres. When full the bobbins are automatically exchanged for others. They are within a casing through which passes a current of air of 50° C., which carries with it the vapour of the solvents. These vapours are condensed or absorbed by different liquids.—H. S.

Improvements in Calendering Textile Fabrics and in Apparatus therefor. J. Haddow, Manchester. Eng. Pat. 4416, March 21, 1890. 6*d*.

FRICTION calenders are usually fitted with three bowls, and the finish is obtained by a single friction process. By this method, however, the machine is often rendered inoperative, if the bowl which gives the finish is damaged by folds or creases in the fabric. The patentee therefore divides the finishing into two operations by the addition of a fourth bowl, hereby eliminating folds and creases, obtaining a second and better finish for the fabrics, and keeping the machine in a much better state.—H. S.

Improvements in the Treatment of, or Finishing of, Manufactured or partially Manufactured Materials from Cotton or other Cellulosic Fibres. H. A. Lowe, Heaton Moor. Eng. Pat. 4452, March 21, 1890. 6*d*.

VEGETABLE fabrics, such as cotton and flax yarns and cloth, are immersed from 1 to 15 minutes, according to the texture of the material, in a solution of caustic soda from 25° to 75° Tw. The shrinkage which usually occurs in this process is obviated by stretching the materials during or after this treatment with caustic soda. Then they are thoroughly rinsed in warm water, and after that they may be further treated with bleaching compounds or dilute acids, in order to remove any colour and to neutralise any remaining traces of the alkaline bath. The caustic soda may be recovered from the wash-water by concentration. The materials thus treated are said to possess the advantages of being considerably stronger, of having a more regular, close and glossy appearance, and of taking many dyes and colouring matters more readily and economically.—H. S.

Improvements in the Treatment of Vegetable Materials for obtaining therefrom Textile Fibres for Spinning Purposes and the like, and Cellulose for Use in the Manufacture of Paper. A. J. Boult, London. From G. Rudel, Dresden, Germany. Eng. Pat. 18,018, November 8, 1890. 4*d*.

THE methods adopted for the production of cellulose from wood, straw, &c. are subject to the drawback that in dissolving the incrusting substances the cellular tissue is destroyed to such an extent as to render the fibres unsuitable for spinning. The patentee claims that by his treatment the incrusting substances are dissolved, whilst the fibres preserve their natural length and firmness. To effect this the vegetable materials are boiled in a mixture of water and calcium-, barium-, strontium or magnesium sulphide from 1 to 10 hours, at a pressure from 2 to 10 atmospheres. The amount of the chemicals varies according to the nature of the materials. The sulphides mentioned may be mixed with carbonates or hydrates of alkalis. The fibres thus obtained are washed, and those suitable for spinning separated from the short ones, the latter being further treated to produce pulp for paper manufacture.—H. S.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

The so-called "Ash-Free" Egg Albumen. E. Harnack. Ber. 23, 3745—3752.

In order to obtain egg albumen free from inorganic salts and from the basic salts with which it is combined, it is cut up fine and first treated with an excess of very dilute acetic acid to separate the globuline; the acid must not be too strong or the albumen will be coagulated. This acid solution is filtered and the filtrate made alkaline by addition of a cold saturated solution of sodium carbonate. A cold saturated solution of copper sulphate is then added, when a light green precipitate of a copper albuminate is thrown down. This, after washing, is dissolved in caustic alkali, and the resulting dark violet-coloured liquid again treated with dilute acetic acid when the copper albuminate again separates. This procedure is repeated several times, and the quantity of copper contained in the precipitate is found to decrease on each treatment until it reaches about 1·35 per cent. When this is the case the precipitate, whilst still moist, is treated with water and strong caustic potash solution, when a thick dark violet-coloured liquid results, from which the albumen is precipitated by the addition of hydrochloric acid. This precipitate when washed free from acid forms the "ash-free" albumen. It dissolves in boiling water to a clear solution, which reddens neutral litmus paper and is not precipitated by the addition of alcohol; mineral acids and neutral salts precipitate it at once, but the precipitation by the latter is prevented by the presence of caustic alkalis. The aqueous solution on prolonged boiling gives the peptone reactions. When placed in distilled water, this ash-free albumen swells up before passing into solution. Organic acids do not precipitate it from aqueous solution, not even tannic acid. When precipitated from aqueous solution by mineral acids, or by neutral salts, the albumen itself can be recovered unchanged by washing out the precipitants, and is then as before soluble in water; it has not been in any way coagulated. When left to itself the moistened albumen shows no tendency to ferment, but dries up to a yellow, brittle, transparent mass; even on addition of pancreas ferment it undergoes no change.

These are the chief distinctions of the "ash-free" albumen from ordinary albumen, in which the former is combined with bases.—C. A. K.

Note on the Fixation of Colours by Steaming. Rosenstiehl. Bull. Soc. Ind. Mulhouse, 1890, 401—419.

In topical styles of calico printing certain colours are used, which after being fixed by steaming in the usual way, require to be developed by oxidation, which is generally effected by chroming. But this operation, although eminently useful for these colours, greatly injures others, such as Alizarin reds and pinks, Persian berry yellows, &c. The author discovered in 1874 that by a modification of the ordinary method of steaming, it was possible at the same time to fix and oxidise the colours requiring oxidation, notably, Prussian blue, Logwood black, and other wood colours, without harming the colours which are injured by chroming. The modification in question consists in introducing hot air along with the steam into the steaming apparatus. The first attempts to do this were unsuccessful. Although the temperature of the mixture of air and steam was 100°—114°, the wet bulb thermometer indicating 73°—78°, the colours were not fixed, not even the pigment colours, which is a curious fact, inasmuch as albumen in aqueous solution is coagulated at 60°—70°. The reason of this was that there was too much air and consequently too little steam in the steaming vessel.

It was found that a mixture of air and steam is capable of fixing colours only when its saturation temperature is at least 91°. With a saturation temperature of 88°, for example, the fixation is very imperfect. The presence of air prevents the saturation-temperature approaching very closely to, or becoming 100°, but 94°—96° may be readily attained. Without air, it is of course easy to obtain a saturation-temperature of 100°, or higher than this, in apparatus arranged to work under pressure. But steam is too moist when fully saturated, that is when its temperature is the same as its saturation-temperature; the former must be at least 4° higher than the latter. In the author's experiments it was frequently 6°, 8°, or even 10° higher. The best limits, however, are 91° to 100° for the wet bulb thermometer against 95° to 106° on the dry bulb instrument. It is unnecessary to force the hot air into the steaming vessel by a fan or other mechanical appliance, all that is necessary, since there is no pressure inside the vessel, being to mix the heated air in properly regulated amount with the steam supply.

To ascertain the degree of humidity in the steaming vessel, weighed wet and dry strips of calico may be conveniently used instead of thermometers. The moist strips of calico, under the most suitable conditions of steaming, lose at most 50 to 129 grms. per square metre per hour. The dry strips gain at most 5 to 10 grms. per square metre per hour, and must on no account lose weight.

This system, which is described in considerable detail in the original, enables an economy to be realised varying from $\frac{2}{3}$ to $\frac{14}{15}$ of the fuel used.—E. B.

Chromium Fluoride. T. Stricker. Bull. Soc. Ind. Mulhouse, 1890, 420—421.

At the request of the Chemical Committee of the Industrial Society of Mulhouse, the author has determined the value of chromium fluoride as a mordanting salt for cotton, as compared with the chromium salts in use for that purpose. Printed with alizarin, the fluoride was found to give paler and yellower shades than did equivalent amounts of the basic acetate, $Cr_3(C_2H_3O_2)_4(OH)_5$, prepared by dissolving chromic hydrate in the calculated amount of acetic acid.

In another experiment a suitably thickened solution of the fluoride was printed. The printed cloth, after being dried, was divided into two parts; one part was passed through a boiling, concentrated solution of sodium carbonate in order to fix the mordant; the other was steamed before being similarly treated. A second lent was printed with an equivalent solution of chromium acetate and treated in the same way. The various lents were then dyed. The colours obtained were much the same in all cases, the greatest difference being observable in the lents printed with chromium acetate, the steamed lent showing a deeper shade; with the fluoride, steaming had very little influence. The shades produced were compared with those obtained on cotton mordanted with chrome by the alkaline method, a solution containing the same proportion of chromic hydrate, as was used in the printing trials, being employed. The colours on the alkaline mordant were found to be brighter than those on the mordants deposited from the fluoride and acetate; they also discharged better. The colours on the acetate-mordant discharged better than those on the fluoride-mordant.

The fluoride possesses no advantage in the matter of cost. —E. B.

A Reserve for Basic Coal-Tar Dyes. M. Prud'homme. Bull. Soc. Ind. Mulhouse, 1890, 549—551.

The author finds that the addition of common salt to the tartar emetic reserve-colour suggested by him (this Journal, 1888, 565) is an improvement. This is based upon an observation made by Juste Koechlin, namely, that alkaline chlorides form with tartar emetic very soluble double salts. Two examples are given of the mixing of the reserve-colour:—

	Parts.	Parts.
Tartar emetic	300	300
Common salt	158	210
Water	1,000	1,000
British gum	700	700

The common salt is directly useful, also, in precipitating the colouring matter, which is brought into contact with it, and thus aids the tartar emetic, whose office is to precipitate the tannic acid of the printing colour, the colour-lake being formed superficially and so prevented from penetrating the fibre. In the case where the reserve has to resist at the same time a dark ground and a pale pad-shade, it is advantageous to add a certain amount of tannic acid to the pad colour in order to avoid "swelling" of the reserve pattern.

After steaming for an hour, the pieces are passed through a bath of tartar emetic, washed with hot water for half an hour, and lightly soaped.—E. B.

A Method of Preserving Printers' Soap-baths. E. Jaquet. Bull. Soc. Ind. Mulhouse, 1890, 551—552.

The chief cause of the rapid soiling of soap-liquors, which takes place during the soaping of printed calicos, is the solution from the cloth of Methylene blue and other dyes, fixed with tannic acid. Methylene blue, in particular, would, if the baths were not frequently or continuously renewed, soil the alizarin pinks and reds, converting the same into clarets and chocolates. The colours may be preserved and the baths kept tolerably clean by the addition to the latter of precipitated tannate of antimony, since this compound possesses more affinity for the basic dyes than do the alizarin lakes. The method has been used on the large scale for upwards of a year with satisfactory results, the soap-baths requiring less frequent renewal than usual. The author hopes to find means of precipitating in a similar manner the other colouring matters which find their way into the soap-liquor.—E. B.

Proceedings of the Industrial Society of Mulhouse. Meeting of June 18, 1890. Bull. Soc. Ind. Mulhouse, 1890, 54—56.

Prud'homme contributed a memoir on the reactions of ferricyanides. Ferricyanides in the presence of alkalis exert an oxidising action, as was discovered by Mercer, who applied the reaction in calico-printing for discharging indigo. It is not generally known that at the boil neutral solutions of ferricyanides decolourise indigo, acid ferrocyanides being formed and hydrogen and oxygen evolved as in the equation—

$$2\ K_3FeC_6N_6 + H_2O = K_6Fe_2H_2C_{12}N_{12} + O.$$

A mixture of a ferricyanide and an alkaline chlorate gives quite as good results, when printed on indigo-dyed cloth and steamed, as the mixture of ferricyanide and alkaline carbonate or bicarbonate, recommended by Jeanmaire. Scheurer, in 1878, discovered that the acetates of certain metals (calcium, magnesium, zinc, lead, &c.) could replace the alkaline carbonate or bicarbonate in Jeanmaire's process. Again, the firm of Koechlin Bros. discovered that indigo was dischargeable by a mixture of potassium ferricyanide and lead nitrate, the action taking place at 30°—35° on ageing the printed cloth. Prud'homme finds that potassium ferricyanide is decomposed by metallic copper, potassium ferrocyanide and potassium copper ferrocyanide being formed. Iron yields in similar manner a white precipitate of potassium ferrous ferrocyanide, $K_2Fe(FeC_6N_6)$, which soon becomes blue on exposure to the air. Lead reacts energetically with potassium ferricyanide, the lead monoxide which is first formed becoming converted into lead dioxide—

$$2\ K_3FeC_6N_6 + 2\ Pb(OH)_2 = K_4FeC_6N_6 + K_2PbFeC_6N_6 + PbO_2 + 2\ H_2O + 2\ O.$$

Potassium chromate and ferricyanide react with formation of bichromate and ferrocyanide and liberation of oxygen. Nitroprussides may be prepared by the action of alkaline nitrites on ferricyanides. A strong solution of alkaline nitroprusside is obtained by treating potassium ferricyanide with a solution of the salt (sodium hydroxylamine-disulphonate), obtained by the action of sodium bisulphite on sodium nitrite. A mixture of sodium nitrite, sodium thiosulphate, and potassium ferricyanide, when boiled some time, also yields nitroprusside along with a brown insoluble compound, which dissolves in strong hydrochloric acid and gives a precipitate of Prussian blue on the addition of water, ferric chloride remaining in solution.—E. B.

A New Method of Formation of Manganese Bronze Colour. J. Dépierre. Bull. Soc. Ind. Mulhouse, 1891, 36—37.

The cloth is passed through a neutral solution of manganese chloride (4 parts in 10 parts of water), dried, and the bronze is developed by a passage through a bath containing, in 20 parts of water, 1 part of potassium permanganate and 0·6 part of sodium carbonate. This "raising" bath is kept at a temperature of 35°, and the cloth immersed in the same for 40 to 50 seconds. To obtain even shades, the use of a "chloring box" is recommended, the apparatus being left empty, to remove the disengaged carbonic acid. The passage through the empty chloring apparatus may be beneficially followed by a passage through another steam chloring-box, using bleaching solution at $\frac{1}{4}$° B. The cloth is then well rinsed and dried. The chief reaction taking place in this method of production of manganese bronze is expressed by the following equation—

$$2\ KMnO_4 + 3\ MnCl_2 + 2\ Na_2CO_3 = 5\ MnO_2 + 4\ NaCl + 2\ KCl + 2\ CO_2.$$

The bronze obtained in this way discharges better than that produced by the old method.—E. B.

Report on a New Method of Formation of Manganese Bronze Colour. A. Frey. Bull. Soc. Ind. Mulhouse, 1891, 38.

The author, who has been requested by the Industrial Society of Mulhouse to report on Dépierre's process (see preceding abstract), confirms the statements of that chemist regarding the advantages of the new method, but adds that the cost of the bronze is slightly higher than that of the bronze produced by the ordinary process. Frey recommends the temperature of the fixing-bath to be kept at about 40°, since the permanganate, in the proportion used, is not entirely soluble below that temperature.—E. B.

Compound Mordants. Prud'homme. Bull. Soc. Ind. Mulhouse, 1891, 39—47.

Vauquelin observed that magnesia, when precipitated along with alumina, had the property of rendering the latter insoluble in caustic alkalis. Later, H. Koechlin drew attention to the advantage of using an alkaline solution of zinc oxide for the fixation of mixed or compound mordants consisting of chrome or alumina with magnesia or lime, triple mordants being thus produced. The author finds that the property of forming with alumina a compound mordant insoluble in caustic alkalis is not restricted to magnesia, but is shared by other metallic oxides. He has also ascertained that other oxides than alumina, which separately are soluble in caustic alkalis, yield, as alumina does, compound mordants insoluble in the same.

An arrangement for the purposes of comparison and study of the common metals in two groups, first, those whose oxides are insoluble in caustic alkali, namely, Mg, Ca, Mn, Fe, Ni, Co, Cu, Sr, Ag, Cd, Ba, Hg, Pb, Bi, and U, and second, those whose oxides are soluble in excess of caustic alkali: Al, Si, P, V, Cr, Zn, As, Mo, Sn, Sb, and W, is not satisfactory. Certain elements, for instance, form two oxides belonging to different groups. Others, such as lead, form oxides which are soluble only in a large excess of alkali; and lastly, the oxides of two metals of the same group, zinc and tin, form together a compound mordant which is insoluble in caustic soda. This zinc-stannic mordant, in fact, resists the friction which occurs during the operation of dyeing even better than the magnesium-stannic mordant, the latter, probably on account of its gelatinous condition, being largely detached from the fibre during that operation. It is possibly due to their being in such a gelatinous condition, too, that the sesquihydrates of iron, aluminium, and chromium do not, when alone, act as satisfactory mordants,

Metallic Hydrates.—The quantity of caustic soda required for the solution of chromic hydrate corresponds with the formation of the compound $Cr(ONa)_3$. This compound is, however, very unstable, its solution soon gelatinising, the action being probably analogous to that which takes place with a solution of zinc hydrate in caustic soda, where the zinc enters into solution as disodium zincate, $Zn(ONa)_2$, but soon separates out as monosodium zincate, $2\,ZnO.Na_2O$.

When alumina is dissolved in the minimum amount of caustic soda, there is formation of a compound of the formula $Al(OH)_2(ONa)_3$, or $2\,Al_2O_3.3\,Na_2O.3\,H_2O$. Commercial sodium aluminate, made from bauxite, is of the same composition, but anhydrous. It is interesting that Rosenstiehl, in his analyses of the ash of the Turkey-red lake, found that the aluminium was present in the proportion of four atoms to three atoms of calcium, the real Turkey-red mordant, consequently, being of the formula, $2\,Al_2O_3.3\,CaO$, or $2\,Al_2O_3.3\,CaO.3\,H_2O$.

Reciprocal Action of Oxides.—In H. Koechlin's method of mordanting for St. Denis Red (this Journal, 1889, 703), cobalt and nickel oxides may with advantage be used instead of the magnesia employed in that process, faster and more solid shades resulting.

The arsenious oxide used in the mordant printing colour for dyeing alizarin chocolates, which Scheurer finds can be replaced by phosphorous acid (this Journal, 1888, 124), may also be replaced by the trioxides of bismuth and antimony, the last-named oxide especially, which is applied in the form of antimonious chloride, being of technical value in this respect.

The use of such assistants in mordanting for dyed alizarin chocolates gives rise in all cases to the production of compound mordants.

Compound mordants are produced in the operations of dunging with chalk, silicates, phosphates, stannates, zincates, &c. The basic sulphates of iron and aluminium may also be considered as compound mordants.

Copper salts, which are generally looked upon as merely assisting the ageing of the chocolate mordant, are of use solely in so far as the copper oxide contained in them becomes deposited on the fibre, forming a compound mordant.

Zinc nitrate, again, the hygroscopic action of which renders it useful in mordanting for Alizarin red, is directly serviceable in forming zinc aluminate in the dunging process. The same operation causes the formation on the fibre of aluminate of tin, which is produced from the stannous chloride used in conjunction with the aluminium mordanting salt, ageing alone but very imperfectly effecting this result.

All metallic oxides possess mordanting power, provided they are suitably combined with at least one other oxide; thus, the oxides of magnesium and zinc, separately, are absolutely devoid of dyeing power, but combined they constitute a very satisfactory mordant for alizarin. On the other hand, single metallic-oxide mordants do not exist. A double mordant, again, although to some extent capable of dyeing, may still require a further addition to enable it to dye properly; thus, the compounds of the oxides of iron and phosphorus, arsenic, antimony, or bismuth, dye very poorly without lime, or a similar oxide, in further combination with them. The best mordants are the compounds of such sesquioxides as Al_2O_3, Cr_2O_3, Fe_2O_3, with protoxides.

Relations to the Periodic System.—In order to determine the influence of the oxides of one group of metals on the mordanting character of a given oxide of another group (iron, aluminium, &c.), two methods were used, namely, dye tests and precipitation of the colouring-matter as a lake. It is noteworthy that, as regards the colour-effect, the two methods may give widely different results, so that, with the same mordant and colouring matter, the shade obtained by one method may be, for example, the bluest obtainable from that particular colouring matter, by the other method it may be the reddest obtainable.

In the first group of elements, K yields redder shades than Na, Cu redder shades than Ag. Similar relations obtain in the second group between Ca and Mg, also with Zn and Cd. With the group Mg, Zn, Cd, there is an irregular progression in the shades yielded by these elements respectively, from blue to red: Zn yields redder shades than Cd; Cd bluer shades than Mg; the middle element of the trio, Zn, appears to possess the maximum colouring power. In the second group, again, Ca, Sr, and Ba exert a regularly decreasing or increasing influence on the colour, that is, they cause the shade to pass from red to blue, or *vice versâ*.

As regards the third group, the author conjectures that Ga and In will yield redder shades than Al does.

In the fourth group, Si gives redder shades than Sn, which yields yellow or orange shades.

In the next group As shows a greater bluing action on Alizarin purples than P or Sb; Bi produces even redder shades than P and Sb. With the lakes produced by the precipitation method the opposite is the case.

Cr, Mo, W, and U, in the sixth group of elements, produce an irregular series of colours, similarly to Mg, Zn, and Cd, this being probably due to the fact that these four elements form part of two trios, consisting of Cr, Mo, and an unknown element, and a second unknown element with W and U. Cr is dyed with alizarin a dull red, U a purple-blue. The colouring effects of Cl, Br and I, of the seventh group, are observable in the class of Eosins.

With regard to the colour-reactions of the various periods of elements, it is observed that Mg, Cu, and Ag do not yield such red lakes as Al, Zn, and Cd do, and that Si gives redder lakes than Al. Again, Sn yields redder lakes than Cd and Sb, which are placed in the table at its right and left respectively, and than Hg, Pb and Bi, which give bluer shades. Further, Pb gives redder shades than Hg and Bi.

The maximum colour-producing (reddening) effect appears, therefore, to be possessed by the members of the fourth group, on both sides of which the elements in the same periods gradate, in the shades they yield, towards blue, such gradation being least shown by the members of the seventh period. The element placed in the middle of this period, and, in fact, in the centre of the table, Sn, gives yellow and orange shades.—E. B.

Lactic Acid and Lactates in Textile Colouring. L. M. Norton and H. C. Tuttle. Technology Quarterly, **3**, 287—294.

Suggestions have frequently been made regarding the use of lactic acid in textile colouring, but hitherto it has not been able to compete in price with tartaric and citric acids, whilst the cheaper qualities have not been sufficiently free from impurities. A suitable acid has been recently produced at a lower cost, and the experiments described were made with it. It contained about 43 per cent. of lactic acid, and was nearly colourless.

The impurities present were calcium sulphate and a faint trace of iron.

Amongst the experiments made in wool-dyeing the following were of exceptional interest. As a substitute for tartar, an acid potassium lactate was prepared by half neutralising the solution with potassium carbonate. Samples of wool were mordanted with the following proportions:—

	Per Cent.
Potassium bichromate	2·5
Tartar	2·5
also with	
Potassium bichromate	2·5
Acid potassium lactate	2·5

The samples were then dyed with alizarin. The sample mordanted with acid lactate gave a decidedly heavier shade. Samples were mordanted with—

	Per Cent.
Potassium bichromate	2·5
Oxalic acid	1·0
also with	
Potassium bichromate	2·5
Lactic acid	1·0

After dyeing with alizarin, the sample mordanted with lactic acid was much deeper in shade, than in the first case.

The most striking results were obtained with tin, the proportions used being—

	Per Cent.
Tin crystals	10
Tartar	10

and

Tin crystals	10
Acid lactate	10

On dyeing with alizarin the colour obtained with tartar was the well-known reddish orange, while the lactate shade was a very brilliant yellowish red of great beauty, such as it has hitherto been very difficult to produce on wool with alizarin. With alum and lactate as a mordant, the alizarin shade obtained was very much bluer, and somewhat heavier than that obtained with tartar. That the heavier shades obtained with lactic acid were due to the more abundant fixation of the base was proved in the following experiments. Three baths were prepared with equal quantities of alum in each, but with equal weights of tartar, acid potassium oxalate and acid potassium lactate respectively. On mordanting equal weights of wool the results were—

—	Tartar.	Oxalate.	Lactate.
Alumina fixed	63·5	71·8	80·0
Alumina remaining in the bath	36·5	28·2	20·0

Similar experiments with ferrous sulphate gave—

Iron fixed	40·4	47·5	60·2
Iron remaining in the bath	59·6	52·5	39·8

On dyeing the samples with alizarin the results agreed with the figures furnished by the analysis, except that the difference in favour of the lactate mordant was more pronounced.

The results obtained on wool with dye-woods were much less favourable to the lactate mordants. With 20 per cent. of logwood, the blue obtained was not so bright or heavy as with the tartar, and in the case of bark liquor the shade was a dull reddish yellow. With fustic or tin mordants, the lactate gave a purer yellow than the tartar.

For use in cotton-dyeing a double lactate of antimony and potassium was prepared by dissolving hydrated oxide of antimony in acid potassium lactate to saturation, and evaporating the clear solution to dryness. In all the experiments the cotton was worked for one hour in a solution of 25 per cent. of sumach, and then treated with a solution containing 2 per cent. of the double lactate in the one case, and with a solution of 2 per cent. of tartar-emetic in the other. Haen's salt, the fluoride of antimony and sulphate of ammonium, was also used for comparison. The colours used for the subsequent dyeing process were—Brilliant green, Bismarck brown, Safranine, Methyl violet, Chrysoïdine, Methylene blue, and Magenta. In general the results were unfavourable to the lactate mordant, as the shades obtained with it were usually lighter.

In cotton-printing lactic acid may find employment as a substitute for the more expensive organic acids, such as tartaric and citric acids, but not for the cheaper acetic acid. In some cases, however, its employment may be of service in the production of a specially superior result, *e.g.* for cochineal pink, for which the following recipe was used :—

	Grms.
Cochineal liquor of 6° Tw.	25·00
Oxalic acid	0·25
Alum	1·25
Starch	32·00
White tartar	1·25
Water	200·00

A swatch was printed after this recipe, and a second swatch with lactic acid substituted for the oxalic acid and acid potassium lactate for the tartar. After drying, the swatches were steamed at 5 lb. for 30 minutes, and then soaped. The lactic print was far superior in depth and brilliancy to the oxalic colour.

As a substitute for tartaric acid for producing white discharges on Turkey red, the results were indecisive, and the same may be said of the experiments to substitute aluminium lactate for the acetate in dyeing Turkey red. Briefly summed up, the experiments described in this article would indicate that lactic acid may be used with considerable advantage in dyeing wool with alizarin, and in cotton-printing, in the place of tartaric and citric acids.

—G. H. B.

PATENTS.

Improvements in Machinery for Printing Fabrics. E. and A. Samuel, Neuville-sur-Saône, France. Eng. Pat. 3301, March 1, 1890. 8*d*.

This invention relates to that class of printing machinery in which the fabric to be printed is stretched upon a table, and the mechanism carrying the printing roller travels lengthwise over the fabric, which remains stationary during the printing operation. For the details of construction it is necessary that the drawings accompanying the specification should be consulted.—W. E. K.

Improvements in Doctors for Calico-Printing and other Machines. J. Thomson, Manchester. Eng. Pat. 4564, March 24, 1890. 6*d*.

The object of this invention is to provide, for calico-printing machines, a doctor of any gauge or thickness, with more flexibility than has usually been the case in a plate of the same gauge. This is effected by forming perforations cut or punched out of the metal behind the working edge. The strength and weight of the metal is thus reduced, and the flexibility of the blade increased. The holes are preferably made square, but may be of any desired shape or size.—W. E. K.

Improvements in or Relating to Machines for Applying Golds, Flocks, Micas, or other Materials to Paper or other Fabrics. C. P. Huntington, Darwen. Eng. Pat. 4580, March 24, 1890. 6*d*.

The gumming or sizing of the paper or other fabric is effected by means of a roller adapted to, or forming part of, a printing machine; the web is then conducted away from the drum of the machine to an additional cylinder, where it is gilded, flocked, or coated with other material by any usual process; from this cylinder the web is re-conducted to the printing machine to receive any subsequent colourings.

—W. E. K.

VII.—ACIDS, ALKALIS, AND SALTS.

Observations made in the Working of Vitriol Chambers. W. Crowder.

See pages 295—305.

Experiments on the Constitution of the Natural Silicates. F. W. Clarke and E. A. Schneider. Amer. Jour. Science, 1890, October, November and December.

See under VIII., *page* 368.

Synthesis of Kainite and Tachhydrite. A. de Schulter. Compt. Rend. **111**, 928—930.

KAINITE, one of the Stassfurt minerals, having the composition $KCl.MgSO_4.3\,H_2O$, is reproduced artificially by evaporating on the water-bath molecular proportions of potassium sulphate and magnesium sulphate with a large excess of magnesium chloride. The compound separates out in monoclinic crystals of ·1 mm. to ·5 mm. in length which have the form and specific gravity of the natural mineral. The fact that the compound is not produced in the cold throws light on the mode of formation in nature.

Tachhydrite is another of the Stassfurt minerals, having the composition $CaCl_2.2\,MgCl_2.12\,H_2O$. It is formed by evaporating a solution of magnesium chloride with excess of calcium chloride on the water-bath. When sufficiently concentrated it is left to crystallise, large rhombohedral crystals being formed which possess the form and specific gravity of the natural mineral.—V. C.

Method of Preparation of Pure Phosphoric Acid. M. Nicolas. Compt. Rend. **111**, 974—975.

A KNOWN quantity of pure calcium phosphate is gradually added to a slight excess of pure dilute hydrofluoric acid, contained in a leaden or platinum vessel, the mixture being well stirred after each addition. An energetic action takes place and considerable heat is evolved. When all the calcium phosphate has been added, the high temperature of the mixture must be maintained for some time in order to complete the reaction. After the removal by filtration of the calcium fluoride which is formed, the solution of phosphoric acid is evaporated. At the point when the solution commences to become viscid, the excess of hydrofluoric acid used is volatilised. The evaporation is continued until a thick syrup, containing 60—70 per cent. of phosphoric anhydride, is obtained. Meta- and pyrophosphoric acids may be prepared by further continuing the evaporation and heating.

The various calcium salts of phosphoric acid described by Erlenmeyer may be readily prepared by adding hydrofluoric acid to a large excess of calcium phosphate, and, after mixing well, dissolving out with warm water the acid salts produced. Impure phosphates, such as bone-ash, may be used for the preparation of phosphoric acid, provided that the resultant acid, after being evaporated to carbonise the organic matters present, is diluted with water, filtered and again evaporated.—E. B.

Investigations on Sets of Vitriol Chambers. S. Retter. Zeits. f. angew. Chem. 1891, 4—18.

THE disadvantage of working with one chamber is demonstrated by a comparatively low production of vitriol, by irregularity in the working of the plant and by the results of gas analysis. Dividing one large chamber into two smaller ones increased the production by about 40 per cent., which is in accordance with observations made by Lunge and Naef (this Journal, 1884, 633). Scherteł and Sorel (this Journal, 1889, 283), on sets of three or more chambers. Gas analytical results are given for a chamber working:—(1.) Under normal conditions; (2.) with a deficiency of air; (3.) an excess of air; (4.) short of nitre; the methods adopted being those used by Lunge and Naef. Results are also given for two two chamber-sets working under normal conditions.—H. A.

On the Tension of the Nitrous Acid of Nitrous Vitriol. G. Lunge. Zeits. f. angew. Chem. 1891, 37—42.

IT is well known that a solution of nitrosylsulphonic acid in *concentrated* sulphuric acid is stable, whilst a solution of nitrous acid in weak sulphuric acid is easily decomposed, the more so the larger the quantity of water present, and the higher the temperature. Though this property of the nitrous vitriol was utilised before the introduction of Glover towers for the recovery of nitre, yet until recently the influence of varying conditions on the stability of these solutions has not been investigated. The important rôle ascribed to the formation and decomposition of nitrous vitriol in the modern theories of the sulphuric acid process prompted Sorel to experiment on the subject with a view of obtaining more exact data regarding the decomposition of nitrous vitriol. His experiments, however, have not been carried far enough to enable him to construct tables available for practical purposes, and the importance and necessity of such tables caused the author to make further investigations, in which he was assisted by Zaloziecky and Marchlewski.

The decomposition of nitrous vitriol (*i.e.* sulphuric acid containing nitrosylsulphonic acid and possibly free nitrous acid) depends upon four factors. (1.) Concentration of the sulphuric acid; in the following experiments this was kept between 120°—141° Tw. (2.) Temperature; the limits were between 50°—90° C. (3.) Quantity of nitrous acid present; this was varied according to the strength of the acid. (4.) Quantity of gas coming in contact with the acid; this was kept constant.

The experiments were carried out in the following way. A stream of carbonic acid free from moisture and oxygen was passed through a 10-bulb-tube, containing 50 cc. nitrous vitriol; both this and the carbonic acid in the long inlet tube were brought to the desired temperature by means of a water-bath. The escaping gas passed through another tube charged with 100 cc. of concentrated sulphuric acid, to retain nitrous acid, and was finally washed with strongly acid semi-normal permanganate, which will absorb nitrogen oxide. The stream of carbonic acid was so regulated that exactly 5 litres of carbonic acid passed through the apparatus in an hour. The tube containing 100 cc. of sulphuric acid is then emptied in a 200 cc. flask, washed with pure vitriol, filled up and the mixture titrated with permanganate and checked with the nitrometer.

The nitrous vitriol was prepared by dissolving varying quantities of nitrosylsulphonic acid in pure sulphuric acid; the solution proved to be free from nitric acid.

The results are given for acids of 144°, 137°, 127°, and 120° Tw., the figures being arranged in tables showing: (1.) the absolute loss of N_2O_3 in grammes per litre of acid, after treating with 5 litres carbonic acid in one hour. (2.) The percentage loss of the nitrous anhydride present. (3.) The quantity of nitrous anhydride taken out of the nitrous vitriol by 5 litres of carbonic acid within one hour.

In placing the amount of N_2O_3 in grammes per litre on the abscissa, the loss of N_2O_3 in grammes per litre on the ordinate, and connecting the values obtained for a certain temperature, curves will be obtained which prove that in strong acids and at low temperatures the nitrous acid is in combination as nitrosylsulphonic acid, but that in diluting the liquor and raising the temperature it is converted into free nitrous acid and rapidly escapes.

The following four tables are obtained by means of the corrected curves. They can be used directly for the four acids in question. The values for acids of other strengths may be obtained by interpolation, but no great degree of accuracy need be expected.

1. NITROUS VITRIOL, SP. GR. 1·720

(about 78 per cent. of H_2SO_4).

Loss in grms. per litre after treating for one hour at temperatures of:—

Orig. present, Grms. per Litre.	50°	60	70	80°	90°
1	..	..	..	..	0·006
2	..	..	..	..	0·018
3	..	..	..	..	0·025
4	..	..	..	..	0·031

1. Nitrous Vitriol, Sp. Gr. 1·720—*continued.*

Orig. present, Grms. per Litre.	50°	60°	70°	80°	90°
5	..	..	..	..	0·037
6	..	..	..	..	0·043
7	..	..	..	0·006	0·056
8	..	..	..	0·010	0·068
9	..	..	..	0·012	0·081
10	..	..	..	0·018	0·093
11	..	..	..	0·025	0·112
12	..	..	..	0·030	0·125
13	..	..	..	0·031	0·143
14	..	..	..	0·043	0·168
15	..	..	0·006	0·056	0·193
16	..	..	0·010	0·068	0·218
17	..	..	0·005	0·087	0·250
18	..	..	0·012	0·106	0·281
19	..	..	0·025	0·125	0·318
20	..	..	0·031	0·150	0·356
21	..	..	0·043	0·175	0·400
22	..	..	0·062	0·200	0·450
23	..	0·006	0·081	0·237	0·500
24	0·006	0·018	0·100	0·275	0·550
25	0·012	0·031	0·125	0·312	0·600
26	0·018	0·043	0·150	0·356	0·662
27	0·031	0·062	0·181	0·400	0·725
28	0·043	0·081	0·212	0·450	0·800
29	0·062	0·100	0·256	0·500	0·850
30	0·081	0·125	0·293	0·550	0·956
31	0·093	0·162	0·337	0·612	1·043
32	0·112	0·200	0·387	0·641	1·125
33	0·125	0·237	0·301	0·743	1·206
34	0·143	0·275	0·475	0·806	1·287
35	0·156	0·312	0·525	0·868	1·375
36	0·175	0·350	0·575	0·931	1·456
37	0·193	0·381	0·618	1·000	1·543
38	0·206	0·418	0·672	1·062	1·625
39	0·237	0·456	0·718	1·125	1·712
40	0·268	0·500	0·775	1·193	1·800
41	0·293	0·543	0·831	1·256	1·890
42	0·325	0·587	0·887	1·331	1·975
43	0·350	0·631	0·937	1·400	2·062
44	0·376	0·675	0·993	1·468	2·150
45	0·406	0·712	1·050	1·537	2·237
46	0·437	0·756	1·106	1·606	2·325
47	0·462	0·800	1·162	1·675	2·392
48	0·493	0·837	1·218	1·743	2·500
49	0·518	0·881	1·268	1·806	2·587
50	0·550	0·931	1·325	1·875	2·675

2. Nitrous Vitriol, Sp. Gr. 1·686

(about 76 per cent. of H_2SO_4).

Loss in grms. per litre and per hour at temperatures of :—

Orig. present, Grms. per Litre.	50°	60°	70°	80°	90°
8	..	..	..	..	0·025
9	..	..	..	..	0·036
10	..	..	..	0·012	0·050
11	..	..	..	0·018	0·062
12	..	..	..	0·025	0·086
13	..	..	0·010	0·050	0·125
14	..	..	0·012	0·075	0·162
15	..	..	0·025	0·100	0·225
16	..	..	0·050	0·150	0·286
17	..	0·010	0·062	0·200	0·350
18	..	0·012	0·100	0·262	0·436
19	..	0·025	0·150	0·350	0·525
20	..	0·050	0·186	0·425	0·625
21	..	0·075	0·250	0·525	0·750
22	..	0·112	0·300	0·650	0·975
23	..	0·136	0·350	0·775	1·200
24	..	0·175	0·400	0·900	1·436
25	0·010	0·200	0·462	1·025	1·662
26	0·012	0·236	0·512	1·175	1·900
27	0·025	0·262	0·562	1·300	2·125
28	0·036	0·300	0·612	1·436	2·350
29	0·050	0·336	0·675	1·575	2·600
30	0·062	0·362	0·750	1·700	2·812
31	0·100	0·412	0·850	1·812	3·086
32	0·136	0·462	0·950	1·975	3·350
33	0·186	0·512	1·050	2·100	3·625
34	0·225	0·575	1·150	2·236	3·900
35	0·275	0·625	1·250	2·362	4·175
36	0·312	0·675	1·336	2·500	4·470
37	0·350	0·725	1·436	2·625	4·736
38	0·400	0·525	1·536	2·762	5·000
39	0·436	0·836	1·636	2·909	5·275
40	0·486	0·886	1·736	3·025	5·550
41	0·550	0·950	1·850	3·150	5·850
42	0·612	1·050	1·986	3·275	6·125
43	0·686	1·125	2·112	3·412	6·400
44	0·750	1·212	2·250	3·525	6·700
45	0·825	1·300	2·325	3·736	6·975
46	0·886	1·386	2·500	3·825	7·250
47	0·962	1·475	2·636	3·962	7·536
48	1·025	1·512	2·762	4·100	7·825
49	1·100	1·650	2·886	4·236	8·100

3. Nitrous Vitriol, Sp. Gr. 1·633

(about 71½ of H_2SO_4).

Loss in grms. per litre in one hour at temperatures of :—

Orig. present, Grms. per Litre.	50	60	70	80	90°
1	0·012	0·025	0·036	0·100	0·150
2	0·050	0·075	0·086	0·225	0·300
3	0·100	0·150	0·186	0·350	0·456
4	0·162	0·212	0·300	0·536	0·612
5	0·212	0·300	0·436	0·736	0·825
6	0·300	0·425	0·676	1·000	1·112
7	0·400	0·562	0·836	1·275	1·425
8	0·500	0·712	1·036	1·550	1·750
9	0·600	0·835	1·236	1·812	2·062
10	0·701	0·936	1·436	2·086	2·375
11	0·801	1·125	1·636	2·350	2·712
12	0·871	1·262	1·825	2·636	3·075
13	0·986	1·400	2·036	2·900	3·436
14	1·086	1·536	2·225	3·175	3·800
15	1·186	1·675	2·412	3·450	4·162
16	1·275	1·800	2·612	3·725	4·512
17	1·375	1·936	2·786	4·000	4·886
18	1·475	2·036	2·975	4·262	5·236
19	1·562	2·250	3·186	4·550	5·600
20	1·662	2·412	3·400	4·850	5·986
21	1·812	2·612	3·650	5·162	6·400
22	1·975	2·812	3·912	5·512	6·862
23	2·186	3·062	4·250	5·912	7·425
24	2·436	3·336	4·612	6·350	8·036
25	2·700	3·636	5·000	6·800	8·662
26	3·000	3·950	5·412	7·300	9·362
27	3·312	4·300	5·850	7·812	10·150
28	3·662	4·636	6·325	8·400	11·000
29	4·025	5·012	6·812	9·025	11·986
30	4·412	5·412	7·350	9·675	13·125
31	4·800	5·836	7·950	10·386	14·500
32	5·236	6·325	8·575	11·175	16·362

4. Nitrous Vitriol, Sp. Gr. 1·60

(about 69 per cent. of H_2SO_4).

Loss in grms. per litre in one hour at temperatures of :—

Orig. present Grms. per Litre.	50	60	70	80	90°
1	0·050	0·086	0·175	0·336	0·412
2	0·100	0·236	0·436	0·725	0·912
3	0·325	0·525	0·775	1·150	1·500
4	0·562	0·836	1·250	1·910	2·100
5	0·812	1·150	1·500	2·120	2·700

4. Nitrous Vitriol, Sp. Gr. 1·60—*continued.*

Orig. present, Grms. per Litre.	50°	60°	70°	80°	90°
6	1·050	1·450	1·900	2·500	3·350
7	1·286	1·800	2·350	3·100	4·112
8	1·512	2·150	2·800	3·725	4·900
9	1·750	2·425	3·250	4·336	5·686
10	1·975	2·812	3·712	4·990	6·475
11	2·250	3·612	4·436	5·625	7·300
12	2·512	3·536	4·675	6·325	8·125
13	2·786	3·936	5·150	7·012	8·962
14	3·065	4·250	5·650	7·700	9·750
15	3·360	4·612	6·125	8·400	10·625
16	3·600	4·975	6·612	9·125	11·462
17	3·862	5·350	7·100	9·525	12·250
18	4·150	5·712	7·600	10·462	13·136
19	4·525	6·075	8·086	11·350	13·975
20	4·700	6·425	8·562	11·850	14·800

—H. A.

The Utilisation of By-Products of Mineral Oil Manufacture for Alkali-Making. A. Veith and C. Schestopal. Dingl. Polyt. J. **279**, 21—22.

The acid and alkaline waste liquors obtained in purifying mineral oils contain sulphuric acid, caustic soda and higher hydrocarbons. It is proposed to unite these semi-liquids to obtain neutral sodium sulphate. In adding to this two-thirds of its weight of calcium carbonate and calcining, large quantities of soda are obtained. It is intended to carry out the experiments on a large scale, and so far the advantages claimed for this process are: An intimate mixture of the ingredients in consequence of their semi-liquid state at atmospheric temperature; (2) the greater reducing action and heat developed by the combustion of the hydrocarbons in comparison with that by using "slack."

—H. A.

PATENTS.

Improvements in obtaining Cyanides from Residuary Liquors formed in Chemical Processes. J. S. MacArthur, Renfrew. Eng. Pat. 3071, February 21, 1889. (Second Edition.) 4*d.*

To the cyanide solutions is added an excess of a salt of iron, such as the protosulphate. After drying the precipitate, it is fused with carbonate of sodium or potassium, producing the corresponding cyanide which is then extracted by lixiviation from the insoluble residue. Or the precipitate may be fused with caustic soda or potash, a ferrocyanide being then obtained. (See also this Journal, 1890, 190.)

—S. G. R.

Improvements in and in Apparatus for the Evaporation of Brine and the Manufacture of Salt therefrom. R. C. Wilson, Birkenhead. Eng. Pat. 393, January 9, 1890. 11*d.*

The steam produced in the evaporation of brine in closed pans is drawn off and passed through a compressor, whereby its temperature is raised and its volume diminished. It is then delivered back again along tubes within the pans, and being condensed the latent heat evolved will evaporate more brine. The water formed by its condensation is still further utilised for heating the feed supply of brine. The pans are covered with wood and packed with a suitable

non-conducting material. The steam which is being evolved from the pan should be at a rather higher pressure than that of the atmosphere outside. If desired the steam from the first pan may be passed to a second and thence to a third. Each pan may or may not be furnished with a separate compressor driven by a common motor. The specification is furnished with three sheets of drawings.

—S. G. R.

A New Method of Treating Borates of Lime and Beracite with a View to the Manufacture of Borax and of other Borates. "The Borax Company, Limited," London. Eng. Pat. 2526, February 17, 1890. (Internat. Conv. October 2, 1889.) 6*d*.

The borate of lime is washed with just enough sodium carbonate solution to decompose all the calcium sulphate present. The residue is then mixed with more sodium carbonate to decompose all the calcium borate, and the mass is diluted with water and placed in air-tight metallic receivers, steam being subsequently blown in. The temperature and pressure both rise rapidly, and the borate of calcium is decomposed with the formation of a basic soluble borate of sodium. To this is added enough boracic acid to convert the basic borate into borax, which is then crystallised out.—S. G. R.

Improvements in or Appertaining to the Distillation or Treatment of Ammonium Chloride with Leblanc Alkali Waste and kindred Substances. J. L. Leith, St. Helens. Eng. Pat. 2633, February 18, 1890. 4*d*.

When alkali waste is distilled with ammonium chloride, either an excess of the former must be used to prevent the loss of ammonia, in which case sulphur is left behind in the waste, or an excess of the chloride be taken when ammonia is lost. At the top, therefore, of the tower ammonium chloride is used in excess, whilst lower down milk of lime is added whereby the excess of chloride is decomposed and the ammonia recovered.—S. G. R.

Improvements in the Manufacture of Salt and in Apparatus and Appliances employed therein. O. E. Pohl, Liverpool. Eng. Pat. 3391, March 4, 1890. 8*d*.

This patent is a continuation and improvement of Eng. Pats. 3116 of 1872, 1503 of 1873, and 1007 of 1889 (this Journal, 1890, 189). The steam and products of combustion passing from the brine pans are led away to a drying-house, below the floor of which they pass, and which is used for drying the salt. Or this waste heat may be utilised below an ordinary brine evaporating pan, which is preferably made of galvanised iron. The petroleum furnace or gas oven is also so constructed that the products of combustion are allowed to pass directly from the furnace into the opening between the two pans which are set one above the other. The third and last portion of the patent refers to an improved means of holding in position the revolving grate at the back of the furnace. There are three sheets of drawings.—S. G. R.

Improvements in or Relating to the Manufacture of Litharge and Red Lead. G. Larrouy, St. Andre-Pez-Lille, France. Eng. Pat. 3786, March 10, 1890. 8*d*.

See under XIII., *page* 375.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

Artificial Production of a Chromium Blue. J. Garnier, Compt. Rend, **111**, 791.

Fremy and Verneuil, in their researches on artificial rubies, attribute the blue tint which they observed *probably to chromium*. The author sent to the Academy in 1887 a sealed packet containing the formula of a blue comparable with cobalt blue, "but containing no cobalt, and producible at a low price." All the compounds having for their base chromium oxide, and melted under oxidising or indifferent conditions, being green, the blue colour observed in this case is probably due to the reducing action occurring in the experiment. It may be added that, according to the conditions of experiment, gems are obtained the tint of which is blue or violet, so it would seem that chromium may give in the dry way an entire scale of colours according to the higher or lower temperature employed and more or less reducing action.

The sealed note contained the following:—

"Process for obtaining a blue with chromium base. If there be melted together in a brasqued crucible—

	Grms.
Potassium chromate	1,862
Fluor spar	65
Silica	157

a fine blue will be obtained, surrounded by a pellicle of metallic chromium, which can be removed."—J. M. H. M.

Experiments on the Constitution of the Natural Silicates. F. W. Clarke and E. A. Schneider. Amer. Jour. Science, 1890, October, November and December.

Olivine, talc, serpentine, chlorite, mica and vermiculite, in some cases samples from several localities, were the six groups of magnesian silicates experimented on. The test experiment, after ordinary quantitative analysis, and the purification of the material, or the determination of its inclusions, was the subjection of the ground mineral to dry hydrochloric acid gas at a temperature between 383° and 412 C., *i.e.*, between the fusing points of lead iodide and zinc. This was then compared with the effect of aqueous hydrochloric acid on the same minerals, sometimes after strong ignition. It was found that sometimes a species previously insoluble could be thus split up into a soluble and an insoluble part. The authors' conclusions are: (1) That the actions of gaseous and aqueous hydrochloric acids differ widely; (2) that in this group of minerals the gaseous acid attacks apparently only that part of the magnesium which is present as the univalent groups—Mg.OH; (3) the chlorites are not hydrated conditions of the micas, or micas plus water of crystallisation.

PATENTS.

An Improved Method of making Porcelain Tablets or Letters. E. Robson, Newcastle-on-Tyne. Eng. Pat. 352, January 8, 1890. 4*d*.

The tablets or letters are moulded in clay and placed face downwards in a plaster mould. "Slip" clay is run in to form a background, and when set the background is cut into the shape required for the tablet. The whole is then replaced in the plaster mould which is filled up with clay and afterwards dried.—V. C.

Improvements in Enamelling Metals. A. E. Robinson, Wolverhampton, and W. H. Wheatley, Lewisham. Eng. Pat. 1894, February 4, 1890. 6*d*.

In the ordinary process of enamelling metal the plate is first heated in a muffle, the ground enamel applied, the temperature lowered and the succeeding enamels applied. The

inventor claims to effect a better control over the temperatures, and to diminish the liability to bending of the plates by subjecting them to less handling. The plate is fixed between clamps attached to an insulating support and an electric current passed through the plate which forms the principal resistance of the circuit. The current is regulated to suit the different fusing points of the enamels employed. The electric generator is preferably of the alternating current class.—V. C.

Improvements in the Method of Frosting or Obscuring Glass Globes. W. H. Akester, London. Eng. Pat. 2293, February 12, 1890. 4*d*.

The improvements relate to a method of frosting glass globes such as those used with incandescent electric lamps. To obtain a white frosting, nitro-cellulose is dissolved in amyl acetate or other suitable solvent and 5 to 15 per cent. of a white powder such as kaolin is added. The emulsion is applied to the surface of the glass and the solvent evaporated off by warming to about 100° F. To obtain a coloured surface an aniline dye or other dyestuff may be added to the emulsion. This gives a comparatively clear and transparent film. A more opaque film is obtained by omitting the dyestuff and substituting a coloured earth for the kaolin.—V. C.

An Improved Process of Coating and Tinting Glass Surfaces. C. Leigh, Homerton. Eng. Pat. 3203, February 28, 1890. 4*d*.

Opal glass has, previously to this invention, never been tinted, unless colour applied to the surface was to be burnt in. The invention is a method of tinting applicable to opal glass equally with other glass. The surface of the glass is roughened by grinding, a coating of shellac or other gum soluble in alcohol is applied to the surface, then the dye is applied, and then the mordant. When a gum is applied in alcoholic solution the mordant can be dispensed with.—V. C.

Improvements in Machinery for the Production of Sheets direct from Molten Metal or Glass. C. M. Pielsticker, London. Eng. Pat. 6464, April 28, 1890. 8*d*.

See under X., *page* 373.

Improvements in Apparatus for Drying Clay Products and other Materials. J. P. Bayly, London. From P. Arnold, Canal Dover, U.S.A. Eng. Pat. 17,503, November 1, 1890. 8*d*.

The invention relates to an improved "tunnel drier," designed for drying brick and pottery materials. The drier is divided into compartments, preferably three being used, so that loading, drawing, and drying may go on systematically.

The claims made are for the combinations of flues, air ducts, and heating coils preferred by the patentee, and cannot be usefully reproduced in abstract form.—B. B.

Improvements in Gas Furnaces for Use in Glass and other Works. R. J. M. Regnault, St. Denis, France. Eng. Pat. 20,606, December 17, 1890. 6*d*.

See under II., *page* 354.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

Blast Furnace Slag and its Utilisation. R. Zsigmondy. Dingl. Polyt. J. **279**, 41—43 and 69—71.

F. W. Lürmann asserts in *Stahl und Eisen* that *E. Langen* anticipated *C. Wood* in the recognition of the hydraulic properties of granulated blast-furnace slag, the latter receiving his information from the former. A use was found for the new material in making building stones which were first made in Osnabrück. Slag cement was also first prepared there.

P. Gredt has compared the fusing points of slags (prepared by mixing known proportions of silica, alumina, and lime) by means of Seger's normal cones, and finds them to range from about 1,400°—1,600° C. Similar experiments in which, however, lime was gradually replaced by magnesia, indicated that up to a certain point the temperature necessary to effect combination and fusion fell, but rose again on the addition of more magnesia.

Péligot has observed a similar phenomenon in the case of glass. The difference in properties between granulated and ungranulated slag has led to various attempts to explain its cause (see this Journal, 1890, 863).

Le Chatelier has put forward the following views: Granulated slag contains the whole of the energy which appears as heat if the same slag be allowed to crystallise instead of being granulated. In consequence of this its constituent molecules being endowed with more potential energy have a greater tendency to combine either among themselves or with the lime that is added to make slag cement than have those of crystallised slag. In one word the quantity of available energy in granulated is greater than that in crystallised slag.

Calorimetric experiments confirm this conclusion. Chatelier has found that the heat of solution of granulated slag is greater than that of crystallised slag; the composition of the slag used corresponded with the formula $2\,SiO_2,\ Al_2O_3,\ 4\,CaO$. Calculating the heat that would be evolved by solution of the constituent oxides of this slag in dilute hydrochloric acid (leaving out of account the heat of hydration of alumina), it is found that 1 grm. would liberate 510 cal. (small). Slowly cooled crystallised slag liberated 301 cal., while granulated slag evolved 420. It follows that the heat of formation of crystallised slag of this composition is 209 cal., while that of granulated slag is only 90 cal., whence it is obvious that each gramme of granulated slag contains an amount of energy equal to 119 cal. over and above that possessed by each gramme of crystallised slag. A practical deduction is that the quicker the cooling the better the product is suited for making slag cement. Viscous or semi-fluid slags consequently give bad cements because they have already passed to some extent into the crystalline state before granulation.

Microscopical investigation of thin sections showed that acid slags in the crystalline state were composed of long crystals placed parallel to one another; in basic slag the crystals are smaller.

Tetmajer has carried out a series of experiments to ascertain what composition a slag should have for cement making. In order to eliminate adventitious factors Tetmajer prepared slags from white marble, calcined clay and powdered quartz, having the following compositions:—

	SiO_2	Al_2O_3	CaO
1	2	0·25	2·25
2	2	0·50	2·50
3	2	1·00	3·00
4	2	0·25	3·25
5	2	0·50	3·50
6	2	1·00	4·00

Besides these two actual blast-furnace slags were used :—

	(7.) Bilbao.	(8.) Marnaval.
	Parts per Cent.	Parts per Cent.
SiO_2	38	28
Al_2O_3	10	19·5
CaO	46	45

The slags were granulated under as nearly as possible the same conditions and ground in the same ball mill. Each slag served for the preparation of three cements :—

(1.) Lime was added in the proportion demanded by the formula $m\ (SiO_2CaO) + n\ (Al_2O_3\ 3\ CaO)$. (Series A.)

(2.) Fifty parts of slaked lime were added to 100 parts of slag. (Series C.)

(3.) A quantity of lime equal to the mean of the quantities used for (1) and (2) was added. (Series B.)

The proportion of lime to 100 parts of slag in each of these is shown by the following table :—

Lime per 100 Parts of Slag.

Series.	1.	2.	3.	4.	5.	6.	7.	8.
A	14	24·5	29	0	0	17	6	12
B	32	37·2	39	25	25	33	28	31
C	50	50·0	50	50	50	50	50	50

Besides these in some cases hydraulic lime from St. Astier was used (this Journal, 1891, 258). The cements thus made were tested in compression by Le Chatelier's apparatus. The test pieces were cylinders 3 × 3 cm., and the cement was mixed with normal sand in the proportion of 1 : 3 and gauged with 11 per cent. (reckoned on the dry mixture) of water. Tetmajer did not make the test pieces in the ordinary manner (presumably with a hammer apparatus or its equivalent), but merely with a trowel used lightly. The results were compared with those given by Boulogne Portland cement similarly treated. Had the method of treatment according to the French prescription been adopted the strength of the test pieces would have been about three times as great as was the case, while the standard German process would have given even higher results.

The test pieces were left in the moulds for 24 hours and afterwards placed in cold water for periods of 7, 28, and 100 days ; others were kept for 100 days in cold water and then dried for 48 hours ; another set was kept in hot water for 7 days (cf. Deval's experiments, this Journal, 1891, 258), while others were exposed to moist air for 100 days.

The test pieces of all three series (A, B, and C) made from cement No. 1 fell to pieces when put into water even after being kept in air for 4 days instead of 24 hours. A comparison of the results of the cement mixtures 1 and 4, of 2, 7, and 5, and of 3, 8, and 6, showed the favourable influence of the presence of a greater percentage of lime *in* the slag upon the properties of the cements made therefrom. A similar result followed the increase of the percentage of alumina. Tetmajer maintains that, contrary to earlier observations, a high content of alumina does not necessarily produce a cement liable to crack. He ascribes the tendency of slag cements to crack to their containing more sulphur than Portland cement (Zsigmondy points out in a footnote that Tetmajer used raw materials free from sulphur) ; this is present in the slag as calcium sulphide, is oxidised by the air to sulphate, and acts in the same way as gypsum is credited with doing. Treatment of the slag with carbon dioxide is not available as a remedy, for according to Tetmajer it saturates a part of the active lime.

The use of hydraulic instead of ordinary lime for adding to the slag appears to have no particular advantage (contrast this Journal, 1890, 863). It does not even hasten the rate of setting, or at least only exceptionally. The quantity of lime added is of great importance ; an addition corresponding to the formula $SiO_2CaO + n\ (Al_2O_3\ 3\ CaO)$ is only desirable for poor slags. For the best slags an addition of 50 per cent. of lime is rather too high ; the best proportions lie between these extremes. The richer the slag in alumina the more lime must be used ; thus to Choindez slag 40—45 per cent. is added, to Donjeux slag 40 per cent., and to Cleveland slag 33 per cent. of lime.

With regard to the use of slag cement, it may be stated that it needs a considerable amount of moisture to harden it properly. Therefore if exposed after setting in ordinary building operations to sunshine or other drying agencies, it may fail not only on account of its failure to attain its full strength under these conditions, but also by reason of the cracks set up in it.

The chance of such failure is increased by smoothing the surface of the cement too much or by finishing the work with a coating of neat cement.

The quantity of water used for gauging neat slag cement should be about 25 per cent., while that requisite for a mixture of 1 part by weight of cement to 3 of normal sand is about 37 per cent. *of the weight of the cement.*—B. B.

PATENTS.

Waterproofing and Preserving Composition for Stone Bricks, also for Plaster and Cement Surfaces. W. Sinclair, Hull, and M. Mackay, London. Eng. Pat. 1178, January 22, 1890. 4*d*.

See under XIII., *page* 375.

New or Improved Building Material. F. Oschwald, Lenzburg, Switzerland. Eng. Pat. 17,795, November 5, 1890. (Internat. Conv. July 5, 1890.) 4*d*.

A substance which may be termed "peat stone" is made by mixing 2—3 parts of peat with 6—7 parts of plaster of Paris, adding water and moulding into blocks or slabs. Laths or bars of wood may be introduced to give greater stiffness ; in such cases the outside of the moulded slabs should be of plaster of Paris only. The material is said to be fairly light, of good compressional strength, and a bad conductor of heat and sound.

A little cement, sand, burnt ballast, &c. may be added to the mixture, but in general peat and plaster should be the sole ingredients.—B. B.

X.—METALLURGY.

Further Contributions to the Metallurgy of Bismuth. E. Matthey. Proc. Roy. Soc. 1891, **49**, 78—79.

Instead of the costly and tedious wet-process previously in use for freeing bismuth from the small but detrimental trace of copper so frequently accompanying it, the author a short time ago adopted the method of fusion with bismuth sulphide (Proc. Roy. Soc. **43**, 172). The disadvantage of this latter process, however, is that it necessitates a temperature sufficiently elevated to fuse the bismuth sulphide, which, unless very great care is taken, causes a loss of bismuth by volatilisation. The author has since found that this loss can be avoided if, instead of employing bismuth sulphide, a small proportion of sodium monosulphide be stirred into the fused alloy at a temperature just above the melting point of the sulphide. By this means 90 per cent. of the bismuth can be obtained entirely free from copper. The remaining 10 per cent. (skimmings), which contain the copper, being worked up again.—O. H.

The Precipitation of Gold from Chloride Solutions. W. Langguth. Eng. and Mining J. 1891, 204.

THE Golden Reward Chlorination Works, of Deadwood, South Dakota, are now stated to work about 40 tons of ore daily. The system of barrel chlorination, in which the whole operation of chlorinating and leaching is done in the same vessel, was introduced and worked out by Mr. J. E. Rothwell. Here are chlorinated successfully refractory ores which carry from 12 dols. and upward in gold, saving from 90—97 per cent. of the assay value. There is a considerable quantity of gold solution to handle, amounting to from 8,000 to 9,000 gallons daily.

After numerous experiments with ferrous sulphate, charcoal, iron and copper sulphide, and other precipitants, it was decided that the safest, quickest, and best precipitant is hydrogen sulphide.

The mode of operation now adopted in the works is: First, to destroy the free chlorine in the gold solution, while cold, with sulphurous acid gas, which is done by drawing a stream of air over ignited sulphur with a small air pump into the precipitating tank till all or almost all free chlorine is converted into HCl. Then, turning on the hydrogen sulphide, start and finish the precipitation of the gold ($2\,AuCl_3 + 3\,H_2S = Au_2S_3 + 6\,HCl$). It takes less than an hour to precipitate the tank of about 5,000 gallons of gold solution. The precipitate is in a voluminous and flocculent form, that settles quickly. Usually after precipitation the tank is allowed to settle for two hours. The heaviest of the precipitate has then settled and the solution is drawn off from 1 in. above the tank bottom through a filter press, only provided with a set of heavy Canton flannel filter cloth. This process of filtration (decantation) takes usually from three to four hours—three hours when the cloth in the filter press is new, four hours when already a considerable amount of gold sulphides has been collected on the filter cloth. The precipitating tanks are placed so as to give about 25 ft. head above the presses. By cleaning up from the tank bottom into the press only once or twice a month, that is, allowing the sulphides to accumulate in the tank bottom and run down and catch in the filter press only the very small amount of gold sulphides remaining suspended in the liquid after two hours' settling, instead of filtering and gathering all the precipitated gold sulphides in the filter press after each precipitation, there is less filter cloth to burn and less loss of precipitate.

If the filter press is filled on the clearing-up day with gold sulphides, the small air-pump is connected with the filter press, and air is pumped through it for an hour to dry the mass of sulphides into hard cakes, which are easily handled and removed. The precipitate thus obtained is roasted in a muffle furnace, mixed with a little borax and nitre, and smelted down to bullion. If carefully handled there is little loss. The bullion is always about 900 to 950 fine in gold, the balance being some silver, copper, lead, and arsenic.

The advantages derived from this method of precipitation are evident from the facts given above, and are enumerated as follows:—

1. There is no gold left or remaining undetected in solution after the precipitation with sulphuretted hydrogen has been completed.

2. The free chlorine is cheaply, quickly, and easily transformed into hydrochloric acid. The latter, with the sulphurous gas converted into sulphuric acid, assists the precipitation of gold with sulphuretted hydrogen, in so far as gold is more quickly and better precipitated out of an acid solution than out of a neutral or alkaline one. There is no heating of solution, no lead lining affected, and no time wasted to decompose free chlorine.

3. There are required only crude chemicals and a simple apparatus.

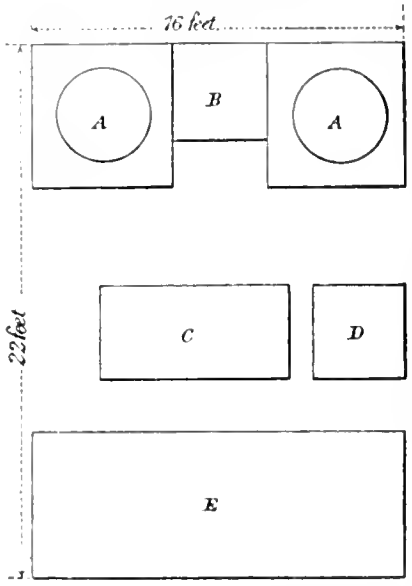
4. The precipitate is in a flocculent form, and settles quickly. There is little loss if carefully handled.

If copper be present, the gold is precipitated from a nitric acid solution by sulphuretted hydrogen.

Refining Silver Bullion. F. Gutzkow. Eng. and Mining J. 1891, 257.

A NUMBER of years ago the author devised a method for refining silver bullion by sulphuric acid, in which iron was substituted for copper as precipitant of silver, the principal feature being the separation of pure crystals of silver sulphate. A full description of this process may be found in Percy's Metallurgy, "Silver and Gold," page 479. The process has been extensively worked in San Francisco and in Germany in refining bullion to the amount of more than a hundred million dollars' worth of silver. Its more general application has been hampered, however, by the circumstance that the patent had been secured by one firm which limited itself to its utilisation in its California works. The patent having expired, the author lately introduced a modification of the process by which the apparatus and manipulations are greatly cheapened and simplified. In the following account is given a short description of the process in its present shape.

Preparing the Silver Sulphate.—The bullion, containing, essentially, silver, copper and gold, is dissolved by boiling with sulphuric acid in cast-iron pots. The difference between the new process and the usual practice consists in the use of a much larger quantity of acid. Thus, in refining ordinary silver "doré" four parts of acid are used to one part of bullion. Of this acid one part is chemically and mechanically consumed in the dissolving process, and the remaining three parts are fully recovered and at once ready for re-utilisation, as will be described hereafter. In the usual process—understanding thereby, here and in the following, the process practised at the United States mints, for instance—two parts of acid are employed for one of bullion; all of this is lost, partly through the dissolving and partly in being afterwards mixed with water, previous to the precipitation of the silver by copper. Economy in acid being, therefore, imperative, the silver solution finally



becomes much concentrated, and it requires high heat and careful management to finish the solution of the bullion. Bars containing more than about 10 per cent. of copper cannot be dissolved at all, owing to the separation of copper sulphate insoluble in the small amount of free acid finally remaining. The advantage gained by dissolving bullion with abundance of free acid in the improved process is so evident that it merely requires to be pointed out. For bullion containing 20 per cent. of copper the author employs six parts of acid to one of bullion; for baser metal still more acid, and so on, never losing more than the stoichiometrical percentage of acid and recovering the remainder.

In this description he, however, confines himself to the treatment of ordinary silver ore with less than 10 per cent. of copper.

In the diagram A A represent two refining pots, 4 ft. in diameter and 3 ft. in depth, each capable of dissolving at one operation as much as 400 pounds of bullion. The acid is stored in the cast-iron reservoir B, which is placed on a level sufficiently high to charge into A by gravitation, and is composed of fresh concentrated acid mixed with the somewhat dilute acid regained from a previous operation. After the bullion is fully dissolved all the acid still available is run from B into A A. The temperature and strength are thereby reduced, the fuming ceases, any still undissolved copper sulphate dissolves, and the gold settles. In assuming that the settling of the gold takes place in A itself, the author follows the practice of the United States mints. In private refineries, where refining is carried on continuously, the settling may take place in an intermediate vessel, and A A be at once recharged. Owing to the large amount of free acid present, the temperature must fall considerably before the separation of silver sulphate commences, and sufficient time may be allowed for settling if the intermediate vessel be judiciously arranged.

Separating the Silver Sulphate.—The clarified solution is siphoned off the gold from A A into C, which is an open cast-iron pan, say 8 ft. by 4 ft., and 1 ft. deep. It is supported by means of a flange in another larger pan—not shown in the diagram—into which water may be admitted for cooling. Steam is blown into the acid solution, still very hot, as soon as C is filled. The steam is introduced about 1 in. below the surface of the liquid, blowing perpendicularly downward from a nozzle made of lead pipe through an aperture $\frac{1}{8}$ in. in diameter. Under these circumstances the absorption of the steam is nearly perfect, and takes place without any splashing. The temperature rises with the increasing dilution, and may be regulated by the less experienced by manipulating the cooling tank. An actual boiling is not desired, because it protracts unnecessarily the operation by the less perfect condensation of the steam. No separation of silver sulphate occurs during this operation (and, consequently, there is no clotting of the steam nozzle), the large amount of free acid, combined with the increase of temperature, compensating for the diminution of the solubility of the sulphate by the dilution. The most important point in this procedure is to know when to stop the admission of steam. To determine this, the operator takes a drop or two of the solution upon a cold iron plate by means of a glass rod and observes whether after cooling the sample congeals partly or wholly, into a white mass of silver bisulphate, or whether the silver separates as a monosulphate in detached yellow crystals, leaving a mother-liquor behind. As soon as the latter point has been reached, steam is shut off and the solution is allowed to crystallise, cold water being admitted into the outer pan. The operator may now be certain that the liquid will no longer congeal into a soft mass of silver bisulphate, which on contact with water will disintegrate into powder, obstinately retaining a large amount of free acid; but the silver will separate as a monosulphate in hard and large yellow crystals retaining no acid and preserving their physical characteristics when thrown into water. After cooling to, say, 80° F., the silver sulphate will have coated the pan C about 1 in. thick. There will also be found a deposit of copper sulphate when the mother-acid, after having been used over and over again, has been sufficiently saturated therewith. Lead sulphate separates in a cloud, which, however, will hardly settle at this stage.

The whole operation just described, which constitutes the most essential feature of the author's improvement upon his old process described in Dr. Percy's work, is a short one, as the acid requires by no means great dilution. The steam has merely to furnish enough water to dilute the free acid present to, say, 62° B. Areometrical determination is, of course, not possible on account of the dissolved sulphates.

Reducing the Silver Sulphate to Fine Silver.—The mother-acid is pumped from C to the reservoir B, for this purpose an iron pipe connecting the top of B with a recess in the bottom of C. The tank B is cast as a closed vessel, with a manhole in the top, which is ordinarily kept closed by an iron plate resting on a rubber packing. The air is exhausted from B by a steam injector, and the acid rises from C and enters B without coming in contact with any valves. The volume of fresh commercial acid necessary for another dissolving operation, say 800 pounds, more or less for refining 800 pounds of bullion in A A, is lifted from some other receptacle into B in the same manner. The mixture of the two acids in B now represents the volume of acid to be employed for dissolving and settling the next charge of 800 pounds of bullion in A A. In this reservoir, B, the cloud of lead sulphate mentioned above finds an opportunity for settling.

The crystals of silver sulphate are detached from C by an iron shovel and thrown into D. D is a lead-lined tank about 4 ft. by 4 ft. and 3 ft. deep. It is divided into two compartments by means of a horizontal, perforated false bottom made of wood. From the lower compartment a lead pipe discharges into the lead-lined reservoir E. Warm distilled water is allowed to percolate the crystals until the usual ammonia test indicates that the copper sulphate has been sufficiently dissolved. Then the outflow is closed, sheets of iron are thrown on and into the crystals, the apparatus is filled with hot distilled water, and steam is moderately admitted into the lower compartment. Ferrous sulphate is formed, and in connexion with the iron rapidly reduces the silver sulphate to the metallic state, the reduced silver retaining the heavy compact character of the crystals. When the reaction is completed, as indicated by the chlorine test, the liquid is discharged into E, the iron sheets are removed and the silver is sweetened either in the same vessel, D, or in a special filtering vessel which rests on wheels and may be run directly to the hydraulic press.

The vat, E, is the great reservoir where all liquids holding silver sulphate in solution are collected; for instance, that from sweetening the gold and from washing the tools. Sheets of iron here precipitate all silver and copper, and the resulting solution of ferrous sulphate is, with the usual precautions, discharged into the sewer. Occasionally when copper and silver have accumulated in E in sufficient amount the mass is thrown into D, silver sulphate crystals are added and sheet copper is thrown in, instead of sheet iron. There results a hot, neutral, concentrated solution of copper sulphate which may be run at once into a crystallising vat for the separation of commercial crystals of copper sulphate. It will be readily understood, of course, that if there should be any advantage in manufacturing that commercial article, besides the amount prepared as described, which represents merely the copper contained in the bullion, copper sheets may be regularly employed for reducing the silver sulphate in D. The author trusts that the practical refiner will recognise that the manufacture of commercial copper sulphate is thus effected in a more rational and economical manner than by the present method of evaporating from 25° B. to 35° B, and of saturating by oxidised copper, generally in a very incomplete manner, the large amount of free acid left from the refining by the usual process. However, the sale of copper sulphate is but rarely so profitable that a refinery should not gladly dispense with that troublesome and bulky manufacture, especially the government establishments, which, besides waste much valuable space with the crystallising vats.

The great saving in sulphuric acid, amounting to about 50 per cent. of the present consumption, has already been pointed out. Another advantage the author merely mentions, namely, the easier condensation of the sulphurous fumes in refineries situated in cities, because the larger amount of acid available for dissolving, greatly facilitates working and makes the usual frequent admission of air into the refining pot for the purpose of stirring and testing unnecessary.

The more air is excluded from the refining fumes the easier they can be condensed.

Work may be carried on continuously, the vessels C and D being empty by the time a new solution is finished in A A. Thus, the plant shown in the diagram, covering 26 ft. by 16 ft., allows the refining of 40,000 ounces of fine silver in 24 hours; that is, four charges in A A of 800 pounds each.

The Nickel and Copper Deposits of Sudbury, Canada. Robert Bell. Bull. Geolog. Soc. Amer. February 1891; Eng. and Mining J. 1891, 328.

The nickel and copper district of Sudbury, Ontario, is situated in the course of the last known and perhaps the longest Huronian belt in Canada. Beginning in the west, the general northerly boundary of this great belt commences at the promontory of Namainse on the east side of Lake Superior, and runs approximately parallel to the shore of that lake, the St. Mary's River and the north shore of Lake Huron as far as Spanish River, leaving a border of Huronian rocks of varying width between the water and the Laurentian nucleus to the north. Near Spanish River the dividing line between the two systems turns inland and runs north-easterly nearly to Lake Wahnapitæ, whence it trends northward and north-westward till it gains a point lying north-east of Michipicoten on Lake Superior, thus almost surrounding a large elliptical area of Laurentian rocks.

The stratified Huronian rocks and also the gneiss and quartz-syenite of the Sudbury district are traversed by dykes of grey, coarsely crystalline diabase, which are often large and can be traced for considerable distances. Their commonest course is about west-north-west. They all have the same physical characters and appear to be of identical composition. The sound, fresh rock is extremely tough, but the exposed surfaces disintegrate easily under the weather into brown, crumbling débris, especially along the joint-planes and at their angles. The outer portions of the masses, thus separated, scale off concentrically, so that they become rounded and boulder-like. These dykes apparently play an important part in the economic geology of the district.

Referring to the nickel and copper ores for which this district is becoming famous, there is much uniformity, both as to characters and the conditions under which they occur. These deposits are not confined to the undoubted Huronian rocks, but are equally abundant within the gneiss and quartz-syenite areas, and may be said to be connected with a certain geographical area rather than with a single geological horizon. The ore consists in all cases of a mixture of chalcopyrite and nickeliferous pyrrhotite. The area over which it has been found up to the present time extends from the Wallace mine, on Lake Huron, in the vicinity of La Cloche, north-eastward to the north side of Lake Wahnapitæ, a distance of about 70 miles, and from the south-eastern boundary of the Huronian belt, in the Sudbury district, north-westward to the limits of the Geneva Lake outlier, a distance of about 50 miles.

The investigations of the writer in this district have shown that the combined nickel and copper ore is found on or near certain lines of contact between diorite, and gneiss or quartz-syenite, but only at certain points on these lines, the concentration of the ore at one place more than another being probably caused by the intersection of the ore-bearing belts either by one of the diabase dykes above described or else from the pinching-in or perhaps from a transverse disturbance of the belt. The ore seems to have been derived in all cases from the diorite, but for some reason the proximity of the gneiss or quartz-syenite appears to be also favourable for the production of large deposits.

The diorite wall rocks on either side and also the included boulders and even the smaller fragments are often thickly impregnated with disseminated grains and patches of all sizes, both of pyrrhotite and chalcopyrite. These spots of ore have usually rounded outlines in cross-section and approach spherical and ovate forms. The two sulphides may occur side by side in the same isolated kernels; but just as frequently the latter consist of one or the other alone, although in such cases the same rock section may contain as many of the one kind as the other, and all indiscriminately mingled together.

Numerous analyses of the ores have shown that the nickel is confined to the pyrrhotite, in which it is present in the proportion of about 1 per cent. to 5 per cent.

PATENT.

Improvements in Machinery for the Production of Sheets direct from Molten Metal or Glass. C. M. Pielsticker, London. Eng. Pat. 6464, April 28, 1890. 8*d*.

The present practice in making metal sheets is to cast ingots or slabs and then reduce these by repeated rollings and reheating. Attempts have been previously made to produce sheets directly from molten metal by pouring the metal: (1) between two revolving rollers; or (2) between a revolving wheel and the surface of an enclosing fixed semi-circular segment. By these means none but very thin plates could be satisfactorily produced. In this invention the machinery consists of a large receiving roller of 5 ft. diameter more or less, and of a length equal to that of the plate to be produced. With this are combined small forming rollers arranged in succession part way round the periphery of the large roller, and revolving at the same rate as the large roller. The rollers can be cooled by a current of water circulating through them. The molten metal flows on to the surface of the large roller and is prevented from escaping sideways by flanges with which the large roller is provided. These flanges embrace the small rollers and are of a depth greater than that of the thickest plate which it is proposed to roll. The distance between the large roller and the small rollers can be adjusted according to the desired thickness of the plate. When dealing with metals of high melting point, such as steel, the first small roller is made of refractory material and is heated from inside by the flame of a blow-pipe. The rollers are coated with plumbago or other material to prevent adhesion to the molten metal. In the case of metals of high melting point the machine is fed direct from a furnace divided into two compartments by a wall or bridge in which is a stopper which can be operated so as to regulate the flow of metal. When applied to forming sheets of glass, the rollers should be warmed by a blow-pipe flame as above described, and the sheet of glass stretched and annealed as it leaves the last roller.—V. C.

XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

Edison's Electricity Meter. Electr. Rev. **28**, 118.

The amount of electrolytic gas evolved from acidulated water is measured by means of a suitable form of gas meter. The acidulated water is contained in a closed vessel, the level being kept constant by a syphon tube from a reservoir which is kept full by the action of a trap.—V. C.

The Chemistry of Secondary Cells. Ayrton, Lamb, Smith, and Robertson. Journ. Inst. Electrical Engineers, **19**, 659—747.

The investigation carried out by the above authors included chemical analyses of plugs taken from the positive and negative plates of E.P.S. cells of the 1888 type at all stages of charge and discharge. The potential differences were also measured, as well as the resistance of the cell itself and of the lugs.

The results of the chemical examination are as follows. At end of charge and at beginning of discharge the composition of the positive plugs were practically the same as that of pure PbO_2. On the negative plugs the sulphate decreased during the process of charging until at the end of the charging there was practically nothing but pure lead. With the removal of the last traces of sulphate there was a rapid rise in potential difference. During discharge the amount of sulphate increased, and towards the end of discharge there was decided evidence of peroxide on the negative plates. On the positive plate

the particles of peroxide very soon get coated during discharge with a layer of lead sulphate, which protects the peroxide from further action. A large proportion of active material still remains at the end of the discharge. The loose powdery surface of the positive plate seems to become completely converted to lead sulphate. When the peroxide in the surface of the plate falls to about 31 per cent. the cell loses its E.M.F. very rapidly, owing to the inactive layer of sulphate impeding the action of the sulphuric acid on the active material behind it, and also to the formation of peroxide on the negatives. The diffusivity of the acid is decreasing, and it has to penetrate further into the plate to find active material. When the whole of the paste approaches this composition of 31 per cent. of peroxide, the cell loses its E.M.F. entirely.

On the whole the rate of chemical action at the top of the plates is greater than at the bottom; this distribution apparently depending on difference of current density.

With regard to the formation of PbO_2 on the negative plate, Gladstone and Tribe have already pointed out that once it is formed more rapidly than it is reduced, the two plates must rapidly approach electrical equilibrium; that when the circuit is broken local action can alone take place, and this will reduce the peroxide on the negative plate. On making the circuit again *the cell gives a current*: and in this way Gladstone and Tribe account for the resuscitating power of the cell, as well as for the rise of E.M.F. on breaking the discharged circuit.

With regard to the resistance of the cells it was found that about one-seventh of the whole mean resistance of these accumulators is that of the lead lugs. Further, that if the contacts between the lugs of successive cells be allowed to become dirty by acid spray falling on them, the resistance of the accumulator when joined up in series may be increased by as much as 25 per cent. Hence it is well that accumulators which are to remain joined up for a long period should have the adjacent lugs fused together; and further, it is recommended that the lugs should be made of greater cross-section than is generally the case.

Construction and "Forming" of E.P.S. Plates.—The positive plates contain about 48 per cent. more peroxide than is required to be converted to sulphate in the discharge. This appears to be necessary (1) because, if completely "formed," the positive plate would be liable to fall to pieces; and (2) on account of the coating of the peroxide with sulphate, which prevents part of the peroxide from entering into the chemical reaction.

With regard to the process of "forming" Ayrton gave the following method as that of the E.P.S. Company. Mr. King, of the E.P.S. Company, does not acknowledge the accuracy of the data.

Positive Plates, $8\frac{7}{8}$ in. by $7\frac{5}{8}$ in. by $\frac{1}{4}$ in. Two ampères per plate, or ·028 ampère per sq. in. sent for 18 hours.

Negative Plates, 9 in. by $9\frac{5}{8}$ in. by $\frac{3}{16}$ in. One-and-a-half to two ampères per plate, *i.e.*, ·017 to ·023 ampères per sq. in. for 120 hours.

Efficiency of E.P.S. Accumulators was dealt with also in a previous paper by the same authors (read at July meeting of the Institution). It was found that if charged with 9 ampères and discharged with 10 a number of times without intermission between 1·8 and 2·4 volts per cell, till a "steady state" is reached, the quantity efficiency is about 97 per cent., and the energy efficiency 87. In the course of the discussion Sir David Salomons advocated as ultimately economical the practice of using a larger battery for given work than would be indicated by the maker's statements. In this way the efficiency may be increased, *e.g.*, from 70 per cent. to 80 or 85 per cent., and hence a greater economy in daily working, which more than outweighs the difference in first cost. This principle, however, as was pointed out by Mr. Frazer, cannot be applied to the case of electric traction, since the *weight* of the accumulator has to be considered.

From their investigation of the relation between resistance and distance apart of the plates the authors conclude that the resistance of an accumulator takes the form—

$$p + ld$$

where p is a constant for a particular cell depending on resistance of the plates themselves, &c., l is a constant depending on the area of the plates, the temperature, and density of the liquid, &c., and d is the distance between the plates.—V. C.

Dry Elements. Elecktrotech. Zeits. **11**, 31.

A series of experiments on the comparative merits of six different dry elements was conducted in the physical laboratory of the Munich University during 1889—90. The elements examined were those of Hellesen, Bender, Thor, Gassner, Jenisch, and Wolfschmidt. The following points were investigated:—(1.) Change of E.M.F. on open circuit. (2.) Variation of E.M.F. with temperature. (3.) Determination of internal resistance. (4.) Fall of E.M.F. on closed circuit and recovery on open circuit. As the result of these trials it was found that the Hellesen's and Bender's elements were the best. Of these two Hellesen's has less polarisation and smaller internal resistance. After long working, however, Bender's recovers better. Thor's and Gassner's stand to each other in a similar relationship. Jenisch's and Wolfschmidt's elements are only suitable for use in cases where the circuit is only closed for a short time. This investigation possesses considerable interest since a good dry battery is a desideratum for telegraphic and telephonic work, as well as for houses fitted with electric bells.—V. C.

Preservation of Accumulators. G. Roux. Electr. Eng. **7**, 181.

Experiments to determine the conditions under which accumulators best preserve their charges when left unworked. The liquid was covered with paraffin wax with a small hole to allow the gas generated in charging to escape. The cells are of glass and are charged on oil insulators. It is important to charge to saturation. Two Julien accumulators treated in the above manner only lost 6 per cent. of their charges when left to themselves for $2\frac{1}{2}$ months.—V. C.

Influence of Hardening Steel upon its Electrical Resistance. H. Le Chatelier. Compt. Rend. **112**, 40—43.

The process of hardening steel modifies both its chemical condition and ultimate structure, and the alteration caused by each of these two orders of phenomena must be carefully distinguished from that produced by the other. Osmond has already studied this question and has taken advantage of the alterations of the properties of the carbon in steel to characterise the chemical condition of the metal. Chatelier has now adopted the measurement of its electrical resistance as a method of greater precision for the same end. His experiments were carried out on wires 100 mm. long and 2 mm. in diameter. The following table shows the electrical resistance and content of carbon of the specimens used:—

——	I.	II.	III.	IV.
Resistance calculated for a wire 1,000 mm. × 1 mm.	0·19	0·25	0·27	0·22
Carbon, per cent.*	0·085	0·485	0·67	0·83

* ω (= ohm) in original.

On hardening the steel at different temperatures it was found that a change of state indicated by a sudden increase in electrical resistance occurred at a point identical with that at which the transformation of carbon takes place, viz., at 730° C., thus confirming one of Osmond's main conclusions.

On annealing the steel the resistance falls again in a manner corresponding to the change observed in other physical properties of the metal. The author considers the method likely to be useful in further research.—B. B.

PATENTS.

Improvements in Secondary Batteries and Plates or Elements therefor. W. P. Thompson, London. From "The Gibson Electric Company of Europe," Paris, France. Eng. Pat. 2091, February 8, 1890. 8*d*.

The plates are in the shape of lead trays with a slight rim, and are placed horizontally in the cells. The bottoms of the trays are perforated obliquely with numerous small holes. The active material covers the tray and fills the perforations.—E. T.

Improvements in Secondary Batteries. E. T. Mackrill, Aylesbury. Eng. Pat. 2845, February 21, 1890. 4*d*.

Small balls or pellets of wax, or other substance unaffected by the acid of the cells, are floated upon the surface of the electrolyte in order to prevent spraying as the bubbles rise to the surface during overcharging.—E. T.

Improvements in and relating to and in the Manufacture of Electric Secondary Cells. A. M. F. Laurent-Cely, Paris, France, and J. A. Timmis, London. Eng. Pat. 2945, February 24, 1890. 11*d*.

Chloride of lead is melted in a closed furnace, and a certain proportion of pure zinc added. Pastilles of any desired shape are cast of this mixture in suitable moulds. These pastilles are then purified from any oxide—the presence of which, the inventors claim, is almost entirely prevented by this method of working—by treatment with hydrochloric acid, and are then washed with water. To oxidise the pellets they are placed on plates of zinc in water slightly acidulated with hydrochloric acid: an electrolytic action is set up which reduces them to porous lead, and they are then oxidised by exposure to the air at temperatures rising to 300° C. Finally a grid is cast round the pastilles and the plate is ready for electrolytic formation to produce peroxide of lead.

For the other plates, the pastilles of chloride have their grid cast round them *before* reduction. The whole plate is then coupled to zinc plates in acidulated water until the pastilles are reduced to spongy lead.

The active material produced in this way is said to be much less dense, and therefore more porous, than that produced by ordinary processes; to have a larger storage capacity weight for weight, and greater rates of charge and discharge.

The plant required for the above operations is described and illustrated on seven sheets of drawings.—E. T.

Improvements in or connected with the Manufacture of Secondary Battery Elements. J. S. Stevenson, South Shields. Eng. Pat. 3967, March 13, 1890. 6*d*.

By a previous patent (11,390 of 1887; this Journal, 1888, 572) the inventor forms plates by pouring melted lead round pellets of active material in a suitable mould. In the present specification methods of producing these pellets are described. A layer of active material is spread over the face of a die and by hydraulic pressure is formed into a cake with grooves running along and across it. The cake when dry can be broken at these grooves into small pellets as desired.—E. T.

Improvements in Electric Batteries and Lighters for Cigars and other Purposes. D. Robertson, Glasgow. Eng. Pat. 18,412, November 15, 1890. 6*d*.

The improvements are to prevent spilling of the liquid, to enable the cell easily to be taken to pieces to be recharged, and to give an ornamental appearance to the whole. The battery cell is in a metal case; the current is produced by pressing a knob and thereby immersing the zinc in the electrolyte; on releasing the knob the zinc is removed from the liquid by a spring.—E. T.

Improvements in Electrical Storage Batteries or Accumulators. H. H. Lake, London. From G. E. Hateh, Cambridge, U.S.A. Eng. Pat. 19,155, November 25, 1890. 6*d*.

The active material is lodged in grooves or indentations on each side of porous plates—peroxide on one side, spongy lead on the other. Thin lead is placed between the various porous plates to make contact with the active material in the latter, and the whole bound together. The electrolyte fills the pores of the porous plates.—E. T.

XII.—FATS, OILS, AND SOAP MANUFACTURE.

Mineral Lubricating Oils used in Italy. V. Villavecchia and G. Fabris. Report of the Central Laboratory of the Italian Customs Department, 1891.

See under XXIII., *page* 390.

XIII.—PAINTS, PIGMENTS, VARNISHES, AND RESINS.

PATENTS.

A Composition suitable for Lining Casks and like Vessels and for Making Screw Stoppers for Bottles. W. Sinclair, Hull, and M. Mackay, London. Eng. Pat. 1177, January 22, 1890. 4*d*.

The invention is intended for vessels and stoppers used for beers and ales, the compound not affecting or being affected by acids or other chemicals contained in those liquors. The ingredients are as follows, the powdered pipe-clay being omitted if the composition is not to be used for moulding stoppers:—Shellac, 4½ lb.; rosin, 1½ lb.; wood carbon, 4 lb.; powdered clay, 4 lb.; palm wax, ½ lb. These ingredients are agitated with 1½ gals. of methylated spirit, which "amalgamates all of them into a compound." Without the clay the compound is semi-liquid, and can be run or brushed over the surface to be coated, and allowed to dry.—A. G. B.

Waterproofing and Preserving Composition for Stone, Bricks, also for Plaster and Cement Surfaces. W. Sinclair, Hull, and M. Mackay, London. Eng. Pat. 1178, January 22, 1890. 4*d*.

One lb. of gum "dammer" is dissolved in 1 gal. of hot turpentine or hot mineral spirit, and 2 lb. of paraffin wax added. The paraffin dissolves, and the composition when cold can be brushed on to the surface to be waterproofed. Dirty surfaces should be first cleansed. The compound is kept in jars carefully corked.—A. G. B.

Improvements in or relating to the Manufacture of Litharge and Red Lead. G. Larrony, St. Andre-Pez-Lille, France. Eng. Pat. 3786, March 10, 1890. 8*d*.

In the present method of making red lead, the metal has first to be converted into litharge, which is then washed to free it from particles of unoxidised lead, and finally heated in boxes for 72 hours at a temperature not above 320°; if the litharge is not completely converted into red lead by the end of this time it is replaced in the furnace and heated for 144 hours.

By this invention the lead or litharge is converted directly into red lead. The finely powdered lead or litharge is put on iron trays contained in an iron case; the case is jacketed and surrounded by superheated steam. The whole is situated in the flue of the furnace which superheats the steam, so that the smoke and gases from the grate may surround the jacket and serve to keep up its temperature.

The following advantages are claimed—(1) the regular and certain manufacture of red lead by means of superheated steam, the temperature 300°—320° being obtainable with precision and easily maintained; (2) considerable economy of fuel, as the steam requires only very little coal to superheat it, and in this condition gives up very easily the heat it contains; (3) saving of time, litharge and red lead being manufactured by this process in at most a quarter of the time required by the methods hitherto known. Plans of the furnace accompany the specification.—A. G. B.

An Improved Furniture Polish. A. McMillan, Thornliebank. Eng. Pat. 4321, March 19, 1890. 4*d*.

The following ingredients are mixed together in or about the proportions given:—Linseed oil, 1 gal.; butter of antimony, from $\frac{1}{4}$ to 1 pint, as desired; spirits of wine, $\frac{1}{2}$ pint; white vinegar, 1 quart; "gum cassia, a few ounces."
—A. G. B.

XIV.—TANNING, LEATHER, GLUE, AND SIZE.

PATENT.

An Improved Leather Finishing Machine. W. W. Horn, London. From G. W. Lennox, Havenhill, U.S.A. Eng. Pat. 15,286, September 26, 1890. 8*d*.

Leather, after having been blacked, has to be treated with a "seasoning solution" consisting of "red aniline dye, blood albumen, extract of logwood, milk, and water" to "set" the black colour, and enable the leather to be polished afterwards. The "seasoning solution" has to be well rubbed in, and hitherto this has been done by hand.

In the machine patented the leather is stretched on a table capable of universal motion, and pressed against a padded roller fed with the solution with which it is to be treated; the solution is contained in an overhead reservoir, and is kept agitated by a set of rotating blades. In order to enhance the ease with which the table is moved so as to present every portion of the area of the leather to the action of the roller, the grip of the latter on the leather tending to oppose displacement of the plate is neutralised by suitable counterweights. Splashers and a drip trough shield the leather from any surplus solution that might fall upon it.
—B. B.

XV.—MANURES, Etc.

The Noxious Vapours of Manure Works. J. Morrison.
See pages 338—340.

Agricultural Value of Ammonium Salts. P. Wagner. J. f. Gasbeleuchtung, **33**, 660—662.

The author being commissioned to investigate the efficiency of nitrogen in ammonium sulphate and in Chili saltpetre on different soils and also to inquire to what extent, in what direction and upon what soils the efficiency of ammonium sulphate as a manure can be raised by simultaneous applications of lime or marl or "Thomas" slag, instituted numerous field and pot experiments. The former, under the control of Märcker, have indicated that the action of ammonium sulphate on barley, oats, and sugar beet can be augmented by simultaneous calcareous manurings, a point confirmed by the author's experiments, especially as regards soils deficient in lime. In such cases, even when lime, either alone or when used with nitrate, has little or no action; its beneficial effect with ammonium salts is, nevertheless, manifest. Märcker's experiments also show that, on an average, ammoniacal nitrogen is less active than nitric nitrogen, this being more marked with barley, potatoes, and sugar beet. The author has also confirmed this view for certain soils, and, attributing the inactivity of ammoniacal nitrogen to the lack of fixed bases in ammoniacal manures, asserts rightly that the soil should contain lime and also potash, or potash and soda, in sufficient quantity, if ammonium salts are to work efficiently, therefore he recommends the use of lime, Stassfurt salts—in fact, mineral along with the ammoniacal manures. The sulphuric acid in the ammonium salts is not regarded as the injurious agent.
—D. A. L.

PATENT.

Improvements in Fertilising Compounds or Fertilisers. J. Patterson, Philadelphia, U.S.A. Eng. Pat. 16,793, October 21, 1890. 6*d*.

Twelve hundred pounds of unslaked lime, 1,200 lb. of powdered gypsum, 3,150 lb. of powdered "rotten rock," 4,000 lb. of "muck or common bog deposit," 300 lb. of sulphate of iron, and 150 lb. of salt, are mixed, the last two ingredients being previously dissolved in water. More water is then added, in sufficient quantity to slake the lime, and the mixture allowed to remain under cover from 3—6 months. (By "rotten rock" is meant "rock which is decomposed or partially decomposed.") The proportions may be varied. The substance thus prepared is said to be a valuable fertiliser.—B. B.

XVI.—SUGAR, STARCH, GUM, Etc.

Further Experiments on the Introduction of Home-Grown Sugar. G. Schack-Sommer.
See pages 318—326.

Gummy Exudation from Beetroots. E. O. v. Lippmann. Ber. **23**, 3564—3566.

The author observed a gummy exudation from some of the larger but unripe roots—used as test samples—which had been stored, wrapped in paper, in a room. The substance, which could be easily detached from the roots, formed brittle, faintly yellow, transparent drops, possessing neither taste nor smell, and resembled ordinary gum. It was insoluble in cold water and in alcohol, and evolved on burning the odour characteristic of carbohydrates, leaving only a trace of ash, which consisted principally of lime. Alkalis slowly dissolved it on heating, but from the neutralised solution it was reprecipitated by alcohol in a form which dissolved by digestion with water, to a neutral solution having a dextro-rotation. The amount of the latter was not ascertained, as the solution was not clear, and the quantity of material was insufficient for further determinations. The crude substance gave numbers on analysis agreeing, when corrected for ash, with the empirical formula $C_{11}H_{20}O_{10}$. It also yielded furfuraldehyde, corresponding to 8·84 per cent. of furfuramide, on distillation with sulphuric acid, and mucic acid 41·83 per cent. on oxidation with nitric acid.

By prolonged heating on the water-bath with dilute sulphuric acid, the compound was hydrolysed, arabinose and galactose, both of which were isolated and identified, being apparently the sole products. It would, therefore, seem to be a mixed anhydride of these two sugars, a view in harmony both with the above formula and also with the amounts of furfuramide and mucic acid which the compound yields, although as a gum, its molecule is probably more complex. These statements can only be regarded as provisional, as sufficient material was not available to even establish the individuality of the substance. The author has not succeeded in separating the substance from beetroots subsequently experimented with, either by allowing them simply to remain aside as before, or by puncturing the tissues; it therefore seems to be a chance product.—A. R. L.

On the Influence of Some Inorganic Salts on the Specific Rotatory Power of Cane Sugar. K. Farnsteiner. Ber. 23, 3570—3578.

THREE series of experiments were made. In the first, the weights of sugar and water were constant, whilst that of the salt was varied; in the second, the weights of the salt and water were constant, whilst that of the sugar was varied; and in the third, the weights of the sugar and salt were constant, whilst that of the water was varied.

In preparing the solution, the amount of salt used was dependent on its properties. All the bodies were weighed, except in the case of hygroscopic salts, in which cases the solution was analysed. The observations of the optical activity were made with a half-shadow instrument with a quartz-wedge compensation and a Ventzke sugar scale (one scale division with a gas flame = 0·3465 of a degree, according to Landolt, Sitzungsber der Akad. d. Wissensch. zu Berlin, 1887, 48). The determinations of the density and optical activity were made at 17·5° C., the density being calculated taking water at 4° C. as unity.

TABLE I.

EFFECT OF INCREASING AMOUNTS OF SALTS WHILST THE PROPORTION OF SUGAR TO WATER REMAINS CONSTANT.

Salt.	Parts by Weight of Salt to 1 part by Weight of Sugar and 5·633 parts by Weight of Water.	Density $\frac{17·5°}{4°}$	$[\alpha]_D$
	0·000	1·0401	66·74
	1·670	1·1086	64·31
$MgCl_2$	3·267	1·2003	62·24
	5·208	1·3075	61·47
	0·265	1·1293	65·41
	1·749	1·1778	64·50
	2·753	1·2185	63·50
	3·398	1·2633	63·41
$CaCl_2$	3·646	1·3056	62·23
	4·195	1·3370	63·45
	5·356	1·3850	65·66
	5·676	1·4085	66·35
	5·987	1·4232	67·88
	1·300	1·1675	65·40
$BaCl_2$	2·250	1·2315	64·68
	3·791	1·3567	63·74
	0·954	1·1271	66·30
$SrCl_2$	2·622	1·2677	66·08

TABLE II.

EFFECT OF VARYING THE AMOUNT OF WATER WHILST THE PROPORTION OF SUGAR TO SALT REMAINS CONSTANT.

Salt.	Proportion of Sugar to Salt.	Proportion of Sugar to Water.	$d \frac{17·5°}{4°}$	$[\alpha]_D$
		1 : 3·182	1·3030	62·31
		4·019	1·2559	63·11
$MgCl_2$	1 : 1·230	5·195	1·2103	63·81
		6·754	1·1700	64·54
		13·505	1·0928	65·63
		29·434	1·0451	66·12
$CaCl_2$	1 : 0·895	1 : 2·396	1·2791	63·51
		6·088	1·1610	64·92
		1 : 3·132	1·3178	64·16
		3·949	1·2663	64·56
$SrCl_2$	1 : 1·096	6·365	1·1795	65·38
		11·195	1·1084	65·90
		17·456	1·0715	66·52
		1 : 3·135	1·3130	65·93
		5·044	1·2175	66·08
$BaCl_2$	1 : 1·050	8·266	1·1414	66·31
		13·503	1·0891	66·37
		27·045	1·0457	66·45

TABLE III.

EFFECT OF VARYING THE AMOUNT OF SUGAR WHILST THE PROPORTION OF SALT TO WATER REMAINS CONSTANT.

100 parts by Weight of Magnesium Chloride Solution contain the following Parts by Weight of $MgCl_2$.	1 Part by Weight of Sugar is Dissolved in the following Parts by Weight of Magnesium Chloride Solution.	$d \frac{17·5°}{4°}$	$[\alpha]_D$
	0·935	1·4254	61·56
	1·516	1·3929	61·57
31·79	1·841	1·3813	61·56
	3·161	1·3486	61·55
	9·911	1·3149	61·49
	29·418	1·3021	61·27
	0·987	1·2832	64·89
8·82	3·848	1·1518	65·49
	8·817	1·1108	65·44
	18·677	1·0917	65·30

It may be noted that in general the greater the amount of salt present, the greater is the specific rotatory powers lowered, and that other things being equal the lowering is greater the less the molecular weight of the salt is, that is, the depression is inversely proportional to the molecular weight.—A. L. S.

The Reduction of Fruit-Sugar (Levulose). E. Fischer. Ber. **23**, 3684—3687.

On the reduction of fruit-sugar to a hexahydric alcohol, the carbon atom of the carbonyl group becomes asymmetric. From this it might be expected that two stereo-isomeric alcohols should be formed under these conditions, which would combine to form a third body.

This is the case with some ketones, as for example, in the conversion of pyrotartaric acid into inactive lactic acid.

Up to the present only mannitol has been obtained by the reduction of fruit-sugar, and it appears as if the analogy did not hold in this case; this however, is not borne out by the fact that mannonic and the stereo-isomeric gluconic acids are produced by the action of hydrocyanic acid on arabinose, a fact which previously led Fischer to conclude that these acids and the corresponding sugars and alcohols contained one asymmetric carbon atom in the right and left positions respectively.

If this be true, then by the reduction of fruit-sugar, besides mannitol, a second stereo-isomeric alcohol might be obtained which must be sorbitol, corresponding to glucose.

This has been found to be the case. A 10 per cent. solution of crystallised levulose prepared according to Wohl's method (this Journal, 1890, 958) is cooled in ice and treated with 2½ per cent. of sodium amalgam with continued shaking, dilute sulphuric acid is added from time to time so that during the first half of the experiment the solution is slightly acid and subsequently slightly alkaline. After about six hours the solution only slightly reduces Fehling's solution, it is thus just neutralised and evaporated on the water-bath until a large crop of sodium sulphate crystallises out, when it is extracted with eight times its volume of absolute alcohol; on concentration mannitol crystallises out. The resultant mass is extracted with 90 per cent. alcohol, and filtered from the undissolved mannitol. On evaporation there remains a colourless syrup, which on standing a few days partly crystallises. This is impure sorbitol; it is best purified by converting it into the benzoic aldehyde compound.

This compound closely resembles the corresponding compound from natural sorbitol. Sorbitol may be obtained from it which is in all respects identical with the natural body.

The two alcohols, sorbitol and mannitol, formed by the reduction of fruit-sugars appear to be produced in approximately equal quantities.

Both the alcohols yielded fruit-sugar on oxidation.

The reduction of fruit-sugar is the second reaction of the sugar group in which two stereo-isomeric bodies are formed which do not combine to form a third isomeric body. Wallach (Ann. **252**, 106) obtained from levo-limonene-nitrosochloride by piperidine, two isomeric nitrolamines, which most probably have the same structure but have a different optical activity. Dextro-limonene-nitrosochloride yields two similar bodies, each of which combines with one of the levo derivatives to form an inactive dipentene derivative. This may possibly be analogous to the two mannonic and the two gluconic acids.

—A. L. S.

Synthesis of a New Glucobiose. E. Fischer. Ber. **23**, 3687—3691.

Many observers have obtained carbohydrates having a high molecular weight by the action of acids, &c. on glucose. The author has obtained a sugar, the properties of which show it to be analogously constituted to maltose, by the action of strong hydrochloric acid on glucose (dextrose). He proposes to call it iso-maltose. Pure glucose is dissolved in four times its weight of hydrochloric acid (sp. gr. 1·19), and the solution allowed to stand for 15 hours at 10°—15° C. Ten times its weight of absolute alcohol is added to the solution; on the addition of an excess of ether the clear mother-liquor yields a colourless, amorphous precipitate, which is filtered out, washed with alcohol and ether and dried; it consists of a mixture of glucose, iso-maltose, and other bodies. It is dissolved in water, neutralised with soda and then slightly acidified with acetic acid and the alcohol and ether expelled by evaporation. The cooled solution is fermented with beer yeast, which quickly destroys most of the glucose.

The impure solution of iso-maltose thus obtained is heated with phenylhydrazine acetate for about one hour, a little glucosazone is precipitated, the hot filtered solution deposits on cooling a yellow precipitate which is filtered off; on further heating the mother-liquor more glucosazone is deposited and the clear solution yields a further precipitate on cooling.

The precipitates obtained on cooling are purified by recrystallisation from water. 2½ grms. of this product, which is iso-maltosazone, are obtained from 100 grms. glucose. The yield of iso-maltose is much greater, as there is considerable loss in the various operations.

The osazone has a composition corresponding to the formula $C_{24}H_{32}N_4O_{10}$; it melts at 150°—153°. It is soluble in hot water, and differs in its melting point and crystalline form from maltosazone, and is much more soluble in hot absolute alcohol. It is decomposed by strong hydrochloric acid in the same way as other osazones, yielding phenylhydrazine and iso-maltosone. When heated with dilute hydrochloric acid, isomaltosone yields glucosone and glucose.

The condensation of glucose may also be effected by the action of a concentrated solution of phosphoric acid.—A. L. S.

Contributions to a Knowledge of the Pentaglucoses. W. E. Stone. Ber. **23**, 3791—3798.

Tollens and the author (Ann. **249**, 227) have previously described a method for the estimation of the pentaglucoses by determining the amount of furfural produced when pentaglucoses or bodies yielding them by hydrolysis are boiled with strong acids.

A series of analyses have been made by this method. The following percentage of furfuramide were obtained:—

	Per Cent.
Millet hay	3·34
"Timothy" (*Phleum pratense L.*)	1·18
Wheat straw	4·16
Oats	2·29
Maize	2·89
Clover hay	1·55
Maize spike (without the corn)	8·06
Flour from the whole of ditto	0·59
Maize bran	1·80
Oatmeal	0·49
Malt acrospire	1·82
Wheat bran	3·51
Brewers' grains	7·20
Linseed meal	1·27
Cotton seed husks	3·66
Beetroot slices	3·59
White lupin seeds	0·95
Yellow lupin seeds	1·60
Sweet orange peel	1·85
Water melon peel	2·70
Strawberries	1·95
Horned cattle dung	3·94
Peach tree gum	4·84
Cherry tree gum	5·75
Gum tragacanth	5·88
Gum Arabic	5·46

The following also gave small quantities of furfural, but not an estimable quantity.

Cotton-seed cakes, maize meal, sweet potatoes, sweet orange pips, coffee beans, buckwheat, beans.

The cupric reducing power of arabinose and xylose were determined. Arabinose ($[\alpha]_D = 104·1$) gave the following results:—70 cc. of boiling Fehling solution were mixed with 25 cc. of arabinose solution and heated for 4 minutes; the precipitated cupric oxide was then filtered out by a Soxhlet tube and washed with water, alcohol, and ether, and reduced in a stream of hydrogen to the metal.

One gramme of arabinose in a—

1 per cent solution reduced	1·945	grms. of copper
½ " "	1·929	"
¼ " "	1·958	"
⅛ " "	2·009	"

In the same way 1 grm. of xylose ($[\alpha]_D = 18·41$) in a—

1 per cent. solution reduced	1·861	grms. of copper
½ " "	1·841	"
¼ " "	1·900	"
⅛ " "	1·959	"

Up to the present all attempts to ferment arabinose or xylose by yeast have failed. The author attempted to ferment xylose both alone and mixed with an equal weight of cane sugar, and in all cases not the slightest trace of fermentation of the xylose was noted.—A. L. S.

Studies on Starch. II.—On Gallisin and its Formation. C. Scheibler and H. Mittelmeier. Ber. **24**, 301—305. (See also this Journal, 1890, 1140.)

Gallisin, the unfermentable residue of commercial starch sugar, may be obtained by fermenting away the dextrose by yeast and precipitating the gallisin from the concentrated residue by alcohol. Its properties have been investigated by many observers; it forms a white hygroscopic powder, which easily reduces Fehling's solution, and on heating with dilute acids yields dextrose.

The authors have prepared gallisin in the above manner, purifying it by repeated precipitations of the concentrated solution with alcohol. The body thus obtained is neutral to litmus paper, and reduces Fehling's solution strongly. This they consider to show that gallisin contains a sugar.

By heating a solution of gallisin with phenylhydrazine acetate, a yellow solution is obtained, which on cooling gives a precipitate of a large amount of yellow osazone, which is purified by recrystallisation from hot water. It closely resembles the osazones of the saccharoses, and on analysis gave numbers corresponding to the formula $C_{24}H_{32}O_9N_4$. It is a little soluble in ether and acetone, more soluble in hot alcohol, from which the greater part is deposited on cooling. It is more soluble in hot water than the other osazones of the same composition. It melts between 152—153°.

From the composition of the osazone, it follows that gallisin contains a sugar having the formula $C_{12}H_{22}O_{11}$, and from the fact that it yields only dextrose on hydrolysis, and easily reduces Fehling's solution, it contains two dextrose nuclei, of which one contains an unaltered aldehyde group.

In their previous communication (Ber. **23**, 3060; this Journal, 1890, 1140), the authors have stated that this sugar is probably an intermediate product between starch cellulose and dextrose; but they now find that this is not so, for the amount of this sugar present during the hydrolysis of starch is least at the commencement of the reaction, and continues to increase as long as the action of the acid goes on. This indicates that the new sugar is formed by the action of the acid on glucose, and this is found to be so.

Fifty grms. of pure glucose and 500 cc. of 2½ per cent. sulphuric acid are heated for 12 hours on the water-bath; the acid is then removed by baryta, and the solution heated with phenylhydrazine acetate. A large crop of glucosazone separates, and on cooling the filtered solution a small amount of another osazone is obtained. One-fifth of a gramme of the purified osazone was obtained, and was found to be identical with that obtained from gallisin.

From the close resemblance of this osazone to that described by Fischer (see above), which he obtained from the sugar (iso-maltose) produced by the action of concentrated hydrochloric acid on glucose; there is no doubt that they are identical, and there appears to be no reason for considering that the sugars yielding them are not identical.

The authors are continuing their researches on the condensation of the hexaglucoses by means of metallic salts, &c., and hope shortly to publish further results.—A. L. S.

XVII.—BREWING, WINES, SPIRITS, Etc.

The Chemistry of Whisky and Allied Products. A. H. Allen.
See pages 305—312.

Growth of Improved Varieties of Potato for Distilleries in France. A. Girard. Compt. Rend. **111**, 795—797.

The author reports the results of two experiments made on the large scale in collaboration with practical distillers. In the first trial, 70,000 kilos. of the "Chardon" variety of potato, containing only 16 per cent. of starch, yielded 11·17—11·20 litres of absolute alcohol per 100 kilos. both when worked alone and when mixed with one-sixth of maize, with a view of enriching the dregs. In the second trial, 100,000 kilos. of Richter's Imperator potato, containing 20·9 per cent. of starch, furnished 14·33 litres absolute alcohol per 100 kilos.; a yield at least equivalent to that obtained from 40 kilos. maize or 250 kilos. beet. A crop of 30,000 kilos. Imperator potatoes per hectare would yield 4,300 litres alcohol per hectare, a result never hitherto obtained. The phlegms are of good quality, and the spirit easy of rectification. The distillery dreg from potatoes contains water, 91·80; soluble matter, 3·23; insoluble matter, 1·90 = 100·00.

The soluble matter is made up of glucose, 0·22; dextrin, 0·72; nitrogenous matter, 0·46; other organic matter, 1·41; ash, 0·42. The insoluble matter is made up of fat, 0·04; cellulose, 1·19; nitrogenous matter, 0·32; ash, 0·05. According to the scale adopted in Germany this would be worth 0·86 fr. per hectolitre, the dreg from maize distilleries being worth 1·57 fr. per hectolitre. As 100 kilos. potatoes yield 1·8 hectolitres dreg, the return from this source is 1·54 fr. per 100 kilos. Eighty head of cattle were fed for two months on a ration of 50 litres of this dreg together with beetroot pulp and hay. It was relished by the animals, who thrived and even fattened on it. The author concludes that potato distilleries would succeed as well in France as elsewhere.—J. M. H. M.

PATENTS.

An Improved Process of Fermentation. S. Joseph and H. Citron, Berlin, Germany. Eng. Pat. 4746, March 26, 1890. 4*d*.

In this process fermentation is carried on in closed vessels under greatly reduced pressure, by which means much less yeast is required to start the fermentation.—H. T. P.

An Improved Fermenting Process for Beer, Wine, and other Fermentable Liquids. J. Salomon, Brunswick, Germany. Eng. Pat. 5673, April 15, 1890. 4*d*.

This invention consists in sterilising the fermentable liquid after the first fermentation by heating it to 80° C. in a suitable vessel, a second fermentation being afterwards effected by the addition of as pure a yeast as is obtainable. Either "top" or "bottom" yeast may be employed. By the above process a much greater stability is conferred on beers, and when required for transport there is no necessity for storing them at a temperature near freezing point. After the first or second fermentation the liquid may be saturated with carbonic acid.—H. T. P.

Improvements in Apparatus for the Production of Yeast and Similar Substances. H. H. Lake, London. From A. Joergensen, Copenhagen, Denmark, and A. Bergh, Stockholm, Sweden. Eng. Pat. 6220, April 23, 1890. 8*d*.

This apparatus is mainly intended for the continuous development of large quantities of pure yeast. It consists of an upper and a lower cylinder, which communicate by

means of a pipe and cock. Each cylinder is provided with a helical agitator, and with pipes and taps for the admission of filtered air. The lower cylinder is fitted with a steam and water jacket. The level of the wort in the lower vessel is indicated by a float, which actuates a pointer outside the apparatus. The wort, preferably already sterilised, is introduced into the lower cylinder, or it may be there sterilised by passing steam through the outer jacket. The wort is then cooled and aërated by means of filtered air which is forced in at the bottom of the cylinder through a pipe provided with a number of holes. A portion of the wort is next forced into the upper cylinder where it is inoculated with a pure yeast-cultivation from the laboratory. This wort is then passed back into the lower cylinder, or it may be left in the upper one, according to circumstances. This yeast may be removed either when the fermentation has reached its highest stage, or when the yeast formed has settled. In either case sufficient fermenting wort must be left in the upper cylinder to start a fresh fermentation. After the removal of the yeast from the lower chamber the latter is cleaned, sterilised, and charged with fresh sterilised wort, which is then infected with the wort from the upper cylinder. The upper cylinder is subsequently cleaned and sterilised in its turn, and so on.—H. T. P.

Improvements applicable to the Manufacture of Pure Grape Spirit, and Apparatus used for the Same or other Spirits, and also the Ageing of the Same. P. L. F. E. Vignier, London. Eng. Pat. 20,430, December 15, 1890. 1*s.* 3*d.*

In order to obtain an improved wash for distillation, concentrated grape juice imported from wine countries, is mixed with tartaric acid, tannin, and other ingredients to render the wort suitable for the production of fine spirit, and diluted to such an extent that the wash after fermentation may contain from 10—20 per cent. of proof spirit. The bouquet of the Charentes district is imparted to the wash by employing for pitching a wine yeast obtained from the said district. Distillation is carried on in three stages, during which "weak low wine," "strong low wine," and finally rectified spirit are obtained. For drawings and description of the distilling apparatus employed the original specification must be consulted.

The ageing of the spirit is effected by blowing through it filtered air heated to 160° F., and it is proposed to complete the ageing by a current of ozone.—H. T. P.

Improvements relating to the Manufacture of Fermented Liquids, and to Apparatus therefor. H. H. Lake, London. From H. Götter, Jersey City, U.S.A. Eng. Pat. 20,985, December 23, 1890. 8*d.*

The rapid fermentation of wines is effected by suspending in the fermenting vessels some inert body exposing a large surface, as, for instance, spun glass or asbestos. For the rapid production of sparkling wines a special apparatus is employed. The must in which fermentation has already commenced is charged into a vat which is placed inside a strong closed metallic vessel capable of withstanding a pressure of 120 lb. per sq. in. A number of woollen bags containing spun glass are suspended in the vat from rods radiating from a central standard. Fermentation is carried on at a temperature of 70°—80° F. until a pressure of 75 to 90 lb. per sq. in. is attained, when fermentation is considered to be complete. Five to six days are required for this purpose. The wine is then run into a receiver common to several fermenting vessels, and from thence through refrigerators and filters charged with some inert filtering material, to bottling machines. Air is excluded during the whole of the operation, the pipes, &c., being filled with water or carbonic acid. The spun glass is rinsed with water after each fermentation, and periodically it is thoroughly washed and heated to purify it. For drawings and details of apparatus the original specification must be referred to.—H. T. P.

Improvements in the Manufacture of Extract of Hops. A. J. Boult, London. From O. Schweissinger, Dresden, and L. Hoffmann, Hamburg, Germany. Eng. Pat. 853, January 16, 1891. 4*d.*

The process consists in separating the lupuline (hop-dust) from the hop leaves by sifting and extracting each separately—the hop leaves with water and the lupuline with a mixture of 10 parts of ether and 90 parts of alcohol, or either solvent may be used alone. The extracts are concentrated to a syrupy consistency at as low a temperature as possible, the aqueous solution being evaporated in vacuo. Finally, the residues are mixed and preserved in vessels in which the air is displaced by carbonic acid in order to prevent oxidation of the extract. This hop extract is claimed to be perfectly soluble in cold water.—H. T. P.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

(*A.*)—CHEMISTRY OF FOOD.

Note on the Action of Meat Extracts on Certain Metals. Balland. Compt. Rend. **111**, 895.

Tin and lead, and their alloys, are slowly attacked by the weak acids contained in canned meats, the amount of action being proportional to the surface in contact. The tin used for the manufacture of tin-plate contains 1—2 per cent. of copper and other metals, besides traces of lead, and offers greater resistance to the acids present in preserved meats than does pure tin or tin containing much lead. The author is of opinion, seeing that such tin is adapted for soldering purposes, that the use for sealing meat-tins of the quality of tin employed by tin-plate manufacturers should alone be tolerated.—E. B.

(*B.*)—SANITARY CHEMISTRY.

Notes on Effluent Water Analyses and on Methods for determining the Value of Rival Processes for the Purification of Sewage. W. Thomson.

See pages 330—332.

The Noxious Vapours of Manure Works. J. Morrison.

See pages 338—340.

On the Heat of Combustion of the Commoner Illuminants, and the Contamination of the Air caused by their Use. E. Cramer. J. f. Gasbeleuchtung, **34**, 27—31, 48—50 and 65—68.

See under II., *pages* 351—352.

PATENTS.

Improved Apparatus to be Used for the Purification of Water. A. Dervaux, Brussels, Belgium. Eng. Pat. 9756, July 4, 1888. (Amended April 30, 1890.) 8*d.*

The amendments mainly relate to the abandonment of the claim for the particular form of "decanter" with hydraulic or rivetted joints embodied in the earlier patent, and the application of mechanical agitation to aid the saturation of water with lime or other material also previously claimed.—B. B.

Improvements in Apparatus employed in Treating Sewage. W. Warner, Nottingham. Eng. Pat. 1623, January 30, 1890. 8*d.*

Precipitation processes for treatment of sewage need some simple means of regulating the quantity of the precipitants added to the water or sewage and of mixing

them therewith. These objects are attained by the patentee by feeding the chemicals to be used through a hopper on to grinding rollers whence they pass into a tank provided with a vertical shaft carrying propeller blades which serve to mix the contents. The flow of sewage through the tank is controlled by a cock, and as it leaves the tank it carries with it a predetermined amount of the precipitant for treating the main quantity of sewage.

A second device of the patentee is the use of dished plates for filter presses, the object being to avoid the breakages that occur with flat plates consequent on the unequal contraction during their cooling after casting. A third claim is for a rack and pinion arrangement for closing the end plate, and another is for a cylinder provided with a four-way cock for moving the end plate when compressed air, water, or steam is used.—B. B.

Improvements in Apparatus for Sanitary Disinfection and other Purposes. A. M. Clark, London. From C. L. Cohn, New York, U.S.A. Eng. Pat. 19,670, December 2, 1890. *8d.*

The apparatus patented consists essentially of a reservoir of some disinfecting liquid such as a solution of zinc chloride which is kept filled from a larger reservoir in such a manner as to ensure the head of liquid in the smaller reservoir being constant. The liquid oozes through a tubulus, in the lower part of the smaller reservoir, which is packed with fibres of asbestos or spun glass arranged longitudinally; the rate of flow of the liquid is controlled by loosening or tightening an elastic washer encircling the bundle of fibres. A continuous and regular supply of disinfectant is thus obtained. On leaving the reservoir the disinfectant meets a constant stream of water with which it mingles and flows to its point of application. The valve controlling the supply of water is arranged so that it is raised further from its seat at intervals when the apparatus is used, and any possible accumulation of grit dislodged. Combined with the reservoir of disinfectant is an "atomiser" actuated by the same motion that performs the flushing action just mentioned, which diffuses at the instant of use a spray of a solution of thymol or similar material into the air of the room.—B. B.

(C.)—DISINFECTANTS.

PATENT.

An Improved Process for rendering Tar Oils Soluble in Water and the Production of Disinfectants and other Useful Products therefrom. W. Dammann, Halle, Germany. Eng. Pat. 1017, January 20, 1890. *6d.*

Tar oils containing such bodies as phenol and cresol are said to be rendered soluble in water in the following manner:—

A fat or fatty oil such as linseed oil or a resin is mixed with the tar oil and the mass treated with caustic alkali in presence of alcohol until saponification is complete. The product is said to be homogeneous and soluble. "Certain tar oils, especially those rich in carbolic acid, are already rendered soluble by simply mixing them with soaps."

The fat itself, the tar oil, or a mixture of the two may be treated so as to introduce a halogen, sulphur, phosphorus, or arsenic, or other elements, or a radicle such as NO_2 or NH_2 or SO_3 into the product, which is rendered soluble in the manner already described.

"The tar oils soluble in water and thus produced have the appearance of a thick but clear or dark brown oily liquid or semi-plastic mass which is clear and transparent. In this form it can be used as a disinfectant, and is to be termed 'Lysol' or 'Lysolin.'" (See this Journal, 1890, 1136.)—B. B.

XIX.—PAPER, PASTEBOARD, Etc.

PATENTS.

Improvements in the Moulds Used on the Sembritzki Patent Machine and any Machine for Mechanically Making Hand-made Paper, and in other Paper-Making Moulds. W. Green, London. Eng. Pat. 1713, February 1, 1890. *6d.*

In connexion with the moulds now in use for the Sembritzki patent machine (Eng. Pat. 4077 of 1883) for mechanically making hand-made paper, light metal mould frames with the required sheets already attached to them are applied by the patentee. These light frames are affixed by means of screws to the top of the moulds now in use, thus obviating the tedious operation of sewing and unsewing, and soldering and unsoldering the sheets.—H. S.

Improvements in Lining Boilers or Digesters Used in the Manufacture of Paper-Pulp and for similar Purposes. C. Kellner, Vienna, Austria. Eng. Pat 6951, May 6, 1890. *4d.*

On the internal surface of iron or steel boilers or digesters, after they have been thoroughly cleaned, a coating is applied consisting of blue slate ground to powder and mixed with a suitable quantity of a solution of silicate of soda. Then a second coating is added, consisting of equal quantities of ground slate and Portland cement, and finally the whole is covered with a paste of Portland cement. In some cases the intermediate coating may be dispensed with. This compound lining is said to resist the action of corrosive acids and alkalis under great heat, and also to adhere firmly to the boilers or digesters without any liability to crack or become detached.—H. S.

Improvements in the Use and Application of Xylonite, Celluloid, and the Like. G. L. Anders and C. H. Elliot, London. Eng. Pat. 17,012, October 24, 1890. *4d.*

Fixed designs or "reading matter" are printed, embossed, or otherwise prepared on cardboard, paper, wood, ivory, metal, &c., and afterwards coated upon either or both sides with xylonite, celluloid, or similar substances, hereby imparting to the design, &c. a high degree of finish, and rendering it perfectly waterproof.—H. S.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES AND EXTRACTS.

Further Improvements in the Utilisation of Atmospheric Oxygen. G. Kassner. Dingl. Polyt. J. **278**, 468—478. (See also this Journal, 1890, 187.)

This paper refers to the manufacture of oxygen by means of the ortho plumbates of calcium, barium, and strontium, the fundamental reactions being—

1. $2\,CaCO_3 + PbO + O\,(Air) = PbO_2.2\,CaO + 2\,CO_2$.

This reaction is best performed at a dark-red heat. The calcium plumbate so formed is afterwards decomposed with carbonic acid, at a bright red heat, and oxygen is given off.

2. $PbO_2.2\,CaO + 2\,CO_2 = PbO + O + 2\,CaCO_3$.

Calcium plumbate is obtained by igniting an intimate mixture of lead oxide and calcium carbonate, the latter being employed in a pure form (calc spar or precipitated chalk) and preferably 5 per cent. in excess of the equivalent quantity. The dry mixture can be furnaced straight away, but a better decomposition and a more porous product is

obtained by damping the mass, adding starch, milk of lime, tar, or sugar, and forming the same into bricks. There may be added substances, such as charcoal, sawdust, ammonium carbonate, straw, which on igniting volatilise, leaving a porous mass behind. The bricks are now burnt in a current of air, preferably with generator gas, and the products of combustion are drawn off the kiln by means of an air-pump. The calcium carbonate gives off its carbonic acid at comparatively low temperatures, in presence of lead oxide; the lead oxide is hereby first of all reduced to metallic lead, which on raising the temperature is again oxidised and finally converted into lead peroxide.

Whilst this operation is performed in one series of kilns, the calcium plumbate in another series is treated, along with steam, with the carbonic acid given off in the first operation, or with flue gases, at a temperature not exceeding 95° C. The first kiln of this series is brought finally to a bright red heat and treated with a small quantity of pure carbonic acid. Oxygen is given off and it is driven out completely by means of superheated steam.—H. A.

Piperazine. W. Majert and A. Schmidt. Ber. **23**, 3718—3723; and Ber. **24**, 241—243.

By means of a new method of purification the authors have succeeded in obtaining Ladenburg's "ethylene-imine" in pure condition from ethylenediamine hydrochloride, and find that it is identical with Hofmann's diethylenediamine. The base has the melting point 104°—107°, and the boiling point 135°—138°, and is almost certainly identical with Ladenburg's compound, although the latter gives the melting point as 159°—163°; this is probably due to the fact that the base had been converted into the carbonate by the carbonic acid present in the air. Piperazine has neither caustic nor toxic properties, but dissolves uric acid even in large excess, forming, however, always the neutral salt, $C_4H_{10}N_2.C_5H_4N_4O_3$.

A direct comparison of Schreiner's spermine with piperazine has shown that these compounds are not identical, great differences being observed in the phosphates and double bismuth iodides of both bases.—H. G. C.

Piperazine or Diethylene-di-imine. A. Ladenburg. Ber. **23**, 3740—3741.

The author has prepared the dibenzoyl compound of the diethylene-di-imine obtained from ethylenediamine (Ber. **22**, 2706) and finds that it is identical with the dibenzoyl compound of diethylenediamine recently prepared by v. Hofmann, a further proof of the identity of the two bases. —H. G. C.

Nicotine. A. Pinner and R. Wolffenstein. Ber. **24**, 61—67.

Nicotine is slowly oxidised by hydrogen peroxide, especially in presence of platinum sponge, a basic body of the formula $C_{10}H_{12}N_2O$ being formed. This so-called oxy-nicotine has resulted by the replacement of two hydrogen atoms in nicotine ($C_{10}H_{14}N_2$) by one atom of oxygen. The oxidation, which takes several weeks, is carried on until there is no longer any smell of nicotine, and the product of the reaction concentrated in vacuo, when a yellow oil remains behind which can be purified by dissolving in alcohol and removing the solvent in an exsiccator. On prolonged standing the oil solidifies to a crystalline mass, but it is too hygroscopic to allow of its being analysed. Of its salts the platinum double chloride and the picrate are the most characteristic and can be obtained in a crystalline form. The first of these separates as an oily mass when an excess of platinum chloride is added to the base, but on standing it becomes crystalline. It cannot be recrystallised owing to its readily undergoing decomposition when in solution. The picrate, which also first forms as an oil, can be recrystallised from water and melts at 154°—158°. Analyses of both these salts are given, which point to the above formula, $C_{10}H_{12}N_2O$, for the base. The picrate has the composition—

$$C_{10}H_{12}N_2O.2\,C_6H_2(NO_2)_3.OH$$

and corresponds to the picrate of nicotine—

$$C_{10}H_{14}N_2.2\,C_6H_2(NO_2)_3OH$$

which latter forms difficultly soluble needles, melting at 218°. The mercuric chloride double salt of the oxidation product forms an amorphous white precipitate. The "*oxynicotine*" is readily soluble in water and in alcohol, insoluble in ether. It is not volatile with steam, and is not decomposed when distilled with caustic alkali. When oxidised with potassium permanganate, nicotinic acid (β-pyridine carboxylic acid) results. It possesses a slight mushroom-like smell and has a similar though less marked physiological action than nicotine.

With the view of obtaining evidence of the presence of an amido group in nicotine, the base was treated with sodium nitrite to form a nitroso-compound, and also with acetic anhydride, but in both cases without result. The latter reagent reacts on nicotine in a closed tube at 150°—170°, but the nature of the decomposition has not yet been worked out.

Benzoyl chloride reacts upon nicotine on warming; the resulting products appear to be different from that obtained by Will by bringing nicotine and benzoyl chloride together in ethereal solution (Ann. Chem. Pharm. **118**, 206), but they are still under investigation.

These experiments are being continued with the view of elucidating the constitutional formula of nicotine, a summary of the present state of knowledge on the subject being given in the paper.—C. A. K.

Preparation of Lecithin from Plant Seeds. E. Schulze and A. Likiernik. Ber. **24**, 71—74.

Lecithin occurs widely distributed in the vegetable kingdom, and is found in the ethereal extracts of plants side by side with glycerides, wax-like products, cholesterin, &c., but up to the present it has not been isolated from such mixtures.

In order to separate the lecithin the following plan was adopted: Finely-powdered plant seeds (vetch and lupin) were first extracted with ether, when only a portion of the lecithin goes into solution. The insoluble residue was then digested with alcohol at 60° C. (in some cases a little alkali was added to neutralise the free acid contained in the seeds), whereby the bulk of the lecithin is dissolved in a fairly pure state. In order to purify the product thus obtained, the solvent was distilled off at 40°—50° C. and the residue treated with cold ether. The lecithin dissolves, and by shaking the solution thus obtained with water the impurities are taken up by the latter. An emulsion, however, forms on shaking the mixture, and crystals of common salt must be added to clear the ethereal solution. This clear solution, when gently evaporated, left a residue of lecithin, which was further purified by dissolving it in alcohol (absolute) and again concentrating. The lecithin separates as a pale yellow product, possessing the characteristic properties of this body; it could not be obtained in a crystalline form. When saponified by baryta water, cholin, glycerol phosphoric acid and fatty acids result, which were separated and identified. Both solid fatty acids and oleic acid were found in the products of saponification, so that the lecithin from plants, like that got from the yolk of eggs, appears to be a mixture of several lecithins. This presence of lecithin in the seeds of plants leads to an error in the determination of the fat contained by extraction with ether, as the lecithin also goes into solution, though to a varying extent. The error is small in the case of seeds rich in fatty matter, but when the ether extract only amounts to about 2 per cent. and the per cent. of lecithin reaches 1·2 to 1·3, as in the seeds of the vetch and of the pea, the error is very considerable, and a determination of the phosphorus in the residue should be made and the quantity of extract free from lecithin thus obtained.—C. A. K.

The Ethereal Oil of Asafœtida. F. W. Semmler. Ber. **24**, 78—81.

The author has examined the constituents of fractions II. and III. of this oil, obtained by simple distillation of the oil (this Journal, 1891, 157).

The second fraction of boiling point 80—85° C. under a pressure of 9 mm. has a specific gravity of 0·9721 at 15°, and is lævo-rotatory. It consists entirely of one product having the formula $C_7H_{12}S_2$, as shown both by analysis and by a vapour density determination. In its behaviour it appears to be a disulphide, containing one saturated and one unsaturated radicle. It boils with slight decomposition at 210—212°, forms a crystalline compound with mercuric chloride, $C_7H_{12}S_2.2HgCl_2$, and when treated with zinc-dust yields a monosulphide $C_7H_{12}S$. It constitutes about 45 per cent. of the crude oil. The third fraction, which boils at 120—130° C. under a pressure of 9 mm., has a specific gravity of 1·0120 at 15°, and is lævo-rotatory. It consists also of a disulphide having the formula $C_{11}H_{20}S_2$, and when treated with zinc-dust yields the corresponding monosulphide $C_{11}H_{20}S$. With mercuric chloride precipitates of varying composition resulted, but could not be separated on account of their insolubility in alcohol. When distilled under the ordinary pressure it decomposes, evolving gases having an unbearable smell. The constituents of the ethereal oil of asafœtida are therefore the following:—

(1.) Two terpenes. (2.) An oxygenated body $(C_{10}H_{16}O)^x$ from which the sesquiterpene $C_{15}H_{24}$ is derived. (3.) A disulphide $C_7H_{12}S_2$. (4.) A disulphide $C_{11}H_{20}S_2$.

—C. A. K.

Kuromoji Oil. W. Kwasnick. Ber. **24**, 81—82.

This is the ethereal oil of the leaves of *Lindera fericia*, occurring in Japan. The oil is of a deep yellow colour, and possesses a powerful aromatic odour; the specific gravity of the oil is 0·901 at 18° C. By fractional distillation and treatment with sodium two terpenes were isolated. One of these boiled between 175° and 180° C., was dextro-rotatory, and gave a tetrabromide melting at 104°; it was thus dextro-limonene. The other boiled above 180°, was optically inactive, and gave a tetrabromide melting at 124°, a nitroso-chloride melting at 101°; it was dipentene. Besides these terpenes were found terpineol, $C_{10}H_{18}O$, and carvol, the former optically inactive, the latter lævo-rotatory. Terpineol was identified by the action of hydrochloric acid and bromine, and by means of its iodide, which melts at 75—76°. The carvol is distinguished from the dextro-rotatory carvol of oil of caraway only by its optical properties.—T. L. B.

Lupeol. A. Likiernik. Ber. **24**, 183—186.

Ether extracts from the husk of the seed of *Lupinus luteus*, a crystalline body, which does not give the reactions of cholesterin. This new substance the author proposes to term *lupeol*.

In order to isolate it the husks were extracted with ether and the extract saponified by alcoholic potash; after evaporation of the alcohol the residue was shaken with water and ether. The ethereal layer was removed and distilled, whereby a crystalline mass consisting chiefly of lupeol was obtained. The benzoate was next obtained by fusion with benzoic anhydride, and recrystallisation; this this was then decomposed by heating with alcoholic potash when lupeol was obtained pure.

It is insoluble in water, easily soluble in ether, chloroform, benzene, petroleum ether, and carbon bisulphide, and likewise in hot alcohol. It crystallises from alcohol in long colourless needles. It gives the following characteristic reaction.—By dissolving a small quantity in about 5 cc. of chloroform and adding a few drops of acetic anhydride, and a couple of drops of concentrated sulphuric acid, a reddish colouration is obtained, turning in the course of half an hour to an intense violet red. Lupeol is dextro-rotatory, a chloroform solution showing $[\alpha]_D = +27°$. The melting point was found to be 204° C. On heating it volatilises with partial decomposition, giving rise to an odour reminding of Russia leather. Elementary analysis agreed with the formula $C_{26}H_{42}O$, but $C_{25}H_{40}O$ and $C_{27}H_{44}O$ are also possible. Analysis of lupeol itself, of the acetate, and of the benzoate indicated a lower percentage of hydrogen in lupeol than is contained in cholesterin. The acetate melts at 230° and the benzoate at 250°.—T. L. B.

Some Constituents of the Seed Husks of Pisum Sativum and Phaseolus Vulgaris. A. Likernik. Ber. **24**, 187—188.

From the seed husks of *Pisum sativum* the author has isolated a body corresponding in properties with the phytosterin of Hesse (1878) (Ann. **192**, 175); *Phaseolus vulgaris* yielded, by the method used for obtaining cholesterin, a quantity of material which on fractional crystallisation from alcohol yielded two substances, one of which was lævo-rotatory, and the other dextro-rotatory; to the former the author gives the name *paraphytosterin*, and to the latter the name *phasol*. The first is a member of the cholesterin group; it crystallises from alcohol in broad shining leaflets. It differs from all other cholesterins, however, in that it melts at 149—150° C., and also in that the crystals of its benzoate are dull and not shining. For paraphytosterin in chloroform $[\alpha]_D = -44·1°$. Elementary analysis agrees with $C_{24}H_{40}O$ or $C_{26}H_{44}O$ or an intermediate formula.

Phasol crystallises from alcohol in small shining tablets, melting at 189°—190°. The chloroform solution showed $[\alpha]_D = +30·6°$. Elementary analysis agrees with $C_{13}H_{24}O$.

The author concludes that it is quite possible that phasol may form a homologous series with cupreol, quebrachol, and α- and β-lactucerol. Its chloroform solution shaken with sulphuric acid (sp. gr. 1·76) shows a purple colouration just as most of the cholesterins do, but the colouration is somewhat weak.—T. L. B.

Olefinic Constituents of Ethereal Oils. F. W. Semmler. Ber. **24**, 201—211. (See also this Journal, 1890, 100, 889, 962, and 1145.)

Geranial, $C_{10}H_{16}O$ (geranium aldehyde, for whose preparation see this Journal, 1890, 1145), boils under a pressure of 760 mm. at a temperature of 224—228°, with slight decomposition. Its specific gravity is 0·8972 at 15°, compared with water at that temperature. It is optically inactive.

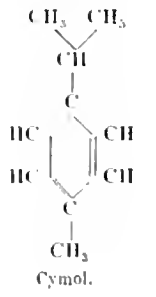
Determination of the molecular refractive power indicates the presence of two ethylene linkages.

Brominated in acetic acid, geranial takes up four atoms of bromine. The brominated compound may be separated as a hitherto unerystallisable oil by addition of water.

By heating geranial to 170° for 20 minutes with potassium bisulphate, and then distilling with steam, an oil is obtained which, after rectifying over sodium, shows the boiling point 174—176°.

The molecular refraction points to the existence of three double linkages, so that the product must belong to the closed-chain series. All properties prove identity with cymol, $C_{10}H_{14}$, so that there is here a direct passage from a methane derivative to a benzene derivative, geranial belonging undoubtedly to the open-chain series. This is shown in the adjoining formulæ:—

Geranial.



Cymol.

Orange Oil.—Völckel (Ann. **39**, 120) states that this oil contains no oxygen, an assertion which the present author cannot support. The specific gravity of the oil at 20° C., compared with water at the same temperature, is 0·8435. If the oil be shaken with a saturated solution of acid sodium sulphite, and allowed to stand, crystals separate after the lapse of several weeks; on decomposing these with soda, and distilling with steam, an oil is obtained having the smell of oranges. Fractional distillation separates from this oil a portion boiling at 224°—228° and identical with geranial.

Citral.—The product which has been brought into commerce under this name, and which is contained in citron oil, in lemon-grass oil, and in citronella oil, is here shown to be identical with geranial. Geranial has been detected in a number of other ethereal oils, so that it is quite widely distributed in nature, and to it must be ascribed in great part the characteristic odour of the citron group.

Coriandrol is the name given by the author to the chief constituent of coriander oil.

It boils between 194° and 198° C. (under a pressure of 760 mm.) with slight decomposition. It is dextro-rotatory. From the molecular refraction there would seem to be present two double linkages, and with this the properties of the body are in agreement. Its empirical formula is $C_{10}H_{18}O$; four atoms of bromine are capable of absorption. Oxidation gives the compound $C_{10}H_{16}O$. Previous work on coriander oil has been done by Kawalier (Jahresb. 1852, 624), and Grosser (Ber. **14**, 2485).

Linalool is the chief product of linaloë oil (see Morin, Ann. Chim. [5], **25**, 427). Its empirical formula is $C_{10}H_{18}O$, and it stands in close relationship to geraniol. It boils (at 760 mm. pressure) near 190° C., and possesses a specific gravity, at 20°, of 0·8702, compared with water at the same temperature. Two double linkages are indicated, and so an open chain.

German Balsam Oil contains an aldehyde, which appears to be identical with citronellol obtained from citronella oil. It has the empirical formula $C_{10}H_{18}O$. The investigation is still incomplete.

Olefinic Camphors is the term proposed by the author for compounds of the composition $C_{10}H_{20}O$, $C_{10}H_{18}O$, and $C_{10}H_{16}O$, which have no closed chain. They are, so far as can be at present judged, all liquid at ordinary temperatures, and possess a lower specific gravity than the isomeric camphors of the closed-chain series. They are either alcohols, aldehydes, or ketones, and are very widely distributed amongst the ethereal oils.—T. L. B.

Cytisine. K. Buchka and A. Magelhaes. Ber. **24**, 253—261.

Cytisine may be more readily prepared according to the following method than by Partheil's process (this Journal, 1891, 63): the ground laburnum seeds are extracted with dilute hydrochloric acid, the solution concentrated, made alkaline, and extracted with chloroform. On evaporating the latter, cytisine remains as a pale yellow oil, which quickly crystallises, and may be obtained almost colourless by repeated crystallisation from water. It melts at 156°, sublimes readily, is easily soluble in water, alcohol, and chloroform, sparingly in ether, insoluble in carbon bisulphide and light petroleum. Analysis and determination of the molecular weight have confirmed Partheil's formula, $C_{11}H_{14}N_2O$. It is a di-acid base, yielding two *hydrochlorides*, the first of which has the formula $C_{11}H_{14}N_2O.HCl$, and forms colourless transparent monosymmetric crystals, whilst the second, $C_{11}H_{14}N_2O.2\,HCl + 2\frac{1}{2}\,H_2O$ forms small colourless hard crystals. Two platino chlorides, an auro chloride, and a double-zinc chloride have also been prepared.

On distillation with soda-lime, a distillate is obtained which contains pyrroline, and smells strongly of pyridine and quinoline bases. Potassium permanganate converts it into a syrupy acid, insoluble in ether.—H. G. C.

Hydrocotoïne, a Constituent of the Coto Bark. G. Ciamician and P. Silber. Ber. **24**, 299—301.

This compound was first obtained from coto bark by Jobst and Hesse (Annalen, **199**, 17). The authors obtained it by repeated crystallisation from alcohol, in long yellow needles melting at 98°, and soluble in ether, acetone, and acetic acid, insoluble in water. The analysis and determination of the molecular weight confirmed the formula $C_{15}H_{14}O_4$. It dissolves in caustic alkalis with a yellow colour, the alkaline compounds separating from concentrated solutions as oils. It is converted by hydrochloric acid at 130 into methyl chloride, benzoic acid, and a reddish-yellow compound soluble in sodium carbonate solution. It was found, by Zeisel's method, to contain two methoxyl groups, and also contains a hydroxyl group, as it yields an acetyl compound and takes up another methyl group on treatment with potash and methyl iodide, the trimethoxy-compound thus formed being insoluble in alkalis and giving only a yellow colouration with ferric chloride.

These results agree with the constitutional formula—

$$HO.C_6H_3\begin{matrix}(OCH_3)_2\\CO.C_6H_5\end{matrix}$$

but further experiments are necessary before it can be regarded as proved.—H. G. C.

PATENTS.

The Manufacture of New Derivatives of Phenyl-amido-acetic Acid. B. Willcox, London. From the "Farbenfabriken vormals F. Bayer and Co.," Elberfeld, Germany. Eng. Pat. 4382, March 20, 1890. 6*d*.

Benzoyl-phenyl-amido-acetic acid results on treating phenyl-amido-acetic acid with benzoyl chloride in presence of alkali. It is separated from the product of the reaction by the addition of acid, and is purified by boiling with hydrochloric acid and water successively, being finally recrystallised from alcohol. It forms white needles very difficultly soluble in water, and melting at 175·5° C. Treated with phenol, and a dehydrating agent, such as phosphorus oxychloride, this benzoyl compound yields a phenyl ether of benzoyl-phenyl-amido-acetic acid, which can be purified by recrystallisation from dilute alcohol. When boiled with alkali, the ether forms what appears to be an anhydride—a body of melting point 101° C. This also results when heat is applied in the preparation of the phenyl ether.—C. A. K.

Production of Guiacol Ether. C. Imray, London. From the "Farbwerke vormals Meister, Lucius, und Brüning," Hoechst-on-the-Maine, Germany. Eng. Pat. 5366, April 8, 1890. 4*d*.

Crude guiacol of boiling point 200°—205° is converted into a salt, preferably the potassium salt, which is purified by recrystallisation from alcohol; this is then employed for the preparation of a benzoyl compound by treatment with benzoyl chloride on the water-bath. The resulting body, for which the name of "*Phthiosol*" or "*Benzosol*" is proposed, is difficultly soluble in water, nearly insoluble in glacial acetic acid, readily soluble in chloroform, ether, and in hot alcohol. It melts at 50°, and when pure has neither taste nor smell, these last qualities being of advantage in its employment for medicinal purposes.—C. A. K.

The Manufacture of Diquinolyline Derivatives. B. Willcox, London. From the "Farbenfabriken vormals F. Bayer and Co.," Elberfeld, Germany. Eng. Pat. 5722, April 15, 1890. 6*d*.

A method for obtaining diquinolyline derivatives by treating amidophenylquinoline or the alkylated derivatives of amido-phenylhydroxyquinoline with aceto-acetic ether in the cold. On heating these substances subsequently to 200°—250° C. with or without condensing agents they are converted into two isomeric hydroxym-thyldiquinolylines or alkylated

hydroxy derivatives of these bodies. The two isomers obtained from amidophenylquinoline (Ber. **18**, 1904) are the α- and β-hydroxymethyldiquinolyline. The former crystallises without water, turns brown at 340° C. without melting, and its hydrochloride contains 3 H_2O. The salt is turned yellow by cold water and decomposed into basic salt. The β-modification crystallises with 1 H_2O, and melts when anhydrous at 312° C. Its hydrochloride contains 3 H_2O, and is not decomposed by water. A further example is also given of the formation of similar bodies from *m*-amidophenyl-*p*-methoxyquinoline (Ber. **20**, 1920). By condensing this substance with aceto-acetic ether in the cold, and subsequently heating the product to 200°—250° C., two bases are formed which differ by the solubility of their sulphates in hot dilute sulphuric acid. The β-compound, which gives the less soluble sulphate, yields a base having a melting point above 320° C. and appears to be methoxyhydroxymethyldiquinolyline. On reduction with tin and hydrochloric acid or sodium and alcohol it yields a hydride of which the base melts at 265°. Its sulphate has a bitter taste similar to that of quinine sulphate, and has the same physiological properties in cases of intermittent fever. The α-isomeride forms a sulphate readily soluble in hot dilute sulphuric acid, and the base which crystallises in shining tablets loses water of crystallisation at 130°—140° C. On reduction it gives a tetrahydride melting at 140° and forming more soluble salts than the β-base. The hydrochloride is sparingly soluble in dilute hydrochloric acid.—T. A. L.

Improvements in the Manufacture of Phenacetine Derivatives. B. Willcox, London. From the "Farbenfabriken vormals F. Bayer and Co.," Elberfeld, Germany. Eng. Pat. 5723, April 15, 1890. *6d.*

Alkylated phenacetines result by treating phenacetine first with metallic sodium and then with an alkyl haloid. The sodium is added to a solution of phenacetine in xylene, when the sodium compound separates in white needles; the whole is then treated with the alkyl iodide or bromide, the resulting sodium salt removed by filtration, the xylene distilled off with steam, and the residue dried and then distilled either under ordinary or reduced pressure. The methyl compound distils at 295°—305° C. as a colourless oil, which solidifies on cooling to a crystalline mass, which can be further purified by crystallisation from ether or from petroleum ether. It is moderately soluble in water, readily in ether, and melts at about 40° C. The ethyl compound is difficultly soluble in water, moderately so in ether; it melts at 36° and boils at 298° C.

Its formation is represented by the following equation:—

$$C_2H_5O.C_6H_4.N.(Na)CO.CH_3 + C_2H_5I =$$
$$C_2H_5O.C_6H_4.N(C_2H_5)CO.CH_3 + NaI$$

Ethyl phenacetine.

The products are valuable for pharmaceutical purposes.
—C. A. K.

Method of and Apparatus for Treating Atmospheric Air to obtain Oxygen therefrom. E. Neave, Sydney, New South Wales. Eng. Pat. 6463, April 28, 1890. *6d.*

Air is drawn by means of pumps through a separator; this is a porous clay cylinder fitted externally with a thin india-rubber jacket and packed internally with specially prepared porous caoutchouc. When the separator is exhausted much more oxygen than nitrogen passes through the porous membranes, and this, after being forced through some vessels filled with calcium hydrate and others with water to still further eliminate the nitrogen, is received in suitable gas-holders. The porous rubber is prepared by first dissolving caoutchouc in naphtha, evaporating this off, and again dissolving in a mixture of naphtha and oil of turpentine, the india-rubber being then left on a second evaporation in a spongy state. The specification is illustrated by a drawing.
—S. G. R.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

The Sector and Grease-Spot Photometers. F. Hurter.
See page 318.

XXII.—EXPLOSIVES, MATCHES, Etc.

The Propagation of the Explosive Wave in Liquids and Solids. D. Berthelot. Compt. Rend. **112**, 16—27.

The propagation of the explosive wave in gases has been already established by Vieille and the author to be subject to the primary laws of undulatory phenomena such as sound. The maximum rate attained is 2,800 m. per second, and depends on the heat developed, corresponding to the total quantity evolved by the reactions that accompany detonation, and which occur too rapidly to be appreciably diminished by loss by radiation, conduction, or even dissociation.

In order to elucidate his more recent work on the propagation of the explosive wave in liquids and solids, the author gives a *résumé* of the experiments with gaseous media already alluded to, and recorded in his book "Sur la force des Matières Explosives." It is there shown that the rate of the explosive wave in the same system is independent of the pressure for pressures varying from 1 to 3 atmospheres. It is identical whether the wave be propagated in a tube of caoutchouc or metal, in spite of the different conducting and radiating powers of the two materials. Further, the pressures developed in an explosive mixture detonated at different initial temperatures are sensibly proportional to the density of the mixture, this result being confirmed by experiments with gaseous mixtures that were isomeric in the sense that they gave the same products of combustion while evolving different quantities (the maximum being as much as twice the minimum) of heat.

Less simple laws appear to govern the propagation of the explosive wave in bodies of greater density than that of gases. An experimental study of the subject has been part of the work of the Commission for Explosive Substances, and some of the results have already been published (Annales de Chimie et de Physique, **6**, 556). They were obtained by using long tubes (100 m.) of narrow bore, made of lead and tin. The highest velocity (7,700 m. per second) was observed in the case of nitromannite.

The pursuance of this investigation appeared likely to be best undertaken by using a fluid homogeneous explosive substance detonated in tubes of varying resistance but similar mass, and strong enough to resist the explosion. This last condition could not be fulfilled, and as will be seen later there appear to be fundamental reasons why it should be unattainable.

The liquid chosen was methyl nitrate, CH_3NO_3, sp. gr. 1·182. On explosion it may decompose thus:—

$$2\,CH_3NO_3 = CO_2 + CO + N_2 + 3\,H_2O,$$

or thus—

$$2\,CH_3NO_3 = 2\,CO_2 + H_2 + N_2 + 2\,H_2O,$$

or both reactions may occur. In either case the volume of the gases produced is the same, viz., 870 litres for 1 kilo. of the original liquid, *i.e.* 1,028 litres for 1 litre. Its heat of formation is 39·9 large calories, taking the value of carbon as 94·3 cal. The first equation gives a heat of decomposition of 107·7 cal., the second 112·6 cal. at constant pressure, the water produced being assumed to be in the gaseous state. The mean of these values gives 1,431 cal. for 1 kilo. of methyl nitrate. The volume of gas and the heat evolved are similar to the same products of other high explosives. The pressure developed, after allowing for the limit below which the gaseous products of its detonation cannot be compressed, is found to show a similar agreement.

Rate of Detonation.—Experiments were carried out in long tubes placed end to end, the rates being determined by the use of chronographs in the manner previously adopted by the author.

Various materials were used for the tubes.

I. Caoutchouc tubes lined with canvas. Internal diameter 5 mm., external diameter 12 mm. The velocity between the first and second point of observation, 10 m. apart, was 1,616 m. per second. Further on the propagation was irregular, a result ascribable to the rending of the tube.

II. Glass tubes, varying from 3 mm. internal diameter, the walls having a thickness of 4·5 mm. to 5 mm. diameter and 1 mm. thickness. The results varied from 2,482 m. per sec. for the former, to 1,890 m. per sec. for the latter. The rate decreased with the diminution of the thickness of the tube, indicating that it was limited by the more or less immediate fracture of the tube. There was nothing to indicate that the maximum speed was being approached. Even the thinnest glass resisted rupture longer than the canvas-lined rubber, and allowed the attainment of a higher velocity.

III. In Britannia metal tubes 3 mm. in internal diameter and 4·8 mm. thick, the velocity was 1,230 m., the material thus appearing to give way more quickly than either glass or caoutchouc.

IV. Solid-drawn steel tubes 5 m. in length and 3 mm. internal and 15 mm. external diameter, and annealed with the utmost care, were used in the next series of experiments. The velocities observed varied from 2,084 m. to 2,155 m. All the tubes were broken, the fragments generally being in the form of lamellæ, as were those of the rubber tubes, forming a testimony to the homogeneity of the metal and defining the character of its elasticity. The figures lie between those given by caoutchouc and *thick* glass tubes. They are in all cases lower than those observed with solid explosives, whether dense like compressed gun-cotton or in the form of powder like picric acid.

The failure of the steel tubes makes it more than doubtful whether any material can be found to withstand the explosion. The theoretical reasons are as follows:—

According to the theory of the elasticity of materials, the resistance to rupture of a metal tube does not increase with its thickness indefinitely, but tends towards a limit, and when this is exceeded fracture takes place, whatever be the thickness. But liquid explosives like methyl nitrate present a noticeable peculiarity: Their volume in the liquid state is smaller than the minimum volume below which the gaseous or liquid products of their explosion cannot, as far as we know, be compressed. Taking the explosion of methyl nitrate as a concrete case, we find that the lowest possible volume of its products is about one-fifth greater than that of the liquid before explosion. Consequently the vessel *filled* with the liquid must be broken before the whole of the explosive has decomposed. The moment of fracture will vary according to the power of the material of the vessel to resist shock; its ultimate statical resistance such as is commonly measured by hydraulic pressure, does not here come into play.

Similar considerations applied to other liquid and solid explosives, lead to the conclusions that hydrogen peroxide decomposed into oxygen and water would similarly shatter the vessel containing it, the expansion being 54 per cent., while the figure for fulminate of mercury is 55 per cent. This enormous dilatation, coupled with the great density of the substance and the rapidity of its explosion, explains the shattering action of fulminate of mercury, and the manner in which the products of its explosion, though wholly gaseous, leave marks on the hardest metals, like those made by a cold chisel. Nitrate of ammonia gives a similar expansion amounting to 65 per cent.

It may be here noted that these explosives the formation of which is of course endothermic, suffer a diminution in their synthesis from the products of their explosive decomposition which is in no way inferior to that observed in the case of the best defined exothermic compounds. This result is of importance because it runs counter to most of the conclusions that have been endeavoured to be established concerning the relations between the heat evolved in a reaction and the changes of volume that accompany it.

The author believes that were measurements possible it would be found that the velocity of the explosive wave in liquids is comparable with that of sound in rigid solids, viz., 5,000 m. per second.

A note by Vieille is appended to the paper in which the phenomena already recorded are summarised, and Berthelot's explanation of the method of transmission of the explosive wave in liquids and solids further elaborated. Nitroglycerin exploded in lead tubes having an internal diameter of 3 mm. has given velocities of about 1,300 m. per second, while dynamite, under like circumstances, gave 2,700 m. This higher velocity is due to the influence of the structure of the explosive material on the speed of propagation. Nitroglycerin itself being a viscous liquid transmits the initial impulse more irregularly than when absorbed in siliceous material. Mica dynamite gives still higher results, as might be foreseen on considering its more crystalline structure: nitro-mannite, a solid crystalline body, behaves in a manner consonant with this idea, the velocity given by it being fairly constant and extremely high, viz., 7,700 m. per second. In the same way picric acid evenly crystallised has given 6,500 m. On the other hand, in the case of powdered explosives brought almost into a state of complete continuity by adequate pressure, a limit of compression exists beyond which detonation cannot be effected; this has been observed with certain chlorate mixtures. Further experiments illustrating the influence of the envelope surrounding the explosive in the case of gun-cotton may be quoted.

Compressed gun-cotton with a density of 1 to 1·27 exploded in lead tubes 3·15 mm. in diameter, has given a velocity of 5,400 m. per second; with a density of 0·73 and a tube 3·77 mm. in diameter, the velocity was 3,800 m. per second; the decrease in this case being due to the lower state of compression of the explosive. Gun-cotton in the form of a mere cord with a density of 0·65 gave 2,400 m. per second. But a low resistance on the part of the envelope may be compensated for by the mass of the explosive, the outer parts restraining the instantaneous evolution of gaseous products from the central portion. *Abel* has observed velocities of 5,300—6,000 m. per second, using cartridges of compressed gun-cotton about 10 times the diameter of the cords above referred to, placed end to end and not enveloped in any way.

The whole investigation has shown that the simple character of a gaseous explosion and the definite nature of the laws which govern it do not obtain in the case of liquids and solids.—B. B.

On Explosives and their Safe Use in Mines. Soupart. Monit. Scient. **37**, 114—119.

Recent experience having shown that most of the explosives in use in mines are dangerous, some owing to the high temperature produced, which is sufficient to ignite the firedamp, and some to their containing sulphates in large enough quantities to yield on combustion harmful amounts of sulphuretted hydrogen, the following experiments conducted by the inventors under the supervision of the author on a new substance—Favier's explosive—are of considerable importance.

Favier's "antifiredamp" while possessing as much power as dynamite No. 1, is yet perfectly safe in its manipulation; it will not freeze, may be hammered, fired upon at 10 yards, thrown into a fire or touched with a red-hot iron, without exploding.

The following table compiled by the French Commission on Explosives shows the pressure developed on detonating the various substances:—

	Charge.	
	0·2 Grm.	0·3 Grm.
	Kilos.	Kilos.
Explosive gelatin	2,081	3,564
Favier's explosive	2,051	3,623
Dynamite No. 1	2,051	2,279

Tried on the author's works by exploding 15 grms. in a hollow block of lead weighing 63 kilos., the capacity of the interior was increased from 140 cc. to 423 cc., "grisoutite" giving only 213 cc.

Further experiments were carried on in an apparatus consisting of a copper vessel of about 10 cbm. capacity, containing a steel mortar to hold the explosive, and fitted with sight holes, leading tubes for filling the vessel with gas, thermometer, a powerful agitator worked from outside and a steam-coil to enable the explosion to take place at a high temperature. The chamber was filled with a mixture of 100 parts of coal-gas and 12 of air, as being most inflammable, and comparative experiments were tried between dynamite No. 1, "grisoutite," forcite, and Favier's explosive, with and without the addition of coal-dust to the gaseous mixture; the explosions being determined electrically. The results are shown in the table:—

Explosive.	Wad.	Coal-dust.	Temperature.	No. of Experiments.	Results.
Favier's	None	Absent	17—24	2	One ignition.
	Clay	Absent	17—48	12	No ignition.
	Clay	Present	16—54	10	No ignition.
	Coal-dust	Present	26—54	10	One ignition at 45°.
	None	Present	30—37	6	No ignition. No air mixed with gas.
Grisoutite	None	Absent	17—39	10	Seven ignitions.
	Clay	Absent	17—48	3	No ignition.
	Clay	Present	17—53	4	Two ignitions.
	Coal-dust	Present	22—51	10	Seven ignitions.
	None	Present	24—37	5	No ignition. No air employed.
Forcite	Clay	Absent	17—46	4	One ignition.
	Clay	Present	18—46	6	Three ignitions.
	Coal-dust	Present	44—53	2	Two ignitions.
	None	Present	20—37	6	Six ignitions. No air employed.
Dynamite No. 1	Clay	Absent	37	1	Ignition.

—F. H. L.

XXIII.—ANALYTICAL CHEMISTRY.

APPARATUS.

The Measurement of Natural Gas with the Pitot Tube-Gauge. S. W. Robinson. Engineering and Mining J. 1891, 261—262.

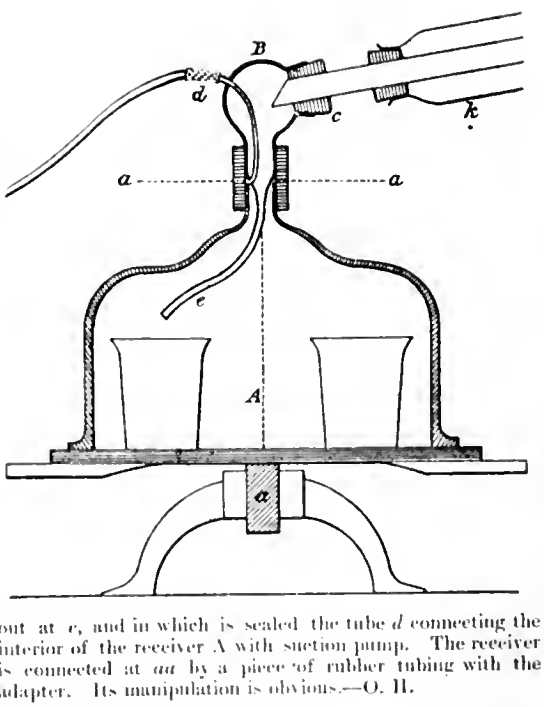
See under II., *pages* 352—353.

An Error in the Principle of Ordinary Exsiccators. W. Hempel. Ber. **23**, 3566—3568.

The author draws attention to the fact that moist air being lighter than dry air, the usual practice of placing the drying agent *underneath* the substance to be desiccated and at the bottom of the receiver is open to serious objection, since the action is dependent on the slow mixing by diffusion of the layers of air; of course when the air is highly rarified this is not of so much importance. By placing the drying agent as high as possible and *above* the substance to be dried, the desiccation is rapid and effective owing to a circulation of the air.—O. H.

An Apparatus for Fractional Distillation under Reduced Pressure. H. Schulz. Ber. **23**, 3568—3570.

The apparatus shown in the figure, combining simplicity of construction with efficiency and handiness, is specially designed for fractionally distilling large quantities of liquids, particularly for technical purposes. Instead of the more troublesome connexions described by Wislicenus (this Journal, 1891, 162), between pump, condenser, and receiver, the simple arrangement shown is employed, in which *k* is the condenser fitting at *c* into the adapter B which is drawn



out at *c*, and in which is sealed the tube *d* connecting the interior of the receiver A with suction pump. The receiver is connected at *aa* by a piece of rubber tubing with the adapter. Its manipulation is obvious.—O. H.

Automatic Mercury Pump. M. Stahl. Ber. **24**, 147—149.

In this pump, which has been patented in Germany, the mercury is raised by air compressed in a suitable vessel by means of the ordinary water supply, a weight with adjustable slide and the lower mercury reservoir being so arranged on a rocking table that the water supply is automatically cut off, and the water in the air vessel allowed to escape when the mercury has been raised to a predetermined height. The descent of the mercury during the working of the pump reverses the operations.—O. H.

INORGANIC CHEMISTRY.—QUANTITATIVE.

The Application of Electrolysis to Quantitative Analysis. C. A. Kohn.

See pages 327—328.

On the Volumetric Estimation of Alumina. G. Lunge.

See pages 314—317.

On the Determination of Manganese in its Ores and Alloys. J. and H. S. Pattinson.

See pages 333—338.

On the Determination of Chromium in Steel. T. W. Hogg.

See pages 340—341.

The Solubility of Gases in Water. L. W. Winkler. Ber. **24**, 89—101.

The author has commenced a redetermination of the absorption coefficients of gases. He describes minutely the apparatus he employs, and gives results as to the absorption of hydrogen by water.

He finds that the absorption coefficient of hydrogen decreases with rise of temperature as far as 60° C., when it becomes constant. His results agree with those obtained by Timofejew (Zeits. f. phys. Chem. **6**, 141). Bunsen gave the absorption coefficient of hydrogen as constant between 0° and 20° C.

The solubility of oxygen and nitrogen is being investigated. —T. L. B.

A New Method for Analysing Silicates. P. Jannasch. Ber. **24**, 273—278.

The decomposition of the silicate is effected by means of concentrated hydrochloric acid under pressure. The following apparatus is used:—A tapering platinum tube closed at one end and provided with a specially constructed cap. This cap contains an inner platinum tube, which is soldered to it. The following are the dimensions:—The total length of the platinum tube is 178 mm., the cap being 43 and the tube proper 151 mm. A portion of the cap overlaps the tube to a length of 16 mm. The inner tube measures 32 mm. (23 mm. outside the cap and 9 mm. inside). The diameter of the tube is 15 mm., of the cap 17 mm., and the inner tube 5 mm. The apparatus weighs 57·5 grms. The capacity is 26 cc.

The finely powdered silicate is introduced through the inner tube by means of a funnel, and washed in with 10 cc. of hydrochloric acid containing 4 vols. of hydrochloric acid to 1 vol. of water. The mineral is well mixed with the acid by the aid of a platinum wire, which is subsequently washed with 5 cc. of acid. The platinum vessel is now introduced into a glass tube, and hydrochloric acid poured into the glass tube until it covers about one-half of the platinum tube. The diameter of the glass tube should be 22 mm. inside and somewhat over 2 mm. thick. When filled the glass tube is drawn out and the air expelled by carbon dioxide, which must be led into the platinum vessel. The tube is sealed and heated from 10 to 12 hours to 190°—210°. The product is washed from the tubes and the acid completely expelled on the water-bath and filtered. The small amount of platinum dissolved from the tube is precipitated with sulphuretted hydrogen. The objections pointed out by the author to this method are the contamination of the solution with platinum chloride and the presence of small quantities of lime and alumina in the silica.

Nothing can be definitely stated as to its general application. The analyses of felspar by this method agree well with results obtained by the ordinary method of fusion with alkali.—J. B. C.

On the Determination of Iron and Alumina in Phosphates. R. Jones. Zeits. f. angew. Chem. 1891, 3—4.

The author publishes some further improvements on Glaser's method of estimating iron and alumina in phosphates (this Journal, 1890, 111).

Ten grms. of phosphate are dissolved in nitro-hydrochloric acid and the solution made up to 500 cc. 50 cc. (equal to 1 grm. of substance) are evaporated to one-half the volume in a beaker, acidulated while warm with 10 cc. of diluted sulphuric acid (1 : 5), shaken up, and 150 cc. of alcohol added, shaken up again and allowed to stand for at least three hours. The calcium sulphate is filtered off, washed with alcohol, dried, and weighed. The filtrate is placed in an Erlenmeyer flask, the alcohol distilled off, the residue washed into a beaker, supersaturated with ammonia, and heated *till all the ammonia is driven off*. The precipitate of ferric phosphate is filtered, washed with boiling water containing ammonium nitrate, without stirring up the precipitate. The filtrate is supersaturated with ammonia, and the magnesia estimated after 12 hours' standing; phosphoric acid, alkalis, and sulphuric acid are estimated in the original solution as usual.

The combination of the methods of Glaser and Stutzer (this Journal, 1890, 218) is only available in the absence of organic matter.—H. A.

Determination of Metallic Aluminium in Commercial Aluminium. F. Regelsberger. Zeits. f. angew. Chem. 1891, 20.

Klemm's method (this Journal, 1889, 710) of estimating aluminium by means of the hydrogen evolved with caustic potash is incorrect, as the same reaction is obtained with silica, which is a common impurity of commercial aluminium. The author prefers the following method:—Dissolve 2 grms. of the sample in concentrated caustic potash (15 grms. of KOH) in a platinum basin, make up with water to 200 cc., boil 50 cc. of this with ammonium carbonate, filter, wash, and ignite. Deduct from this the alumina of the reagents, which is estimated in the same way.—H. A.

The Precipitation of Manganese as Ammonium Manganous Phosphate. A. G. McKenna. Technology Quarterly, **3**, 333—337.

The determination of manganese by the usual process of precipitation as dioxide by bromine and subsequent ignition, is subject to two sources of error. First, the precipitate always carries down some of the potassium or sodium salts, whilst if ammonium acetate be employed, the solution must be made alkaline before the precipitation by bromine and the separation from calcium is then rendered less sharp.

Secondly, the composition of the ignited precipitate varies somewhat according to the temperature of ignition and other causes. It is, therefore, now customary to redissolve the manganese dioxide and to reprecipitate it as ammonium manganous phosphate, as proposed by Wolcott Gibbs. The author has examined this method of determination with the object of ascertaining what conditions are essential to accurate results. He finds that no appreciable error is introduced by precipitation and boiling in glass vessels, and that the precipitate is equally insoluble in hot water as in solutions of ammonia or ammonium nitrate. In fact, ammoniacal water dissolves a perceptible quantity of the precipitate when iron is present. The essential condition is that the precipitated ammonium manganous phosphate must be boiled long enough to transform the whole into characteristic silky crystals, which allow of easy filtration, and the time required is about eight minutes boiling with constant stirring to prevent bumping. The washing should be conducted with hot water and the ignited precipitate weighed as manganous pyrophosphate. The results are accurate.—G. H. B.

The Analysis of Ferro-chromium, Ferro-aluminium, Ferro-tungsten, Ferro-silicium and Ferro-titanium. A. Ziegler. Dingl. Polyt. J. **279**, 163–166. (See this Journal, 1889, 639, and 1890, 216–218.)

To decompose the above alloys the author uses a mixture of 6 grms. of pure caustic soda or potash, and 3 grms. of pure sodium or potassium nitrate: 0·5 grm. of the powdered and sieved alloy is taken and fused with the flux in a silver crucible. The crucible must have a capacity of about 50 cc. and weigh 45 to 46 grms. The silver crucible is heated in the luminous flame of the Bunsen lamp so that the crucible remains covered with soot.

The author has determined the loss of weight of the crucible after fusion by (1) extracting with water; (2) washing with hydrochloric acid; and (3) cleaning with sand after decomposing ferro-chromium:

	Grm.
I.—Lost	0·0063
II. and III. Lost	0·0072
Total loss	0·0105

The loss after fusion of ferro-aluminium was 0·0138 grm.; ferro-tungsten, 0·0223 grm.; ferro-silicium, 0·0125; and ferro titanium, 0·0192 grms. Potash salts give similar results.

Ferro-chromium is analysed as follows. 0·5 grm. of powdered alloy is placed in the silver crucible, to which 6 grms. of caustic alkali and 3 grms. of alkaline nitrate are added. The crucible is covered with soot by the reducing flame and gently heated, the temperature being slowly raised. Just before solidification the fused mass is allowed to cover the sides of the crucible and then cooled. The crucible is placed in a porcelain basin and filled up with water.

The solution of the contents may be hastened by stirring with a platinum rod. The solution and precipitate of ferric oxide is transferred to a beaker and saturated with carbon dioxide.

The liquid is evaporated in a basin over the water-bath to dryness, redissolved and filtered. The precipitate is washed with water containing sodium carbonate. The chromium is now completely in solution. The reddish film on the interior of the crucible appears to be silver chromate, and is readily decomposed by dilute hydrochloric acid. This latter solution is added to the iron solution, or the minute quantity of chromium it contains may be determined separately. The chromate solution is made up to a given volume, portions of which are evaporated to dryness with hydrochloric acid, the silica separated and the chromium precipitated twice with ammonia. The insoluble portion of the extract from the crucible contains the iron, manganese, most of the silica, &c. This is dissolved on the filter with hot dilute hydrochloric acid (1 part to 3 parts of water) and washed with 1 per cent. acid. The acid solution is evaporated to dryness, taken up with dilute hydrochloric acid and filtered. The filtrate contains iron and manganese chloride.

The iron precipitate should be tested for chromium. The silica must be expelled with hydrofluoric acid, and the residue also tested for chromium.

Silicon is best determined by decomposing 0·5 grm. of the substance with sodium bisulphate. The fused mass dissolves in dilute sulphuric acid, leaving the whole of the silica.

The silica is not pure, and must be treated with hydrofluoric acid. In the filtrate from the silica, manganese may be determined. For the determination of phosphorus, 2 grms. are taken and decomposed with 9 grms. of sodium nitrate and 18 grms. of caustic potash. The product is digested with nitric and a little dilute hydrochloric acid, and evaporated repeatedly with concentrated nitric acid. The acid is neutralised with ammonia and phosphorus, determined as usual. The sulphur may be estimated with the same fusion mixture.

The weighed chromic oxide is free from iron or manganese. Any silica present may be found by fusion with sodium bisulphate.

The chromium may also be oxidised with permanganate in sulphuric acid solution to chromate, and titrated with ferrous ammonium sulphate. The author also recommends the oxidation of the sulphuric acid solution of ferro-chromium (after fusion with sodium bisulphate) with permanganate and precipitation of the solution with sodium carbonate, whereby the manganese and iron are completely separated from the chromium. In the determination of *ferro aluminium*, the fusion is conducted precisely as in the preceding case, but requires a somewhat longer fusion. During evaporation of the extract no carbon dioxide is used, but a little caustic alkali may be added with advantage. The greater part of the aluminium may be separated from the filtrate without passing in carbon dioxide, by simply neutralising the solution with hydrochloric acid. Another method is to dissolve, in a platinum basin, 0·5 grm. of substance in a sufficient quantity of dilute hydrochloric acid, to evaporate to dryness, and to fuse with excess of sodium carbonate or a mixture of sodium and potassium carbonate. The rest of the process, after separation of the silica, is identical with the chromium method. Or, the dry hydrochloric acid solution may be transferred by the help of a pure filter paper to a silver crucible, and fused with six parts of caustic soda and three parts of sodium nitrate. If the alumina contains iron it may be brought into solution by fusion with sodium bisulphate, and the iron reduced and titrated with permanganate. It appears as if on fusion of the dry acid solution with sodium carbonate, that the ferrous iron passed more readily into the alkaline solution. The author, therefore, recommends the evaporation in a porcelain basin with nitric acid.

Ferro-tungsten may also be decomposed by the same fusion mixture. The product must be evaporated with nitric acid, taken up with warm nitric acid, filtered, and the filtrate tested for tungsten. The residue on the filter is dissolved in ammonia, the insoluble portion fused with sodium nitrate dissolved in water, and the residue in hydrochloric acid, and evaporated repeatedly with nitric acid.

Ferro-silicium may also be treated with caustic alkali and nitrate, but sodium bisulphate in a platinum crucible answers equally well, and the silica may be further tested for purity by treating with hydrofluoric acid and sulphuric acid.

Ferro-titanium is treated as follows:—0·5 grm. of the powdered and sieved alloy is fused with sodium bisulphate as in the decomposition of ferrochromium, but dissolved in cold water. The silica residue is evaporated with hydrofluoric and sulphuric acid, whereby the silica is determined. Any residue is fused with sodium bisulphate, and is added to the principal solution. This solution is diluted to 1 litre, partly neutralised with ammonia, and sulphur dioxide passed in. The liquid is slowly heated to boiling

and boiled for 1½ to 2 hours. In this first precipitation nearly all the iron remains as ferrous salt. It is filtered through a double filter and washed with 4 per cent. acetic acid. The filtrate must be absolutely clear. It is again partly neutralised with ammonia saturated with sulphur dioxide and boiled again for one hour.

The first precipitate of titanic acid containing iron is burnt, decomposed with sodium bisulphate, and treated as after the first fusion. When properly carried out, the second precipitation yields a pure white precipitate containing only traces of iron. If iron be present, a second precipitation will be necessary.

When titanic acid filters cloudy, dilute ammonium chloride solution may be added or a filter paper in pulp. Titanic acid retains sulphuric acid, and the burnt precipitate must be carefully heated with ammonium carbonate. 0·5 grm. of ferro-titanium is decomposed with aqueous hydrofluoric acid in two hours. Fused sodium nitrate does not take up titanium from ferro-titanium. The alloy treated thus is incompletely decomposed by hydrochloric acid, nitric acid, or aqua regia.

The following notes are added :—

Titanic acid is not soluble in potassium cyanide, potassium sulphocyanide, aluminium nitrate or potassium oxalate. Oxalic acid dissolves titanic acid and basic sulphate of iron completely. Sodium hyposulphite produces a violet colouration in the solution of the fused mass containing titanic acid.—J. B. C.

The Estimation of Aluminium in Iron and Steel. A. Carnot. Monit. Scient. **37**, 14—15; and Compt. Rend. **111**, 914—916.

The author's method, which somewhat resembles that of Pattinson and Stead, has been in use in the French School of Mines for eight years, and has been found to give very exact results, while only occupying a few hours.

Ten grms. of the metal are dissolved in hydrochloric acid in a covered platinum basin, and filtered from the insoluble portion; and the filtrate nearly neutralised with ammonia and sodium carbonate. A small quantity of sodium thiosulphate is then added, and when the reduction to the ferrous state is complete, known by the liquid becoming colourless, two or three cc. of a saturated solution of sodium phosphate, and about 20 cc. of sodium acetate (30 per cent.); the liquid is then boiled for about three-quarters of an hour till all smell of sulphur dioxide has disappeared. The precipitate containing sulphur and silica mixed with the aluminium phosphate is filtered off, washed and dissolved in the platinum basin in 10 to 15 cc. of hydrochloric acid diluted with water; the solution is evaporated to dryness and kept at 100° for an hour, redissolved in acid, filtered, diluted with 100 cc. of cold water, and reprecipitated as before.

Experiments by the author on cast iron have given negative results, only traces of aluminium being found, and these being probably due to slag. In cast steel, however, aluminium has been detected in several samples, but whether in the form of an alloy or as alumina is unknown.—F. H. L.

ORGANIC CHEMISTRY.—QUALITATIVE.

Colour Reactions of Aromatic Amines. C. Lauth. Compt. Rend. **111**, 975—977.

On treating dimethylaniline acetate with lead dioxide a deep green colouration is produced (see *Derivatives of Dimethylaniline, C. Lauth, page* 357); this reaction, which is very delicate, causes the production, with most amido-compounds, of characteristic colourations, and may therefore be of use in identifying the same when only small quantities are at disposal. The following is a convenient method of making the test: A drop or small quantity of the amido-base under examination is placed on a watch-glass and mixed with ten drops of dilute acetic acid (3 vols. of acetic acid at 8° B. and 7 vols. of water); generally, the base completely dissolves; should it only partially do so the result is the same; but if the base be quite insoluble in aqueous acetic acid it is necessary to employ an alcoholic solution of the acid (3 vols. of acetic acid at 8° B. to 7 vols. of alcohol) to dissolve it; in any case it is advisable to make two tests simultaneously, one with aqueous, the other with alcoholic, acetic acid, since the presence of the alcohol, by reason of the aldehyde, &c., formed from it, frequently affects the result. A few grains of lead dioxide are next sprinkled on the edge of the watch-glass, which is then inclined so as to bring the solution of the amido-compound into contact with the lead dioxide, a colouration, as a rule, being instantly visible.

Testing in this way, the author records the following observations :—

Colourations Produced by the Action of Lead Dioxide on an Acetic Acid Solution of the Amido-base.

—	In presence of Water.	In presence of Alcohol.
Aniline	Red-violet, changing to red-brown.	Same as with water.
Methylaniline	Blue-green, changing to violet, blue, and finally olive.	Violet, red-violet, olive.
Dimethylaniline	Orange, green, green-olive, grey.	Orange, green.
Ethylaniline	Blue-green, blue-violet olive.	Violet, purple, olive.
Diethylaniline	Bright orange, yellow.	Green-yellow.
Benzylaniline	Red-brown, red-violet, grey.	Yellow-grey, green.
Methylbenzylaniline	Orange, green-yellow, olive-green.	Bright green, blue-green, violet.
Ethylbenzylaniline	Orange.	Olive, bright green, olive.
Diphenylamine	Pale purple-grey.	Bright green, olive.
Methyldiphenylamine	Magenta-red, purple, brown.	Purple.
Paratoluidine	Full red, red-brown.	Full red.
Orthotoluidine	Dull green, violet.	Red-violet, purple, dull red.
Dimethylparatoluidine	Olive, yellow-olive.	Olive, yellow-olive.
Dimethylorthotoluidine	Bright orange-red, brown-orange.	Brown olive, olive.
α-Metaxylidine β-Metaxylidine Mixture of *o*- and *p*-xylidines.	Blue-violet, grey-black.	Red-violet, dull red.
Paraphenylenediamine	Bright blue-green, brown.	Bright blue green, brown.
Metaphenylenediamine	Brown.	Brown.
Dimethyl-*p*-phenylene diamine.	Magenta-red, blue-violet, dark purple.	Magenta-red, blue-violet, dark blue.
Dimethyl-*m*-phenylene diamine.	Pale brown-yellow.	Yellow-brown.
Tolylene diamine (common).	Bright red-brown.	Bright red-brown.
α-Naphthylamine	Pale blue-violet.	Pale blue-violet.
β-Naphthylamine	Pale yellow-brown.	Pale red-brown.
Dimethyl-α-naphthylamine.	Full red, opaque white.	Madder-red, little soluble.
Benzidine	Deep rich blue, violet, red.	Yellow solution, blue precipitate.
Tetramethylbenzidine	Green-olive (with excess of acid).	Dull green.
Dimethyl-*o*-anisidine	Violet-red, dull purple.	Dull green, olive.
Dimethyl-*m*-anisidine	Yellow-brown.	Yellow-brown.

—F. B.

Detection of of Adulteration of Olive Oil. R. Brullé. Compt. Rend. **111**, 977.

The test is based on the colourations produced with different oils by a 25 per cent. solution of silver nitrate, and is effected by mixing in a test-tube 5 cc. of the silver nitrate solution with 10 cc. of the sample of oil to be tested, and then heating the mixture on the water-bath for half an hour. Treated in this way:—

(1.) Pure olive oil is coloured green, but remains clear; (2.) arachis oil takes a red-brown tint; (3.) sesamé oil is coloured red; (4.) colza oil becomes first black then dull green; (5.) linseed oil is coloured deep red; (6.) cotton-seed oil is blackened; (7.) poppy oil is coloured dark green; and (8.) camelina oil is rendered very deep red.

—E. B.

New Method for Testing Olive Oils, Seed Oils, Natural and Artificial Butter. R. Brullé. Compt. Rend. **112**, 105—106.

For the discrimination of olive oils and other oils liable to be used for adulteration, the author applies nitrate of silver in the following manner:—25 parts of silver nitrate are dissolved in 1,000 parts of 95 per cent. alcohol, and 5 cc. of this solution are added to about 12 cc. of the oil under examination, which should be filtered if not quite clear, then the test-tube is heated in boiling water, and the effect observed.

Kind of Oil.	Colour after Heating in Boiling Water.
Virgin olive oil.....	Bright green.
Olive oil of second and third pressures, containing some olive-kernel oil.	Darkens slightly, quickly changing to intense green.
Olive oil of inferior quality, strongly coloured.	Same as previous oil, but takes longer (15—20 minutes).
Cotton-seed oil, pure.....	Black.
Earthnut oil.....	Brownish-red, greenish as it loses in transparency.
Sesame oil.....	Dark reddish brown, not changing to green.
Rapeseed oil.....	Greenish yellow, then opaque.
Poppy-seed oil.....	Same as preceding.

The author states that with practice it is possible to determine in many cases thus colorimetrically 5—10 per cent. of one of these oils in a mixture.

In the same way natural butter, which gives no change, may be distinguished from artificial butter, the latter, owing to the presence of margarin, acquiring a brick-red colour; and the proportions in a mixture may be approximately determined.—K. E. M.

ORGANIC CHEMISTRY.—QUANTITATIVE.

The Determination of Impurities in Paraffin Scale, &c. J. Stuart Thomson.

See page 342—347.

An Apparatus for Determining the Flash-Points of Heavy Mineral Oils. J. Gray.

See page 348.

On the Adulteration of Mineral Oils with Caoutchouc. Holde. Mitt. Konig. tech. Versuchs. 1890, 308—310.

Mineral oils are sometimes adulterated with caoutchouc, in order to increase their viscosity and lubricity. For the detection of caoutchouc in mineral oils, it is recommended to:—1. Determine the specific gravity. 2. Ascertain the different degrees of viscosity from 20° to 150° C. 3. Find the quantity of free acids present. 4. Test for fatty oils by saponifying with caustic soda. 5. Test for resin oil by treatment with sulphuric acid of 1·624 sp. gr. (compare this Journal, 1890, 419). 6. Ascertain the solubility by shaking 1 vol. of the oil with 2 vols. of alcohol, benzene, or ether. 7. Precipitate the caoutchouc contained in the oil by treating the latter with a mixture of 3 parts of ether and 4 parts of alcohol. The precipitate is weighed, after having been filtered, washed and dried.—H. S.

Mineral Lubricating Oils used in Italy. V. Villavecchia and G. Fabris. Report of the Central Laboratory of the Italian Customs Department, 1891.

The duty upon heavy mineral oils being 6 and 12 lire per quintal, according as they contain under 20 per cent. or from 20—30 per cent. of light oils respectively, whilst the duty upon illuminating oils is 17 lire per quintal, a class of heavy oils containing about 20 per cent. of light oils has recently been largely imported into Italy for purposes of adulteration. As it is proposed to change the tariff so as to exclude these mixtures, the experiments described in the report were undertaken in order to discriminate between them and genuine lubricating oils.

In these experiments the acidity was determined by Martens' method (this Journal, 1890, 902, 1042); the colour by Stammer's colorimeter; the specific gravity with Greiner's densimeter; the viscosity with Engler's viscosimeter (this Journal, 1890, 654); the solidifying point by agitating the oil in a small thin glass cylinder placed in a vessel containing alcohol cooled to −15°, and observing the change produced by the gradual fall of temperature; the flashing point by heating the oil in a crucible and arranging a small flame about 7 or 8 mm. above the surface of the oil; the percentage of light oils by distillation in a flask, resembling Engler's, but with a shorter stem and larger bulb (this Journal, 1890, 1074); vegetable oils and fats were looked for by Lux's method (this Journal, 1885, 746). The following observations are of general interest. Dark coloured and bituminous oils containing an admixture of vegetable oil, fat, &c., do not solidify when heated with solid caustic potash to 200—210°, but acrolein is evolved. In the use of Greiner's densimeter it is of the greatest importance to keep the temperature constant, the correction tables provided not being equally applicable to all classes of oils. The viscosity apparatus must be made perfectly clean before *each* experiment, the efflux aperture being especially attended to; in two consecutive experiments with the same oil made without disturbing the apparatus, equal quantities of oil flowed out in 1,898 and in 1,471 seconds respectively. The authors' results show that not only does the viscosity diminish very rapidly with a rising temperature, but that the decrease is relatively greater in the more viscous oils. The following are some of the figures obtained:—

Specific Viscosities (with respect to Water).

—	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.	No. 7.
At 20°.....	41·39	51·07	40·85	38·77	72·03	67·92	56·03
At 50°.....	6·81	5·94	5·50	6·03	8·35	9·66	5·71

In technical analyses it is therefore important to determine the viscosity at the temperature which the oil would have whilst in actual use. An addition of light oil to heavy oils greatly reduces their viscosity, more especially of those which have a high viscosity at ordinary temperatures.

From an analysis of the experiments with 85 samples of heavy mineral oils and a comparison with the results obtained by Martens (this Journal, 1890, 902, 1042), and Kinkler (this Journal, 1890, 197, 198), the authors conclude that besides the varieties of oil already described, a heavy oil is imported into Italy of a clear yellowish, or at most, reddish-yellow colour, with a specific gravity equal to or less than 0·870, and a viscosity at 20° of about 22 (colza oil = 100), characters which would render it a valuable adulterant for illuminating oils.—S. B. A. A.

The Analysis of Spirits. E. Mohler. Compt. Rend. **112**, 53—55.

The method described is general in its scope, and allows of the determination of the alcohol, extract, acidity, furfurol, ethers, aldehydes, higher alcohols, and nitrogenous bodies

in the alcohols and spirits of commerce, on as small a quantity as 500 cc. The determinations needing notice are those of the ethers, aldehydes, higher alcohols, and nitrogenous bodies, and are, with exception of the last, made on the liquid obtained by distillation and brought to a strength of 50°.

Ethers.—100 cc. is boiled with 20 cc. of decinormal potash for one hour under a vertical condenser; the potash absorbed by saponifying the ethers is ascertained by titration, and after allowing for the acidity of the spirit is calculated to ethyl acetate.

Aldehydes.—10 cc. of a solution containing $\frac{1}{100000}$ of aldehyde and 10 cc. of the spirit to be tested, both at 50° strength, are treated with 4 cc. of rosaniline bisulphite; the tests are compared after 20 minutes in a Dubosc colorimeter; as the colouration is not *proportional* to the quantity of aldehyde, the alcohol being examined has to be diluted and the comparison repeated until identity is attained.

Higher Alcohols.—100 cc. of the distilled sample is heated with 1 cc. of aniline and 1 cc. of phosphoric acid for one hour under a vertical condenser, and then distilled to dryness in a salt-bath. The distillate thus freed from aldehydes is treated with sulphuric acid at 66° B. in the usual way, and the tint compared with that given by an alcoholic solution of iso-butyl alcohol containing 0·25 grm. per litre in the same manner as was described in the case of the aldehydes.

Nitrogenous Bodies.—100 cc. of the original sample (not distilled) is distilled with 2 cc. of phosphoric acid at 45° B. The residue containing the phosphates of the bases is diluted with about 1 litre of distilled water, 10 grms. of sodium carbonate added, and the mixture distilled until the distillate gives no colouration with Nessler's reagent. Alkaline permanganate is then added, the distillation proceeded with, and the ammonia estimated as before. The first portion corresponds to the amides and saline ammonia, the second to the pyridine bases and alkaloids.

A lengthy table is appended to the paper showing the results obtained by these methods for natural and factitious spirits. In general the total amount of matter other than alcohol and extract in the latter is only about one-third to one-sixth that of the quantity in the former. The author hopes when a sufficient number of analyses have been accumulated to be able to determine the limit below which a spirit may be considered adulterated.—B. B.

The Valuation of Coal. H. Bunte. J. f. Gasbeleuchtung, **34**, 21—26 and 41—47.

See under II., *pages* 350—351.

On the Heat of Combustion of the Commoner Illuminants and the Contamination of the Air caused by their Use. E. Cramer. J. f. Gasbeleuchtung, **34**, 27—31, 48—50, and 65—68.

See under II., *pages* 351—352.

New Books.

CHEMISTRY IN SPACE. From Professor J. H. Van 't Hoff's "Dix Années dans l'Histoire d'une Théorie." Translated and edited by J. E. MARSH, B.A., Demonstrator in Organic Chemistry at the University Laboratory, Oxford. Oxford: At the Clarendon Press. 1891. London: Oxford University Press Warehouse, Amen Corner, E.C.

OCTAVO volume bound in cloth. Price 4*s.* 6*d.* It contains Prefaee, Table of Contents, and text covering 124 pages, one sheet of Diagrams, and Alphabetical Index. The subject-matter is sub-divided as follows:—Historical. The Asymmetric Carbon Atom. The Single Linking of Carbon. Separation of Compounds inactive by Compensation. Point of Transition. The Unsaturated Compounds of Carbon. Further Development of the Theory. Conclusion.

Trade Report.

TARIFF CHANGES AND CUSTOMS REGULATIONS.

PHILIPPINE ISLANDS.

New Customs Tariff.

The following is a statement of some of the rates of Customs duty now levied in the Philippine Islands on articles imported from abroad under the new tariff which came into operation on the 1st April.

Note.—Kilogramme = 2·204 lb. avoirdupois. Peso = 4*s.* 2*d.* (nominal value). Hectogramme = 3·215 oz. troy.

No. in Tariff.	Classification of Articles.	Rates of Duty.	
	CLASS I.—STONES, EARTHS, MINERALS, GLASS, AND CERAMIC PRODUCTS.		Pes. Cts.
	Schist, Bitumen, and their Derivations.		
6	Tar, pitch, asphalt, bitumen, and schist ..	100 kilos.	0·09
7	Naphtha oils, vaseline, crude, natural petroleum, and crude oils derived from schist.	„	2·00
8	Benzene, gasolene, and petroleums, and other mineral oils, refined.	„	3·00
	Minerals.		
9	Mineral oils	1,000 kilos.	0·25
	Crystal and Glass.		
10	Blown glass, common and ordinary	100 kilos.	1·60
11	Crystal, and glass imitation of the same, also gilt and plated in the interior.	„	6·00
12	Plate and sheet glass	„	3·00
13	Silvered glass and crystal, and glasses for telescopes and watches.	Kilog.	0·05
	Earthenware and Porcelain.		
14	Tiles, bricks, and plaques for building purposes, and crucibles.	100 kilos.	0·02
15	Glazed bricks and tiles, and earthenware pipes, glazed tiles, glazed bricks, and pipes.	„	0·40
16	Stoneware and fine earthenware	„	6·00
17	Porcelain.....	„	10·00
	CLASS III.—SUBSTANCES USED IN PHARMACY, PERFUMERY, AND THE CHEMICAL INDUSTRIES.		
58	Coco and palm oil and other heavy oils ..	„	0·20
59	Vegetable oils of other kinds except olive oil.	„	4·60
60	Woods and barks for dyeing and tanning.	„	0·02
61	Madder.....	„	4·00
62	Sesame, linseed, and other oleaginous seeds, including copra.	„	0·04
63	Other vegetable products not elsewhere specified.	„	2·00
64	Animal products used in medicine	„	0·40
	Colours, Dyes, and Varnishes.		
65	Ochres and other earthy colouring matters	„	0·02
66	Indigo and cochineal	„	2·00
67	Extracts for use in dyeing	„	0·60
68	Extract of madder.....	Kilog.	0·15

NEW CUSTOMS TARIFF OF PHILIPPINE ISLANDS—*cont.*

No. in Tariff.	Classification of Articles.	Rates of Duty.	Pes. Cts.
69	Varnishes	100 kilos.	4·80
70	Colours in powder or cake	,,	1·50
71	Do. prepared and dyes	,,	5·00
72	Do. derived from coal-tar and other artificial colours.	Kilog.	0·15
	Chemical and Pharmaceutical Products.		
73	Muriatic and chlorhydric acid	100 kilos.	0·20
74	Nitric acid	,,	0·80
75	Sulphuric acid	,,	0·30
76	Alkaloids and their salts	Kilog.	0·00
77	Alum	100 kilos.	0·30
78	Sulphur	,,	0·05
79	Barrilla (a mineral alkaloid), natural and artificial.	,,	0·20
80	Alkaline carbonates, alkalis, caustic and ammoniacal salts, except sulphate.	,,	0·20
81	Chloride of lime	,,	0·30
82	Chloride of potash, sulphate of soda, chlorate, carbonate and sulphate of magnesium.	,,	0·10
83	Chloride of sodium (common salt)	,,	0·05
84	Glue and albumen	,,	2·40
85	Phosphorus	Kilog.	0·07
86	Nitrate of potash (saltpetre)	100 kilos.	0·30
87	Do. of soda and sulphate of ammonia	,,	0·05
88	Oxides of lead	,,	0·40
89	Sulphate and pyrolignite of iron	,,	0·50
90	Pills capsules pilules &c.	Kilog.	1·00
91	Pharmaceutical products not otherwise specified.	,,	0·80
92	Chemical products not otherwise specified	,,	0·20
	Miscellaneous Articles.		
93	Starch	,,	0·02
94	Lead in bars, industrial uses and doctrine	100 kilos.	0·20
95	Common soaps	,,	3·75
96	Paraffine stearine, wax and sperm, unrefined	,,	3·30
97	Do., manufactured	,,	10·00
98	Perfumery and cosmetics	Kilog.	0·40
99	Gunpowder, explosives, and miners' fuses	,,	0·10
	CLASS VIII.—PAPER AND ITS MANUFACTURES.		
	Printing and Writing Paper.		
162	Paper, calf's size, sized or half-sized for printing.	,,	0·03
163	Do., do., for writing, lithographing, or engraving.	,,	0·08
164	Do., cut, hand-made and ruled	,,	0·12
	CLASS X.—ANIMAL PRODUCTS.		
	Skins and Leather.		
194	Skins and hides, not tanned	100 kilos.	1·20
195	Leather, varnished, or calf skins dressed or prepared.	Kilog.	0·24
196	Other leather dressed or prepared, including sole leather	,,	0·04
197	Leather bands for machinery	Kilog.	0·20
198	Skins, whether for use or for ornament, in a natural state or made up.	,,	0·25
199	Do., in manufactured articles	,,	1·80
	Other Animal Products.		
205	Animal fats	100 kilos.	0·20
207	Animal manures of all kinds	,,	0·01
208	Tripe	Kilog.	0·04
209	Animal product not otherwise mentioned, not manufactured.	100 kilos.	0·10
	CLASS XII.—FOOD PRODUCTS.		
	Oils and Liquors.		
258	Olive oil	Kilog.	0·12
259	Common spirit of wine	Litre	0·09
260*a*	Spirits of wine flavoured or mixed	,,	0·20
260*b*	Spirits, other, common, flavoured, or mixed, and liqueurs.	,,	0·36
261	Beer and cider	,,	0·06
262	Sparkling wines	,,	0·25
263	Wine, of other kinds	,,	0·12
	CLASS XIII.—MISCELLANEOUS.		
284	India-rubber and gutta-percha not manufactured.	100 kilos.	0·60
285	Do., in plates and tubing	Kilog.	0·15
286	Do., in elastic threads	,,	0·10
287	Do., manufactured in any form or shape	,,	0·44
288	Oil cloth and waxed cloth for soles of shoes and for packing.	,,	0·07
289	Do., of other kinds	,,	0·16

EXTRACTS FROM DIPLOMATIC AND CONSULAR REPORTS.

PROPOSED SUGAR LEGISLATION IN FRANCE.

The Earl of Lytton, Her Majesty's Ambassador at Paris, in a despatch to the Foreign Office, dated the 25th February, encloses a copy of the report drawn up by the Budget Committee appointed to examine the Bill on sugar duties recently presented to the Chamber of Deputies. This Bill provides as follows:

After the 1st September next, and for subsequent seasons, the legal yield per 100 kilos. of beets worked in native sugar factories is fixed at 7·75 kilos.

When the real yield of each factory does not exceed 10·5 kilos. of refined sugar per 100 kilos. of beet, the excess is admitted to the benefits of the reduced duty provided by the first paragraph of the first article of the law of the 5th August 1890.

Half of the excess obtained over 10·5 kilos. of sugar per 100 kilos. of beets only equally benefits by this reduced duty; the other half is added to the charge leviable with the full duty of 60 francs per 100 kilos.

To those manufacturers who, before the 15th October in each year, declare to the Excise Bureau that they elect to give up the bounty on the excess yield, a waste of 15 per cent. will be allowed on the total amount of their manufacture.

Sugars corresponding to this waste are liable to a duty equal to that which is applicable to sugars representing excesses.

The waste in manufacture allowed to distilling manufacturers by Article 6 of the law of the 5th August 1890 is reduced to 15 per cent., dating from the 1891—92 season.

For the 1890—91 season a waste of 15 per cent. on the total amount of their manufacture will be allowed to the manufacturers of sugar who, by a declaration made at the excise office within five days after the promulgation of the present law will give up the bounty on sugars obtained over and above the legal yield (*prise en charge*).

The Laurium Mines in 1890.

Mr. H. Lewis Dupuis, Her Majesty's Consul at the Pirœus, in a report to the Foreign Office dated the 26th February, quotes the following details of the operations of the Laurium mines in 1890 from the report of Vice-Consul Desposito :—

The Greek company which began by smelting the ancient scoriæ 15 years ago, having nearly used up that of the old works, obtained the concession of all ancient mine refuse on mineral grounds, known as bevolades, which spread over a surface of about 300 acres. These, it is estimated, contain about 4 to 9 per cent. of lead, and 75 to 200 grms. of silver per ton of ore. The dressing of the ore, as it is called, is done by complicated machinery which washes it and extracts from 7 up to 15 per cent. of lead, and 1,700 to 1,800 grms. of silver per ton of lead. The plant alone for these operations occupies a space of about 10,000 metres, and similar works are now in course of construction to work over the mud and refuse left by the first by a new and improved system of machinery, for which an outlay of 2,400,000 frs. was sanctioned for the building and machinery. The section now at work gives employment to about 1,200 workmen, and turns out sufficient dressed ore to feed 13 furnaces (Pilz's system).

The raw material or mineral earth dressed during last year amounted to 246,000 tons; this was supplied from different sources within the limits of the concession. Original contents of lead averaged 4·05 per cent. with 75 grms. of silver, and produced 68,800 tons of dressed ore containing 10·87 per cent. lead and 1,910 grms. of silver to the ton of lead. The best part of the large deposits of mud and sand left by the washing is shaped into bricks and smelted with other raw material, but this will soon be discontinued, and the work will be passed on to the new section when ready, which will enrich them from 3, the actual contents, to 20 per cent. lead. Herr Lury, the inventor and patentee of the machinery, undertakes to realise such a result, from essays and trials made in his factory at Dresden. The quantity of these new washing refuses of mud and sand, which has to be re-worked by Herr Lury's system, is calculated to amount to about 2,500,000 tons. This will keep the company going for some 10 or 12 years longer on this alone, after which there will still remain the large quantity of non-worked bevolades which have to undergo the first and second dressing. The company, however, in order to secure a long life to their enterprise, work two mines in the district and one in Asia Minor; the output of the three will keep their furnaces supplied with a quantity of virgin lead, ore, and galena, which is now being mixed up with dressed ores.

During 1890 the company's 13 furnaces smelted 99,518 tons of dressed and undressed ore, which yielded 8,081 tons of lead containing about 1,694 grms. of silver per ton, at a cost of 1,892,522 dr., the market value of which was about 110,000*l*. The import of galena (55 to 60 per cent.) from the concession in Asia Minor, included in the above quantity of smelted ore, was 1,076 tons, this added to 68,800 tons dressed ore, and 1,399 tons of iron lead ore, and 13,643 tons of sulphuric lead ore, obtained from their mines at Laurium, make up the 99,518 tons which fed the furnaces during 1890.

7,531 tons of lead were shipped to the United Kingdom, and 550 tons to Italy. The same company erected, two years ago, works for the disargentation of part of their lead, but though good from an industrial point of view, the result commercially cannot be said to be a profitable one. The difficulty being to find a market for the sweet lead and silver produced at a price proportioned to the heavy expenses entailed by the works, they were therefore obliged to carry it on on a very small scale, and the quantity of pig lead submitted to disargentation was only 567 tons, which produced 481 tons of purified sweet lead and 340 kilos. of silver. The lead was sold in Athens and Syra, but the silver had to be sent to England. The number of hands employed by this company in all the various branches of their works amounts to 3,500 all told. This company owns the Attica railway, connecting Laurium and the surrounding villages with Athens. The capital engaged for this was 5,500,000 dr., and last year's balance sheet shows a net profit of 181,390 dr.

The French company was started in 1875, with a capital of 16,000,000 frs.; head offices being in Paris, with a representative at Athens. The mining and smelting operations carried on by them are very extensive and important, and the results are better than those of the Greek company, owing to superior management. The mines owned by this company, including the concessions obtained during the last 15 years, extend over an area of about 14,300 acres, and the underground works hitherto executed may be estimated at upwards of 5 kilom. The centr of these works is at Camarisa, where several ancient pits having been explored, now reach a depth of about 500 feet, divided into three storeys, and connected by an underground railway. These mines, besides lead ore and galena, produce several kinds of zinc ore. Five miles from the mines are the buildings, dressing machinery, lead smelting and zinc calcinating furnaces, and the employés' and workmen's dwellings, a village in itself, half a mile from Ergasteria, and it is there that the working of the different ores is carried on.

The produce of these mines during 1890 was as follows: raw zinc ore (calamine), 55,704 tons, containing about 27 per cent. and 458 tons of lead ore. This ore was first tested, and the poorest dressed by washing; the whole afterwards was calcinated, and produced marketable stuff of about 31,089 tons, containing about 50 per cent. of zinc, value 186,530*l*.—(*No.* 834, *Foreign Office Annual Series.*)

Phosphate Lands in Florida.

Writing with regard to a recent discovery of phosphate lands in Florida, Mr. A. de G. Fonblanque, Her Majesty's Consul at New Orleans, in his last annual report to the Foreign Office, says :—

A short time ago quite an important discovery was made in Florida, which is not only contributing to the wealth of certain portions of the State, but is opening up a large export demand. I refer to the discovery of phosphate lands in Florida. The *Times Union Trade Report* for 1890 says: "To tell one half of the wonderful phosphate story of Florida would require several pages of the trade edition. As it goes to press the whole State of Florida is stirred from centre to circumference over the wealth which this discovery promises. The business is not only in its infancy, it may be said to have hardly been born as yet. To present anything like an exhaustive review of it at present would be impossible."

To give some particulars about this interesting discovery it may be related that about the middle of the year 1888 a gentleman, while digging a well in his yard at Ocala, Florida, found marly earth, which was examined and found to be a chalky lime substance not unusual in that portion of the State. It was, however, determined to have the "stuff" properly analysed, and a parcel of it was sent to eminent chemists of a large western city for analysis. The reports were that the stuff was rich in phosphorous acid, and advised that if there was much of it to look after it, as it was valuable. Other similar scientific establishments in large cities confirmed these reports, whereupon the land from which the sample was taken was searched, and the marly substance was found there in quantities, and also at several other places on adjoining properties. About 8,000 acres of these phosphate lands were immediately purchased in the "phosphate belt" followed by other purchases. A company was soon organised, which secured early in the year about 15,000 acres of choice phosphate lands. Other companies

have since been formed which have also secured extensive quantities. I have heard of several vessels loading at some of the ports in Florida nearer to the phosphate beds, and among them some British steamers.

A house is, I am informed, about to be established at Pensacola by parties from the northern States of this country (and who are operators in fertilisers in Ireland for shipment abroad) for the purpose of putting up a regular factory there for the preparation of the crude phosphate into superphosphate (or whatever the refined article may be termed—for general fertilising purposes. This phosphate business will, I am informed, add immensely to the circulation of money in Florida, and, of course, thereby be of general good to large portions of the State. The working population, it is supposed, will also materially benefit in the work of excavation, &c. that must go on in connexion with the business. The original proprietors, or pioneers, in this new industry will also get rich, no doubt, in addition to the actual possessors of the phosphate land.—(No. 833, *Foreign Office Annual Series.*)

GENERAL TRADE NOTES.

The Development of the Russian Match Industry.

The February number of the *Deutsches Handels Archiv* devotes an article to this subject, from which it appears that the industry has developed to such an extent within the last four years that Russia is being gradually enabled to cover her own requirements by manufacture. In 1881 the quantity of matches imported across the European frontier of Russia was 39,000 pounds, but from that time there has been a steady decrease in these imports, and in recent years they have become quite insignificant, for instance, in 1884 the total imports were 42,667 pounds, and for each succeeding year they were as follows:—31,007 pounds, 20,216 pounds, 8,786 pounds, 1,827 pounds, and in 1889, 372 pounds (the pound = 36 lb. avoirdupois).

In 1889 there were 864 pounds of matches exported from Russia. During the same year there were 312 match factories at work, which produced 139,704 millions of matches. It is not possible to give comparative figures for 1888, as reliable returns have only been compiled since May of that year, that is, since the introduction of the match tax. The production for the period from May to the end of the year 1888 was 59,355 millions of matches, and there can be no doubt that the production of 1889 greatly exceeded that of the previous year. The average production per factory during eight months of 1888 was 213·5 million, and that for 1889, 447·8 million, although there were 34 more factories at work in the latter year.

Of the factories at work during 1889, 77 per cent. manufactured phosphorus matches, 5·4 per cent. produced an article free from phosphorus, and 17·6 produced both kinds. The match tax yielded a revenue in 1889 of 4,222,795 roubles, exceeding the budget estimate by 3,029,000 roubles, or 46 per cent.

Tallow Trade of Russia.

The following is an extract from a recent report of the Belgian Consul-General at Moscow:

The principal houses of Northern and Central Russia engaged in the tallow export trade are at St. Petersburg. This capital serves as an outlet for tallow coming from the distant regions in the Empire, notably the governments of Siberia, Perm, Kazan, Samara, Orenburg, Saratow, &c. There are estimated to be in Russia nearly four works, which annually produce 2,000,000 pounds of tallow. The most important works are situated in the following governments:—Orenburg, Samara, Perm, St. Petersburg, Ekaterinoslaw, Tambow, Cherson, and Moscow.

The exportation is relatively small, the major part of the production of tallow being consumed by the candle and soap factories. Among these establishments may be mentioned the factory of Kresto?nikow Brothers, at Kazan, which annually uses more than 600,000 pounds of tallow of native origin, and the Neva Company, whose factories at Moscow and St. Petersburg consume almost as large a quantity of native tallow, and more than 150,000 pounds of tallow imported from abroad.

The exports amount, according to official data, to 186,958 pounds, distributed as follows:—

By the Baltic Sea frontier, 65,857 pounds; Russo-Prussian frontier, 8,352 pounds; Black Sea frontier, 48,553 pounds; Sea of Azov frontier, 63,569 pounds; Russo-Austrian frontier, 627 pounds.

By the principal ports:—Taganrog, 63,530 pounds; Odessa, 46,220 pounds; St. Petersburg, 40,976 pounds; Libau, 10,932 pounds; Reval, 7,359 pounds; Port Baltic, 3,154 pounds; Riga, 3,434 pounds.

The principal countries of destination are:—Turkey, 107,419 pounds; Germany, 41,706 pounds; England, 16,258 pounds; Netherlands, 15,846 pounds; France, 3,597 pounds.

Up to the 1st August 1890 the exports had not exceeded 100,000 pounds.

Production of Bauxite in Arkansas.

Bradstreet's for the 7th March has the following:—

It has recently been reported to the Government that extensive deposits of bauxite exist in Arkansas in irregular patches. As this mineral has only hitherto been found in small quantities, and, with the exception of a single bed in Georgia, never before in the United States, "the find is likely to prove a valuable one." The growing demand for the better class of refractory crucibles and tiles has caused an increased use of this mineral; and as it is also employed in some of the aluminium processes and for the manufacture of alum and aluminate of soda, the discovery is of great commercial interest.

Oil Production of New Zealand.

The following notes with regard to the oil production of New Zealand are taken from the report of the Registrar-General for that colony for the year 1889:—

Petroleum Oils.

Some very fine oils have been found in the colony. In reference to this, Sir James Hector remarks: "There are three principal localities, and these produce each a distinct kind of oil: the Sugar loaves, in the Taranaki province; Poverty Bay, on the east coast of the province of Auckland; and Manutahi, Waiapu, East Cape. The oil from the first has a very high specific gravity, 0·960 to 0·964 at 60° F. (water 1). It has thus too much carbon in its composition for its commercial success as an illuminating oil, but is capable of producing a valuable lubricating oil. The second kind, from Waipaoa, Poverty Bay, is a true paraffin oil resembling the Canadian oil. The third produces a pale brown oil, nearly or quite transparent, specific gravity 0·829 at 60° F., which burns well in a kerosene lamp for some time, and is therefore of a very superior class. It contains only traces of paraffin, and produces 84 per cent. of an illuminating oil fit for use in kerosene lamps by means of a single distillation." Specimens of oil shales have been found at Kaikoura and Blueskin in Otago; and at Orepuki, in Southland, extensive and apparently valuable formations of shale have been discovered. Attempts have been made to develope the oil resources at Waipaoa, but marketable petroleum cannot yet be classed among the industrial products of the colony.

Papers of Interest to Technologists and Manufacturers.

The following articles in the *Board of Trade Journal* for April will repay perusal:—

"Trade Mark Laws of America," p. 379.
"Sugar Production in Central and South America," p. 384.
"Production of Caoutchouc in Brazil and Mexico," p. 390.
"The Ramie Industry in Mexico," p. 447.
"Natural Products of the Amazon Valley," p. 449.

INFLAMMABLE LIQUIDS BILL.

193. February 9th, 1891.

A Bill to amend and consolidate the law relating to the keeping, selling, and conveyance of inflammable liquids.

The term inflammable liquid is held to include carbon bisulphide and all varieties of liquid petroleum or oil prepared from coal, shale, &c., except liquids having a specific gravity above 1,000 or of specific gravity above 846 and flashing point above 150° F. Any such liquid having flashing point below 73° F. is termed a *mineral spirit*, above 73° F. a *mineral oil*. The Bill provides for the licensing and registration of all places used for the storage of inflammable liquids. The quantity allowed to be stored is regulated according to the means employed in storage, whether wholly or partly in tanks, and whether underground or not. The quantity allowed to be stored also depends on the distance from "protected" buildings, as theatres, churches, &c. Receptacles of inflammable liquids are to be marked in a distinctive manner as, *e.g.*, by a coating of yellow paint. Places of storage may be entered and inspected by the proper authorities at all times. A sample of any liquid suspected to be an inflammable liquid may be taken by the police for the purpose of testing, the regulations with regard to the taking of samples being similar to those of the Food and Drugs Act. Hawkers vending inflammable liquids may not carry any article likely to cause the inflammation of an inflammable liquid. The regulations for conveyance do not call for special remark; they are to be supplemented by byelaws of the railway companies, &c. to be approved by the Secretary of State. In case of accidents arising from the inflammation of inflammable liquids special inquiries may be instituted by the Secretary of State in which specialist and other witnesses may be examined as in other such inquiries.

Acts Repealed.—Petroleum Acts of 1871 and 1879, Hawker's (Petroleum) Act of 1881.—V. C.

BOARD OF TRADE RETURNS

Summary of Imports.

	Month ending 31st March	
	1890.	1891.
	£	£
Metals	1,929,528	1,831,153
Chemicals and dyestuffs	1,121,999	706,735
Oils	538,800	531,674
Raw materials for non-textile industries.	2,695,141	2,591,726
Total value of all imports	36,140,334	35,253,059

Summary of Exports.

	Month ending 31st March	
	1890.	1891.
	£	£
Metals (other than machinery)	3,193,151	3,780,663
Chemicals and medicines	711,152	846,273
Miscellaneous articles	2,800,032	2,954,560
Total value of all exports.....	20,067,022	21,663,378

Imports of Metals for Month ending 31st March.

Articles.	Quantities.		Values.	
	1890.	1891.	1890.	1891.
			£	£
Copper:—				
Ore ..... Tons	12,507	6,226	113,943	57,673
Regulus ..... „	6,403	6,873	186,168	198,286
Unwrought .... „	3,631	3,160	184,504	170,125
Iron:—				
Ore ..... „	426,382	257,884	336,121	230,232
Bolt, bar, &c. .... „	1,076	3,426	38,852	33,079
Steel, unwrought .. „	536	553	6,469	6,757
Lead, pig and sheet „	13,215	10,536	172,428	133,767
Pyrites ..... „	63,248	51,811	112,147	98,766
Quicksilver ..... Lb.	26,250	822,556	3,194	92,305
Tin ..... Cwt.	54,330	65,183	250,085	296,572
Zinc ..... Tons	3,925	4,924	88,266	114,768
Other articles ...Value £	..	..	117,351	398,823
Total value of metals	..	..	1,929,528	1,831,153

Imports of Raw Materials for Non-Textile Industries for Month ending 31st March.

Articles.	Quantities.		Values.	
	1890.	1891.	1890.	1891.
			£	£
Bark, Peruvian .. Cwt.	12,670	16,329	40,336	38,771
Bristles ..... Lb.	201,052	275,796	29,190	43,265
Caoutchouc ..... Cwt.	27,720	22,245	338,016	286,843
Gum:—				
Arabic ..... „	1,058	5,506	13,296	15,568
Lac, &c. ..... „	12,839	13,879	49,059	54,889
Gutta-percha .... „	5,240	5,831	70,753	83,429
Hides, raw:—				
Dry ..... „	48,703	47,697	127,016	119,032
Wet ..... „	51,980	38,221	118,493	83,268
Ivory ..... „	922	1,057	46,429	53,262
Manures:—				
Guano ..... Tons	3,430	1,872	20,502	10,492
Bones ..... „	6,750	7,903	35,664	47,602
Paraffin ..... Cwt.	51,639	54,651	65,258	76,743
Linen rags ..... Tons	3,231	2,656	33,534	24,783
Esparto ..... „	16,945	19,383	82,079	95,805
Pulp of wood .... „	9,509	10,044	56,111	59,565
Rosin ..... Cwt.	167,223	137,343	35,674	30,596
Tallow and stearin „	144,929	135,260	179,691	172,633
Tar ..... Barrels	7,469	2,027	4,729	1,099
Wood:—				
Hewn ..... Loads	136,810	138,927	352,886	227,854
Sawn ..... „	84,232	92,857	219,404	216,455
Staves ..... „	5,599	3,724	35,796	22,276
Mahogany ..... Tons	5,455	3,837	51,154	37,709
Other articles....Value £	..	..	690,871	789,807
Total value	..	..	2,695,441	2,591,726

Besides the above, drugs to the value of 66,093*l.* were imported, as against 74,967*l.* in March 1890.

Imports of Chemicals and Dyestuffs for Month ending 31st March.

Articles.	Quantities.		Values.	
	1890.	1891.	1890.	1891.
			£	£
Alkali..... Cwt.	1,949	6,536	1,946	3,818
Bark (tanners, &c.) „	39,327	31,160	16,647	9,549
Brimstone..... „	12,578	38,754	9,536	11,517
Chemicals..... Value £	..	..	110,325	119,716
Cochineal ..... Cwt.	500	266	3,012	1,592
Cutch and gambier Tons	1,300	1,373	37,257	33,378
Dyes:—				
Aniline ..... Value £	..	..	21,985	22,917
Alizarine ..... „	..	..	29,598	32,780
Other ..... „	..	..	774	1,396
Indigo ..... Cwt.	19,107	7,199	348,633	150,622
Madder ..... „	1,187	771	1,512	1,041
Nitrate of soda.... „	659,072	231,035	269,674	96,591
Nitrate of potash . „	32,017	32,351	28,260	28,858
Valonia ..... Tons	2,783	1,513	55,326	31,617
Other articles... Value £	..	..	187,803	162,233
Total value of chemicals	..	..	1,121,969	706,745

Imports of Oils for Month ending 31st March.

Articles.	Quantities.		Values.	
	1890.	1891.	1890.	1891.
			£	£
Cocoa-nut..... Cwt.	19,799	1,085	25,099	2,854
Olive ..... Tuns	2,568	1,529	97,951	62,084
Palm ..... Cwt.	72,069	50,955	74,774	59,352
Petroleum ..... Gall.	6,646,239	10,993,410	173,178	230,854
Seed ..... Tons	1,389	2,591	40,876	65,160
Train, &c..... Tuns	824	735	17,074	15,658
Turpentine ..... Cwt.	23,969	15,017	36,993	21,344
Other articles .. Value £	..	..	73,478	76,268
Total value of oils ...	..	..	538,899	534,674

Exports of Drugs and Chemicals for Month ending 31st March.

Articles.	Quantities.		Values.	
	1890.	1891.	1890.	1891.
			£	£
Alkali..... Cwt.	417,269	542,288	328,442	264,426
Bleaching materials „	109,139	111,452	29,417	38,446
Chemical manures. Tons	28,211	35,176	180,807	252,571
Medicines..... Value £	..	..	92,470	90,070
Other articles .. „	..	..	270,086	258,860
Total value	..	..	711,152	814,373

Exports of Metals (other than Machinery) for Month ending 31st March.

Articles.	Quantities.		Values.	
	1890.	1891.	1890.	1891.
			£	£
Brass..... Cwt.	7,129	8,748	36,620	49,077
Copper:—				
Unwrought ..... „	62,247	84,265	166,217	249,023
Wrought..... „	23,125	24,136	65,852	80,509
Mixed metal .... „	17,902	25,851	51,725	72,121
Hardware ..... Value £	..	..	231,231	215,793
Implements..... „	..	..	107,278	110,597
Iron and steel..... Tons	324,721	256,439	2,543,619	2,104,729
Lead ..... „	4,070	3,517	62,859	51,873
Plated wares... Value £	..	..	37,901	26,834
Telegraph wires, &c. „	..	..	51,390	392,554
Tin ..... Cwt.	7,976	8,212	37,070	38,913
Zinc ..... „	12,397	12,869	11,841	13,741
Other articles .. Value £	..	..	95,624	96,908
Total value	..	..	3,493,151	3,780,693

Exports of Miscellaneous Articles for Month ending 31st March.

Articles.	Quantities.		Values.	
	1890.	1891.	1890.	1891.
			£	£
Gunpowder..... Lb.	948,600	756,800	25,435	17,016
Military stores.. Value £	..	..	106,505	63,927
Candles..... Lb.	1,256,800	1,124,800	23,916	28,132
Caoutchouc ..... Value £	..	..	94,297	103,146
Cement..... Tons	57,655	65,611	117,603	131,245
Products of coal Value £	..	..	133,351	174,218
Earthenware ... „	..	..	130,641	165,317
Stoneware ..... „	..	..	17,699	18,002
Glass:—				
Plate..... Sq. Ft.	256,350	267,032	12,612	17,730
Flint..... Cwt.	12,337	8,435	23,123	20,107
Bottles..... „	75,276	67,184	35,011	31,514
Other kinds.... „	13,674	19,489	14,963	16,713
Leather:—				
Unwrought .... „	12,734	14,306	115,482	129,134
Wrought ..... Value £	..	..	29,367	32,979
Seed oil..... Tons	5,674	7,268	129,085	167,369
Floorcloth ..... Sq. Yds.	1,648,900	1,731,700	73,081	76,179
Painters' materials Val. £	..	..	132,870	136,330
Paper ..... Cwt.	83,313	89,284	147,389	154,973
Rags..... Tons	3,127	3,754	26,470	25,704
Soap..... Cwt.	40,186	40,231	45,791	51,742
Total value	..	..	2,809,032	2,951,560

Monthly Patent List.

* The dates given are the dates of the Official Journals in which acceptances of the Complete Specifications are advertised. Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the said dates.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

Applications.

4870. R. K. Boyle. Improvements in apparatus for compressing air or gases. March 18.

4972. J. A. Fletcher, S. Fletcher, and J. Fletcher. Improvements in furnaces for melting metals in crucibles. March 20.

5175. S. C. Hauberg. Improvements in centrifugal apparatus for testing the composition of milk and other compound of fluids. Complete Specification. March 23.

5340. A. Dervaux. An improved mode of and apparatus for clarifying muddy liquids. March 25.

5342. H. L. Callendar. Improvements in electrical thermometers or pyrometers. March 25.

5442. M. Gehre. An improved process of and apparatus for ascertaining the percentage of liquid contained in steam or vapour. March 28.

5510. R. Gough. A new or improved apparatus and means for the aëration of carbon in filters. March 31.

5529. J. S. Sawrey and H. Collet. Improvements in apparatus for separating liquids from solid matter suspended therein. March 31.

5555. R. Haddan.—From J. W. Evans, United States. Improvements in evaporators. Complete Specification. March 31.

5749. J. Johnson.—From T. S. Blair, jun., United States. Improvements in refractory linings for furnaces. April 3.

5919. H. J. E. Jensen. Improvements in apparatus for purifying water and for lixiviating chemicals. April 6.

5924. O. M. Row and J. B. Brew. Improvements in apparatus for heating or evaporating liquids. April 7.

5931. J. J. Hardy and W. H. Hardy. Improvements in valve seats, and in the general construction of acid-resisting valves and cocks. April 7.

6057. W. H. Munns.—From G. Kaffenberger, United States. Improvements in digesting apparatus. April 8.

6159. J. Hardman and J. Peake. Improvements in retort-charging devices. April 10.

6374. J. Guenet. Ozonising apparatus. Complete Specification. April 14.

6387. W. Heyes. Improvements in apparatus for concentrating acids and other liquids. April 14.

6405. J. R. Whiting and W. A. Lawrence. Improvements in methods for the recovery and utilisation of certain vaporised solvents. Complete Specification. April 14.

6488. P. M. Pinal, V. Letinil'lier, and C. L. Pinal. Improvements in liquid gauges. Complete Specification. April 15.

6587. H. Hencke. Improvements in the method of and in apparatus for drying and evaporating. April 16.

Complete Specifications Accepted.*

1890.

6433. G. E. Davis and A. R. Davis. Furnace or heating chamber for conducting chemical operations. April 22.

8167. G. Moffat and S. Stuttaford. Apparatus for consuming smoke and saving fuel. April 1.

8168. G. Moffat and S. Stuttaford. Apparatus for delivering air into furnaces. April 1.

8523. E. F. Paddon. Furnaces. April 15.

8707. J. von Langer and L. Cooper. Gas furnaces for metallurgical and other purposes. April 22.

8790. W. R. Watson and R. A. Robertson. Apparatus for evaporating, concentrating, and distilling liquids. April 15.

9181. The Lucigen Light Co., Lim., and T. M. Jarmain. An oil flame furnace. April 22.

9685. G. Cox. Metal drums for carrying oil and other liquids. April 15.

10,116. F. B. Pemberton. Composition for preventing the passage of heat through bodies, deadening of sounds; and method of applying same. April 15.

14,370. A. Dannenberg. *See* Class II.

1891.

4292. The Brins Oxygen Co., Lim., and K. T. Murray. Apparatus for automatically changing the flow of fluids through pipes or passages. April 22.

II.—FUEL, GAS, AND LIGHT.

Applications.

4764. W. Bagley and J. W. Bagley. Improvements in and connected with the manufacture of gas for heating purposes. March 17.

4834. A. Lutschaunig. An improved manufacture of fire-lighter or fire-lighting material. Complete Specification. March 18.

5022. J. Moeller. An improvement in incandescent illumination, and apparatus for that purpose. March 20.

5036. W. P. Thompson.—From J. M. A. Gerard, France. Improvements in the treatment and desiccation of peat. March 20.

5037. R. C. W. Maltby. An improved artificial fuel. March 20.

5038. R. C. W. Maltby. An improved coke oven. March 20.

5187. F. Tschofen. Improvements in the manufacture of candles. March 23.

5207. T. Thorp and T. G. Marsh. Improvements in the purification of gas. March 24.

5212. W. H. Munns.—From E. de Beauharnais, United States. Improvements in the art of manufacturing illuminating gas. March 24.

5217. J. T. Key. Improvements in the manufacture of gas for illuminating and other purposes, and apparatus therefor. March 24.

5299. B. H. Thwaite. Improvements in the production of combustible gases, and in apparatus therefor. March 25.

5468. J. Russell and J. C. W. Stanley. Improved manufacture of artificial fuel. March 26.

5468. W. H. Wilson. Improvements in or connected with the manufacture of illuminating gas. March 28.

5489. M. Mackay. Improvements in purifying gas and in apparatus therefor. March 28.

5701. O. W. Ketchum. Improvements in gas generating furnaces or gas producers. April 2.

5960. B. J. B. Mills.—From E. L. Clarke, Canada. Improvements in machinery for the manufacture of peat fuel. April 7.

6134. J. Laing. Improvements in the distillation of mineral oils and like bodies, and in apparatus therefor. April 10.

COMPLETE SPECIFICATIONS ACCEPTED.

1890.

5239. J. Blum. Instantaneous production of water gas. April 8.

7714. C. B. Newton. Apparatus for automatically delivering any proportionate quantity of oxygen, air, or other gaseous bodies into gas purifiers or other vessels, pipes, or conduits, irrespective of any pressure in such gas purifiers, &c. April 15.

8274. P. Shuttleworth. Manufacture of fire kindlers. April 15.

8535. S. Pitt.—From L. J. Jerzmanowski. Process and apparatus for the manufacture of illuminating gas. April 22.

9199. J. Bowing. Manufacture of fuel from coal slack and similar substances, and obtaining tar products. March 25.

9320. T. Travers. Gas burners and apparatus for naphthalising gas. April 22.

12,639. R. Schimper. Manufacture of artificial fuel. March 25.

14,370. A. Dannenberg. Method of firing periodically and continuously worked chamber and annular furnaces. March 25.

14,832. J. H. W. Stringfellow. Treatment of liquid hydrocarbons. March 25.

17,159. T. G. Springer. Manufacture of gas. April 8.

1891.

971. B. H. Thwaite. Generating, heating, and lighting gases from liquids and solid hydrocarbons, and apparatus therefor. April 22.

1682. J. Bowing. Coking processes. April 8.

2021. P. F. Macullum.—From J. C. Reissig and J. Landin. Separating carbonic acid from other gases, especially in the production of lighting and heating gases free from carbonic oxide. March 25.

2452. I. André. Hydraulic mains for gas-making apparatus. April 22.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

APPLICATION.

6131. J. Laing. See Class II.

IV.—COLOURING MATTERS AND DYES.

APPLICATIONS.

1688. J. Y. Johnson.—From the Badische Anilin and Soda Fabrik, Germany. The manufacture and production of new mordant-dyeing colouring matters related to the rosaniline series. March 16.

1871. B. Willcox.—From The Farbenfabriken vormals F. Bayer and Co., Germany. Improvements in the manufacture of colouring matters derived from anthraquinone. March 18.

5103. R. Holliday and Sons, Limited, T. Holliday, and P. R. E. Seidler. Improvements in the manufacture of a sulpho acid of alpha naphthol and of colouring matters therefrom. March 21.

5104. R. Holliday and Sons, Limited, T. Holliday, and P. R. E. Seidler. Improvements in the manufacture of azo-colouring matters. March 21.

5122. B. Willcox.—From F. von Heyden, Nachfolger, Germany. Improvements in the manufacture or production of ortho-oxy-diphenylcarbon acid. March 21.

5184. J. Y. Johnson.—From F. von Heyden, Nachfolger, Germany. Process for the production of mono-bromo and di-bromo-para-oxy-benzoic acid, suitable for conversion into proto-catechuic acid, pyro-catechin, and the like. March 23.

5269. W. Majert. Improvements in the manufacture of aromatic glycocoll derivates. March 24.

5137. W. Sherwood. A new or improved composition of ink for reproduction of copies by the manifold process and the like. March 26.

5904. O. Imray.—From The Farbwerke vormals Meister, Lucius, and Brüning, Germany. Improvements in the production of black colouring matters. April 6.

5984. B. Willcox.—From The Farbenfabriken vormals F. Bayer and Co., Germany. Improvements in the manufacture or production of azo-colouring matters. April 7.

6268. J. Dawson and R. Hirsch. The manufacture of new raw materials for the production of colouring matters. April 13.

6376. Brooke, Simpson, and Spiller, Lim., and A. G. Green. The production of new bases and of azo-colouring matters therefrom. April 14.

COMPLETE SPECIFICATIONS ACCEPTED.

1890.

6875. J. Y. Johnson.—From The Badische Anilin and Soda Fabrik. Manufacture of sulpho acids of a red basic naphthalene colouring matter. April 8.

8506. O. Imray.—From The Farbwerke vormals Meister, Lucius, and Brüning. Production of a yellow colouring matter. April 8.

8530. B. Willcox.—From The Farbenfabriken vormals F. Bayer and Co. Production of azo colours upon fibres. April 8.

8725. B. Willcox.—From The Fabenfabriken vormals F. Bayer and Co. Manufacture of new derivatives of alizarin and its analogues. April 15.

9080. J. Dawson and R. Hirsch. Manufacture of phenol ether and oxydiphenyl, their homologues, and analogues. April 22.

9258. O. Imray.—From H. K. Marburg. Production of colouring matters. April 22.

9530. O. Imray.—From The Farbwerke vormals Meister, Lucius, and Brüning. Production of blue-green colouring matters. April 22.

9537. J. Y. Johnson.—From The Badische Anilin and Soda Fabrik. Manufacture of substantive dyestuffs, and new materials therefor. April 22.

10,047. O. Imray.—From the Society of Chemical Industry, Switzerland. Production of colouring matters. April 1.

1891.

3263. J. C. L. Durand, D. E. Huegnenin, and A. J. J. d'Andiran-Kocchlin. Manufacture of colouring matters derived from pyrogallic acid, and their application to dyeing and printing. April 22.

V.—TEXTILES, COTTON, WOOL, SILK, Etc.

APPLICATION.

5160. S. Stern. An improved composition, applicable to wool, shoddy, or mixed with cotton and other suitable material for spinning. March 23.

6294. J. Daw jun. An improvement in lycing mats, carpets or other fabrics of fibre, wool, yarn, silk, or any other material. April 13.

6663. A. George. Improvements in cleansing wool and similar materials. Complete Specification. Filed April 17. Date applied for October 31, 1890, being date of application in France.

6698. J. G. Smith.—From F. Doller, Germany. Improvements in the process of water-proofing textile materials. April 18.

Complete Specifications Accepted.

1890.

8520. P. A. Favier. Machines for decorticating ramie and other textile plants. April 8.

17,342. B. Tettweiler. Fabrics composed mainly of fibrous material. March 25.

1891.

2348. J. B. Barton. Process for the manufacture of granite linoleum. March 25.

2808. W. Barton. Utilising leather waste, and preparing therewith a material for covering floors, roofs, &c. March 25.

3447. T. Mitchell. Manufacture of linoleum and like floorcloths. April 1.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, and BLEACHING.

Applications.

4754. E. Bentz. A new or improved method of fixation of the chrome mordant employed in dyeing and calico printing. March 17.

4928. G. Young and W. Crippin. Improvements in arrangements and mechanism or apparatus for dyeing and bleaching and otherwise treating cotton, wool, silk, and other fibrous materials in the raw and manufactured or partly manufactured state. March 19.

5515. C. F. S. Rothwell. Improvements in the method of and apparatus for applying the liquor used for fixing basic aniline dyes, and other dyes fixed in a similar manner, on cotton piece goods and the like. March 31.

Complete Specifications Accepted.

1890.

7202. P. Cavailles. Process and apparatus for dyeing wool. April 1.

8183. J. M. Campbell. Process and apparatus for colouring, sizing, and otherwise treating paper, applicable for filling and treating woven fabrics. April 1.

8270. E. Sutcliffe and G. E. Sutcliffe. Apparatus for washing, dyeing, and treating textile materials. April 1.

8530. B. Willcox.—From The Farbenfabriken vormals F. Bayer and Co. *See* Class IV.

8799. A. North. Black piece dyeing for improving the colour of warp or weft in mixed fabrics of wool and cotton. April 15.

8809. W. L. Wise.—From Favre and Braun. Treatment of fabrics printed or dyed with several colours. March 25.

1891.

2533. H. Thies and F. Cleff. Dyeing or printing in aniline black or analogous colours. March 25.

2993. J. Leitz and W. Weise. Printing and shaping textile materials. April 15.

VII.—ACIDS, ALKALIS, and SALTS.

Applications.

4661. W. Mills. Improvements in the manufacture of alkali, and apparatus therefor. March 16.

4712. J. Pedder. Using a combination of sulphuric acid and hydrochloric acid for the decomposition of chlorides, sulphides, sulphates, and of sulphuretted hydrogen. March 17.

4730. C. Marriott. Improvements in apparatus used in the manufacture of sulphate of ammonia. March 17.

4820. G. T. Beilby. Process and apparatus for the manufacture of cyanides. March 18.

4878. J. M. Macdonald. A new and improved method of liquefying carbonic acid gas and storing the same in apparatus therefor. March 18.

5352. F. M. Lyte. Improvements in the production of alkaline carbonates, and chlorine and their derivatives. March 25.

5354. J. J. Hood and A. G. Salamon. Improvements in the manufacture of cyanogen compounds, and the treatment of substances used therein. March 25.

5519. M. W. Beylikgy, C. J. Everett, and C. A. Collins. Alkalino-magnesian silicate compound. Complete Specification. March 31.

5547. C. Kellner. Improvements in apparatus for electrolytic decomposition. Complete Specification. March 31.

5748. A. Moss and E. Newton. Economical production of carbonic acid gas. April 3.

5777. W. T. Bruce. Improvements in the manufacture of sulphuric acid and apparatus therefor. April 3.

5788. W. Feld. Improvements in the manufacture of sodium and potassium carbonates, sulphur, and sulphuric acid, and in apparatus therefor, applicable also to other purposes. April 3.

5801. M. Royon. An apparatus to produce sulphuretted hydrogen. April 4.

5819. D. Rowat and J. Fullerton. Improvements in and relating to the treatment of pickles, and apparatus therefor. April 4.

5844. A. G. Haddock and J. Leith. Improvements in or appertaining to the manufacture of alkali. April 4.

6388. P. J. B. Vincent. Improvements in the manufacture of salt in blocks or cakes. April 14.

6415. M. N. d'Andria. Improvements in utilising waste acid residues from the "pickling" of iron, and obtaining useful products therefrom, the said improvements being also applicable to the treatment of sulphate of iron and of chloride of iron. April 15.

6500. J. Kolb. Improvements in the production of chlorine. April 15.

6509. J. W. Wilson and C. H. G. Harvey. The manufacture of ferric chloride from waste pickle from galvanising works. April 16.

Complete Specifications Accepted.

1890.

6333. F. M. Lyte. Production of magnesic oxychloride. March 25.

7058. J. Y. Johnson.—From J. Marx and Dr. Weller. Process and apparatus for liquefying and storing chlorine. April 22.

7764. D. J. Playfair. Obtainment of cyanides and ferrocyanides. March 25.

1891.

2224. H. H. Lake.—From J. Massignon and E. Watel. Manufacture of chromates, bichromates, and other chromium compounds. April 8.

2812. J. N. Zeitler. Converting carbonate of lead, obtained by decomposition of sulphate of lead or other compound of lead, with carbonate of sodium into basic salt. April 15.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

Applications.

1657. L. Forester and H. J. Greatbatch. A composition for economy in placing glazed tiles or plaques, &c., majolica, and earthenware in kilns or ovens; also washing kilns. March 16.

5063. F. Quéry. Improvements in kilns for use in the manufacture of pottery, porcelain, and earthenware, and other similar goods. March 21.

5324. W. Walker. Improvements in the production of glass-making materials. March 25.

5566. R. Lindsay. *See* Class X.

5782. A. J. Boult.—From L. T. Karras and G. Hoffmann, Germany. Improvements in the manufacture of glass letters and the like. Complete Specification. April 3.

5787. C. H. Edwards. Improvements in the manufacture of gas retorts, drain pipes, and other like earthenware or clayware. April 3.

5807. J. Lauder and W. Thomson. Improvements in bath walling and flooring tiles. April 4.

6118. H. Warrington. Improvements in kilns or ovens for bricks, earthenware, porcelain, and similar material. Complete Specification. April 9.

6205. The Company Glastechnisches Laboratorium Schott and Genossen and Otto Schott. New method of manufacturing toughened glass wares (composite glass). April 11.

6257. W. C. Gibson. Improvements in kilns for biscuiting and burning glazed and enamelled clay goods. April 13.

6524. W. W. Pilkington. Improvements in kilns for annealing plate glass. April 16.

6525. W. W. Pilkington. Improvements in apparatus for rolling glass. April 16.

6691. W. W. Pilkington. Improvements in kilns for annealing plate glass. April 18.

Complete Specifications Accepted.

1890.

1356. A. J. Wilkinson. Ovens for firing pottery. March 25.

5970. H. M. Ashley. Manufacture of ceramic ware, and apparatus therefor. March 25.

7145. D. Rylands. Machinery for manufacture of bottles and other glass ware, and method of working same. April 15.

7822. D. Y. Cliff. Means for effecting correct designs in decorative tiles. March 25.

1891.

1704. H. Warrington. Ovens or kilns for burning bricks, tiles, or the like. March 25.

3365. H. H. Lake.—From E. Sochaczewski. Production of a plastic moulding material, and articles therefrom. April 1.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

Applications.

1672. E. Olson. Improvements in stucco for plastering. Complete Specification. March 16.

1738. W. Thompson. Improvements in calcining limestone. March 17.

1750. The Société Anonyme des Ardoisieres de Deville and V. van der Heyden. A new manufacture of material suitable for building, paving, and other purposes from waste pieces or débris of slate. March 17.

4990. J. V. Boyd-Wilson. Improved compositions for use in building constructions, fire-resisting constructions, and the like. March 20.

5599. J. C. Bloomfield. A new or improved material, applicable for ceilings, wall linings, cement slabs, and for other purposes. April 1.

5709. O. Clausen. Improvements in the manufacture of fireclay and magnesian bricks, and in kilns for firing same. April 2.

5719. A. J. Boult.—From L. Grote, Germany. Improved manufacture of artificial stone. Complete Specification. April 2.

5810. T. Hydes. Improvements in the manufacture of hydraulic cement, concrete, dry mortar, bricks, tiles, pipes, nd the like. April 4.

6011. J. Craven. Improvements in or connected with kilns for drying and burning bricks or other articles or materials. April 8.

6118. H. Warrington. *See* Class VIII.

6227. T. Potter. Improvements in fire-resisting floors. April 11.

6244. R. H. Hepburn. Improvements in roofs, walls, and other parts of buildings, and in slabs, sheets, or tiles for the same. April 11.

6389. R. A. Cheesebrough. Improvements in the preservation of wood and iron imbedded or buried in the earth. Complete Specification. April 14.

6532. J. Jackson. Improved manufacture or production of decorative material, more especially intended for application to walls, ceilings, or like surfaces. April 16.

6630. J. Griffiths. Improvements in street and other pavements. April 17.

Complete Specifications Accepted.

1890.

6952. C. Kellner. Coating iron, steel, or other metals with Portland or other cement. March 25.

8113. J. Hartnell. Manufacture of artificial stone. April 1.

8519. O. Prinz. Manufacture and treatment of cement. April 15.

8919. D. Wilson. Manufacture of cement, and apparatus therefor. April 15.

1891.

2865. H. F. Williams. Composition for paving, roofing, and building purposes. March 25.

2894. O. Claussen. New or improved paving. April 8.

3351. R. R. Coursen. Plaster slabs. April 8.

1672. E. Olson. Stucco for plastering. April 22.

X.—METALLURGY, MINING, Etc.

Applications.

4644. J. O. Arnold. Improvements in the processes of manufacture of steel ingots, steel castings, and ingot iron, and in apparatus and appliances employed therein. March 16.

4695. W. A. Baldwin. Improved process and apparatus for alloying metals. Complete Specification. March 16.

4696. J. C. Butterfield. Improvements in the treatment of tinned iron for the recovery of the tin and other products. March 16.

4713. H. Rensch and B. Preu. Improvements in or relating to the manufacture or casting of hard metal or chilled rolls. March 17.

4793. W. B. Middleton. Improvements in the treatment of steel. Complete Specification. March 17.

4955. I. A. F. Bang and M. C. A. Ruffin. Process for separating the tin from tin-plate waste, used preserve tins, and the like. March 19.

4972. J. A. Fletcher, S. Fletcher, and J. Fletcher. *See* Class I.

5107. H. Warrington. Improvements in fire grates for puddling, heating, and similar purposes. Complete Specification. March 21.

5128. A. Gutensohn. Improvements in the dry metallurgical treatment of sulphide ores such as galena. March 21.

5169. J. F. Duke, A. S. Bishop, and I. Symons. Improvements in the production of aluminium. March 23.

5170. J. F. Duke, A. S. Bishop, and I. Symons. Improvements in the production of aluminium bronze. March 23.

5171. J. F. Duke, A. S. Bishop, and I. Symons. An improved metallic alloy. March 23.

5242. W. R. Hinsdale. Process of casting ingots. Complete Specification. March 24.

5527. T. H. Mallaband. Improvements in melting furnaces. March 31.

5566. R. Lindsay. An improved furnace for heating branding irons and annealing metals and glass. March 31.

5642. W. Sowerby and E. Casper. Improvements in casting metals. April 1.

5822. G. A. Herdman. Improvements in treating waste products resulting from the smelting of ores and in producing a valuable product therefrom, or from analogous compounds, and improved apparatus in connexion therewith. April 4.

5851. W. Sowerby and E. Casper. Improvements in casting metals. April 6.

6013. R. Crosthwaite and J. B. Spence. Improvements in the manufacture of iron amalgams. April 8.

6080. J. D. Wilson. Improvements in cupolas. April 9.

6152. G. Jones. A new or improved fettling for puddling furnaces and steel-making furnaces. April 10.

6233. J. Lang and F. H. Wigham. A process for protecting iron and steel wire against corrosion. April 11.

6235. J. Lang and F. H. Wigham. A process for protecting iron and steel wire against corrosion. April 11.

6246. W. S. Lockhart and E. W. Streeter. An improved process and apparatus used therein for the separation of metals, precious stones, or other minerals from gangue or other matter mixed therewith. April 11.

6303. J. H. Darby. Improvements in the manufacture of steel. April 13.

6323. E. Taussig. Improvements in apparatus for smelting and casting. Complete Specification. April 13.

6479. W. T. Rickard. Improvements in the mechanical and chemico-metallurgical treatment of copper, the precious, and other metallic ores. April 15.

Complete Specifications Accepted.

1890.

2901. F. J. Jones. Making tubes, cylinders, and other hollow ware of copper, alloys, and aluminium. April 22.

6645. J. H. Lancaster and M. R. Couley. Manufacture of iron or steel. April 1.

7070. J. Heaton and G. H. Holden. Manufacture of steel and iron, and apparatus therefor. March 25.

7253. W. Hodge. Converting iron into steel, or steelifying wrought-iron objects. April 8.

8352. W. McDermott. Apparatus for concentrating and separating ores, &c. April 1.

8707. J. von Langer and L. Cooper. *See* Class I.

8884. J. W. MacFarlane. Extracting gold from auriferous ores by an improved method of amalgamation. April 15.

8922. T. Peters. Application of the iron residues which result from the reduction of organic nitro-compounds. April 15.

9182. C. R. Weston. Means and apparatus for extracting gold and other precious metals from their ores. April 22.

13,486. A. Schueller and A. Astfalic. Production of pure aluminium. April 1.

17,186. S. B. Evans. A gas ingot-heating furnace. April 8.

17,663. E. P. Martin and E. James. Method and means for preparing moulds for casting pig iron, and for breaking the pigs and separating them from the "sow." April 8.

18,066. Davies Bros. and Co., Lim., and M. Bayliss. Galvanising sheet metal. April 15.

19,180. J. C. Bayles. Method and apparatus for welding iron or steel sheets or plates. March 25.

1891.

251. W. R. Hinsdale. Process for forming ingots April 22.

XI.—ELECTRO-CHEMISTRY and ELECTRO-METALLURGY

Applications.

4757. T. L. Wilson. Improvements in the electric reduction of aluminium and other metals, and in the production of alloys thereof. March 17.

4781. W. J. Engledue. A new or improved solution or electrolytic fluid for galvanic batteries. March 17.

4860. H. Howard. Improvements in apparatus for heating and welding by the electric arc. March 18.

4869. H. H. Lake.—From L. A. W. Desruelles, France. Improvements relating to primary and secondary electric batteries, and to the manufacture of plates or electrodes for use therein. March 18.

4877. H. H. Lake.—From E. A. G. Street and L. A. W. Desruelles, France. Improvements relating to plates or electrodes for primary and secondary batteries, and to the production of compounds or agglomerates for the manufacture of such plates or electrodes. March 18.

4949. J. Y. Johnson.—From A. Tardy, France. Improvements in galvanic batteries. March 19.

5167. F. E. Elmore and A. S. Elmore. An improvement in the manufacture of tubes by electrolysis. March 23.

5637. R. W. Barker.—From M. G. Farmer, United States. Improvements in electric converters. April 1.

5638. W. A. Crowdus. Improvements in electric batteries. Complete Specification. Filed April 1. Date applied for October 7th, 1890, being date of application in United States.

5690. H. C. Bull. Improvements in and connected with electric batteries. April 2.

5948. H. I. Harris and W. H. Power. Improvements in electric batteries. April 6.

5953. W. A. Byron and E. George. Improvements in and relating to voltaic batteries. April 7.

5972. W. Sillery. Improvements in electric storage batteries. April 7.

5995. F. E. S. D'Odiardi. Improvements in liquid electrodes. April 7.

5996. F. E. S. D'Odiardi.—Improvements in magneto-voltaic and static electrodes. April 7.

5999. J. Greenwood. Improvements in and relating to the manufacture or production of chlorine and sodium amalgam. April 7.

6029. W. H. Walenn and I. A. Timmis. Improvements in electro depositing copper, brass, and bronze, parts of which improvements are also applicable to other purposes. April 8.

6030. W. H. Walenn and I. A. Timmis. Improvements to electro depositing copper, brass, or bronze. April 8.

6243. S. M. L. Patz and R. Grebner. Improvements in galvanic batteries. April 11.

6247. J. Y. Johnson.—From F. Gendron, France. Improvements in automatic regulating apparatus employed in connexion with galvanic batteries. April 11.

6502. J. von der Poppenburg. Improvements in galvanic batteries. April 15.

COMPLETE SPECIFICATIONS ACCEPTED.

1890.

6266. J. Marx. Means for use in electrolysis. April 1.

7513. W. L. Wise.—From P. Schoop. Manufacture of electrodes for secondary batteries. April 1.

8534. N. De Benardos and Lloyd. Secondary batteries. April 8.

9361. T. L. Willson. Electric reduction of metals, and apparatus therefor. April 22.

13,463. J. Mosely. Zincs for galvanic batteries. March 25.

18,180. Sir C. S. Forbes, Bart. Primary batteries, and apparatus connected therewith. April 22.

18,942. W. P. Thompson.—From F. Marx. Galvanic batteries. March 25.

20,986. H. H. Lake.—From H. Lemp. Apparatus for electrically welding and otherwise working metals. March 25.

1891.

1007. E. Ferraris. Apparatus for separating ores and metals by the aid of electricity. April 1.

1425. A. J. Boult.—From W. Roberts. Storage batteries. April 1.

3336. H. H. Lake.—From H. Lemp and L. M. Schmidt. Process and apparatus for welding metals by electricity. April 1.

3349. M. W. Dewey. Electric welding apparatus. April 22.

3589. H. H. Lake.—From W. R. H. Dowse. Electric batteries. April 15.

XII.—FATS, OILS, AND SOAP MANUFACTURE.

APPLICATIONS.

5405. E. Azémar. An improved compound to be used for removing grease of all kinds from wood and woollen cloth, washing all kinds of cloth, and cleaning household utensils and woodwork. March 26.

5870. J. E. A. Bokeland. Improved preparation for use as a substitute for linseed oil in the mixing of pigments. Complete Specification. April 6.

5951. R. F. Halleck. A new or improved washing preparation. April 7.

COMPLETE SPECIFICATIONS ACCEPTED.

1890.

7142. H. Stern. Decolourising mineral, animal, and vegetable oils, fats, and the like by means of silicic acid. March 25.

7696. F. N. Mackay. Appliances for cooling oil and like liquids. April 22.

XIII.—PAINTS, PIGMENTS VARNISHES, AND RESINS.

APPLICATIONS.

5396. R. J. Friswell. Improvements in the manufacture of lamp black and similar substances. March 26.

5501. W. Smith and W. Elmore. Improvements in the production of white lead or basic carbonate of lead from galena or sulphide of lead ore, or from suitable residual products or substances containing sulphide of lead. March 28.

5624. W. P. Thompson.—From A. Flugge. Improvements in and relating to the production of a solution of myrrhic resin. April 1.

5681. C. A. Burghardt. Improvements in pigments having a lead basis. April 2.

5977. J. Robson. Improvements in or appertaining to preservative coatings for iron or other structures. April 7.

6063. W. Jones. Improvements in the manufacture of blue for laundries, distempering, and other purposes. April 8.

6306. W. P. Thompson.—From A. Flugge, Germany. Improvements in and relating to the production of a solution of myrrhic resin. April 13.

6366. S. Springer. A protective compound. April 14.

6548. R. Wilson. Blues and greens,—colour pigments. April 15.

6683. R. J. White. Improvements in the manufacture of white lead. April 18.

COMPLETE SPECIFICATION ACCEPTED.

1890.

6805. W. P. Thompson.—From A. F. von Pereira. Improvements in paints, colours, varnishes, and distempers, and method of applying them. April 1.

XIV.—TANNING, LEATHER, GLUE, AND SIZE.

COMPLETE SPECIFICATIONS ACCEPTED.

1890.

19,216. C. L. Lawrence. Making leather boards, soles, &c. waterproof. April 8.

1891.

2808. W. Barton. *See* Class V.

XV.—AGRICULTURE AND MANURES.

APPLICATIONS.

5111. O. Jachne. Improvements in process for making superphosphatic manure. Complete Specification. March 21.

5357. H. H. Lake.—From A. Briart and P. Jacquemin, Belgium. An improved method for enriching calcareous phosphates, and for manufacturing superphosphates and various by-products. March 25.

XVI.—SUGARS, STARCHES, GUMS, ETC.

APPLICATIONS.

5191. A. Wohl and A. Kollrepp. Improvements in the production of invert sugar. March 24.

5236. A. Schneller and W. J. Wisse. Improvements in the refining or extraction of sugar from raw sugar solution, juice or molasses. March 24.

5683. R. Warwick. An improved prepared laundry starch, white and in various tints of colour, and for rendering textile fabrics less inflammable. April 2.

COMPLETE SPECIFICATION ACCEPTED.

1890.

5282. G. F. Redfern.—From M. Wienrich. Manufacture of sugar. April 1.

XVII.—BREWING, WINES, SPIRITS, Etc.

Applications.

4680. A. von Sigmond. A method of producing yeast and spirit from materials containing starch. March 16.

4744. E. H. Wagner. An improved temperance beverage or beer. March 17.

5004. J. Mitchell. Improvements in machinery or apparatus for drying distillers' or brewers' draff or dreg, but which is also applicable for drying other similar materials. Complete Specification. March 20.

5420. W. S. Squire. Obtaining lactic acid from distillers' spent wash. March 26.

5700. J. Takamine. Composition of matter for use as an artificial food and fertiliser of moyashi or ferment cells, and processes for producing Moyashi, Moto, Koji, and fermented alcoholic liquors. Complete Specification. April 2.

5853. W. Heasman. Improvements in or relating to means for the hot aëration of wort. April 6.

6317. M. Schwab. Improved method of and apparatus for regulating the egress of spent liquor from distillatory apparatus. Complete Specification. April 13.

6354. A. H. Allen and W. Chattaway. An improved method of maturing spirits. April 14.

6401. J. P. Cavallier. An improved method of ageing alcoholic liquors. April 14.

Complete Specifications Accepted.

1890.

6075. F. M. Maynard. The aëration of yeast for exciting alcoholic fermentations. March 25.

7098. A. J. Boult.—From La Société Generale de Maltose. Manufacture of maltose, or the fermentation of amylaceous matter. April 1.

7880. H. T. Brown, G. H. Morris, and E. R. Moritz. Preparing raw grain or other amylaceous substances for mashing. April 1.

1891.

2936. H. J. Haddan.—From J. Batalle. Improving wine and other alcoholic liquors. April 1.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, and DISINFECTANTS.

Applications.

A.—Chemistry of Foods.

4706. H. Gardner.—From E. Serrant, France. Improved method of preparing bread biscuits specially adapted for preservation, to be called "Biseronte" or condensed bread, and in moulds therefor. March 16.

4837. D. Tallerman. Improvements for the slaughter of animals and the preservation of perishable foods. March 18.

4967. C. G. Campbell. Destroying animal life in cheese, and preventing its recurrence. March 20.

5196. C. B. Lesser. Improved method of or process for the preparation of condensed milk. Complete Specification. March 24.

5380. J. B. Marshall. Improved means of preserving eggs. March 26.

6255. J. Dunn and W. Dunn. Improvements in the manufacture of cattle food. April 13.

6417. A. J. Boult. From J. J. Sheppard, France. Improvements in the treatment of cereals for food and other purposes, and in apparatus therefor. April 15.

B.—Sanitary Chemistry.

5330. E. E. Scruby. Improved process for purifying sewage effluents and other impure liquids, and apparatus therefor. March 25.

5358. S. Delepine and A. F. B. Gomess. A new method of and apparatus for the removal of smoke from chimneys for the purpose of preventing contamination of the air by the products of combustion, or of removing these products after they have become mixed with the air, so as to prevent the production of so-called yellow and black fogs; part of which apparatus is also applicable for collecting the carbon from gas and other lights. March 25.

5908. E. E. Dulier. A method of destroying smoke, and apparatus for that purpose. April 6.

6031. P. H. Williams. Improvements in method and means of and apparatus for deodorising or purifying and utilising sewage. April 8.

C.—Disinfectants.

4772. E. Serrant. A new compound for general healing and for disinfecting purposes, to be known as "Service acid." March 17.

5263. J. Y. Johnson.—From F. von Heyden, Germany. Improvements in the production of salicylic acid derivatives containing chlorine and sulphur. March 24.

Complete Specifications Accepted.

A.—Chemistry of Foods.

1890.

6102. W. S. Simpson. Means and appliances for preserving flesh food. April 1.

B.—Sanitary Chemistry.

1890.

6660. M. M. Brophy. Furnaces for destroying organic substances. March 25.

XIX.—PAPER, PASTEBOARD, Etc.

Applications.

5240. J. Valeton. New or improved anti-nicotine cigarette paper. March 24.

5310. R. Aitken. Improvements in the treatment of paper or other substances for fixing or protecting water-colour drawings or printings or the like thereon, and also for rendering paper or other substances impervious to water. March 25.

6423. W. Andrew. Improvements in boilers or digesters used in the manufacture of paper pulp. April 15.

6589. C. Lenz. Improved manufacture of paper and cardboard. April 16.

Complete Specifications Accepted.

1890.

6644. J. Johnston and G. Johnston. Treatment of paper-making fibre materials. April 22.

1891.

2349. J. C. Juel and E. Ryan. Purifying wood pulp, and apparatus therefor. April 1.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES, AND EXTRACTS.

Applications.

5222. A. Schneller and W. J. Wisse. Improvements in the formation of ozone in presence of air or oxygen, and apparatus therefor. March 24.

5425. A. M. Clark.—From The Verein fur Chemische Industrie, through their agents, Wirth and Co., Germany. An improved method for the production of acetic anhydride and other anhydrides of the fatty acid series. March 26.

5981 J. Le Roy Webber. Improved manufacture of pepsine. Complete Specification. April 7.

6234. O. Imray.—From The Farbwerke vormals Meister, Lucius, and Bruning, Germany. Production of basic gallate of bismuth. April 11.

Complete Specifications Accepted.

1890.

8454. T. H. Williams and W. H. Simons. Production and application of a solution of calcium phosphate in carbonic acid water for use in pharmacy. April 22.

15,687. F. Valentiner. Manufacture of artificial musk. April 8.

1891.

115. G. Link and R. Avenarius. Manufacture of artificial perfumes. April 1.

XXI.—PHOTOGRAPHIC PROCESSES AND MATERIALS.

Applications.

5298. T. D. Ashplant. Application of talc or mica as a substitute for glass, celluloid, paper films, and other things now in use for photographic purposes, dry plates, transparencies, and lantern slides. March 25.

5833. J. Y. Johnson.—From P. Mercier, France. Improvements in the manufacture or production of sensitive paper for photographic purposes. April 4

6172. G. T. Teasdale-Buckell. Improvements in the production by the aid of photography of surfaces for printing in colours, and in the means and apparatus employed therein. April 10.

6340. G. T. Teasdale-Buckell. Improvements in the production, by the aid of photography, of surfaces for use in printing in colours, and in means or apparatus employed therein. April 14.

6431. G. T. Teasdale-Buckell. Improvements in the production, by the aid of photography, of surfaces for use in printing in colours, and in means employed therin. April 14.

Complete Specifications Accepted.

1890.

5742. E. Fairweather. Developing photographic plates or other substances carrying a sensitive film. April 1.

7453. A. G. Green, C. F. Cross, and E. J. Bevan. Process for photographing by means of organic compounds. April 15.

9538. W. Rebikow. Manufacture of emulsions and other materials sensitive to light. April 15.

XXII.—EXPLOSIVES, MATCHES, Etc.

Applications.

1797. H. Maxim. Improvements relating to the manufacture of nitro-substitution compounds of cellulose, and to apparatus therefor. March 17.

5010. H. Maxim. Improvements relating to the manufacture of nitro-substitution compounds of cellulose, and to apparatus therefor. March 20.

5027. E. von Brauk. New or improved explosive compositions. March 20.

5657. H. Maxim. Improvements relating to the restoration or strengthening and utilisation of the weakened or spent acids from the manufacture of pyroxyline or gun-cotton and nitroglycerin, and to apparatus therefor. April 1.

5821. C. H. Curtis and G. G. André. Improvements in explosives. April 4.

5843. A. Mosehek and A. Brunner. An improved smokeless blasting compound. Complete Specification. April 4.

6128. J. Y. Johnson.—From The Dynamite Actiengesellschaft Nobel, Austria. Improvements in the manufacture or production of gunpowder or like explosives. April 9.

6129. J. Y. Johnson.—From The Dynamite Actiengesellschaft Nobel, Austria. Improvements in the manufacture or production of gunpowder or like explosives. April 9.

Complete Specifications Accepted.

1890.

5376. H. de Chardonnet. Processes and apparatus for the nitration and denitration of cellulose, and for regaining the acids employed. April 8.

6614. W. Hurst. Manufacture of wax matches, vestas, and tapers. April 1.

8814. H. Kolf. Manufacture of gunpowder. April 15.

19,125. W. M. Nix. Manufacture of friction matches. April 15.

1891.

2970. W. P. Thompson.—From La Société Coignet et Cie. Manufacture of phosphorus in sticks or blocks. April 22.

3679. G. A Rosenkolter. Improved lucifer matches. April 1.

XXIII.—ANALYTICAL CHEMISTRY.

Application.

5175. S. C. Hauberg. *See* Class I.

Printed and Published by Eyre and Spottiswoode, Last Harding Street, London, E.C., for the Society of Chemical Industry.

THE JOURNAL

OF THE

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NOTICES.

In accordance with the provisions of Rule 18 of the Bye-laws, notice is hereby given that those Members of Council whose names are placed in italics in the annexed list will retire from their respective offices at the forthcoming Annual General Meeting.

Professor J. Emerson Reynolds, F.R.S., has been nominated to the office of President; and Mr. E. Rider Cook has been nominated Vice-President under Rule 11.

Dr. John Evans, F.R.S., Mr. A. Norman Tate, and Sir John Turney, have been nominated Vice-Presidents under Rule 8.

The Treasurer and Foreign Secretary have been nominated for re-election.

Members are hereby invited to nominate fit and proper persons to fill four vacancies among the Ordinary Members of Council under Rule 18. Special nomination forms for this purpose can be obtained from the General Secretary upon application.

Extract from Rule 18.—"No such nomination shall be valid unless it be signed by at least ten Members of the Society who are not in arrear with their subscriptions, nor unless it be received by the General Secretary, at the Society's Office, at least one month before the date of the commencement of the Annual General Meeting, to the election to take place at which it refers. Nor shall any such nomination be valid if the person nominated be ineligible for election under Rules 12 or 15. No member shall sign more than one nomination form."

Annual General Meeting.

Notice is hereby given that the next Annual General Meeting will be held in Dublin on Wednesday, Thursday, and Friday, the 8th, 9th, and 10th of July next. Detailed arrangements and the programme of proceedings appear in this issue. Tickets of membership will be issued in time for the meeting, and will form, as heretofore, vouchers for visits to works and excursions.

Post Office Orders should be made payable at the General Post Office, London, to the Honorary Treasurer, E. Rider Cook, and should be forwarded to him at Bow, unless it be desired to notify a change of address.

Members who require extra sets or back numbers of the Journal are requested to make application to the General Secretary only, to whom also changes of address should be communicated.

Authors of communications read before the Society, or any of its Local Sections, are requested to take notice that under Rule 41 of the bye-laws, the Society has the right of priority of publication for three months of all such papers. Infringement of this bye-law renders papers liable to be rejected by the Publication Committee, or ordered to be abstracted for the Journal, in which case no reprints can be furnished to the author.

Notice is hereby given, for the information of members and advertisers, that the advertisement columns of this Journal have been contracted for by Messrs. Eyre and Spottiswoode, the Society's printers and publishers, to whom all communications respecting them should be addressed.

The Secretary is instructed to negotiate for the purchase of copies of the Society's Journal for January and May 1883, and January, February, and April 1886. Members possessing odd copies of these numbers are particularly requested to communicate at once, stating price required, with Mr. Cresswell. The stock of all other numbers is at present sufficient for the Council's requirements.

LIST OF MEMBERS ELECTED, 22nd MAY, 1891.

Beck, H., 22, Bush Lane, London, E.C., chemical agent.

Brown, Cæsar R., Anglo-Continental Guano Works, Victoria Docks, E., foreman.

Caldecott, Wm. A., Eureka City, Barberton, S.A.R., assayer.

Cameron, Jas., c/o Nobel's Explosives Co., Lim., Polmont Station, N.B., chemist.

Cook, Jas. Williams, 30, Bury Street, St. Mary Axe, E.C., dyer.

Denison, Joseph R., 1, Park View Terrace, Manningham, Bradford, Yorks, analyst.

Doran, Robt. E., 1, Goldsmith Terrace, Bray, co. Wicklow, analyst.

Eager, Wm., Fermoy, co. Cork, Ireland, mineral water manufacturer.

Hatschek, Moritz P., 18, Featherstone Buildings, Holborn, W.C., chemical engineer.

Hirsch, Dr. Robt., 17, Zetland Street, Huddersfield, chemical works manager.

Meldrum, Jas. Jones, Atlantic Works, City Road, Manchester, engineer.

Osborne, Jas., c/o Rio Tinto Co., Lim., 30, St. Swithin's Lane, E.C., general technical manager.

Watson, Harry F., Erie, Pa., U.S.A., chemical and paper manufacturer.

Wollheim, Hugo, 21, Ridgway Place, Wimbledon, Surrey, research chemist.

Wonfor, Wm. Jos., Lake View, Bessbrook, co. Armagh, bleacher

CHANGES OF ADDRESS.

Bell, Jno., Journals to Lockner Holt, Chilworth, Surrey.

Bradburn, J. A., l/o Warren Street; Solvay Process Co., Syracuse, N.Y., U.S.A.

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Charlton, Jas., l/o New Chambers Street; 118, Warren Street, New York City, U.S.A.

Claus, C. F., jun, l/o Mumbles; Heatheliff, Heathfield, Swansea.

Cliff, Cromwell, l/o Leeds; 30, Trentham Street, Runcorn.

Collins, J. H., l/o Dulwich; 13—14, Basinghall Street, E.C.

Colquhoun, D., Journals to Maulesbank, Carnoustie, N.B.

Cooper, Walter J., l/o Mitcheldean; c/o South Wales Cement Co., Penarth, Cardiff.

Deering, W. H., l/o Woolwich; 13, Hervey Street, Kidbrook Park Road, Blackheath, S.E.

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Field, Walter D., l/o Shorthills; Wyoming, N.J., U.S.A.

Fletcher, F. W., l/o Holloway; Beauchamp Lodge, Enfield.

Fogg, Jas., l/o Trinidad; 6, Steel Street, Glasgow.

Hodgkinson, Dr. W. R., l/o Vanbrugh Park; 8, Park Villas, Blackheath, S.E.

Howarth, R. S., l/o Stockport; Chemical Works, Miles Platting, Manchester.

Hutchinson, T. J., l/o Elton; Aden House, Manchester Road, Bury.

Imperial Institute, The, l/o Adelphi; Imperial Institute Road, London, S.W.

Jarvis, J. W., l/o Leicester; Rowley Park, Stafford.

Kingdon, Jas. C., l/o Bordeaux; 1, Myecne Road, Westcombe Park, S.E.

Kitamura, Y., l/o London; c/o R. Fujihamaya, Yokoyamacho, Sanchome, Tokio, Japan.

Lowe, H. A., l/o Stockport; Halliwell Works, Bolton-le-Moors.

Mayer, N. B., l/o Philadelphia; Uhland Strasse, 14, Tubingen, Germany.

Moore, R. T., l/o Hope Street; 156, St. Vincent Street, Glasgow.

Neil, Jas., Journals to 1, Maxwellton Place, Paisley Road, Glasgow.

Ogden, J. M., l/o Ellscope House; 49, West Sunniside, Sunderland.

Orr, Alex., l/o Irvine; 19, Albion Crescent, Dowanhill, Glasgow.

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Ramsay, Wm., l/o Kirkdale; 15, Lime Grove, Seaforth, near Liverpool.

Sanderson, T. C., l/o Oporto; 28, Aberdeen Road, Highbury, N.

Scott, W. T., l/o Hornsey Rise; retain Journals until further notice.

Strype, W. G., l/o College Street; 115, Grafton Street, Dublin.

Swinburne, G. (subs.), Suffolk House, Lawrence Pountney Hill, E.C.; Journals as before.

Watson, Erie E., l/o Birkenhead; 11, Dale Street, Liverpool.

Witt, Dr. Otto N., l/o Charlottenburg; Lindenallée 33, Westend, bei Berlin.

Wyatt, Dr. F., l/o 24; 12, Park Place, New York City, U.S.A.

Wynne, W. P., l/o Elthiron Road; 7, Tyneside Terrace, Parson's Green, Fulham, S.W.

CHANGES OF ADDRESS REQUIRED.

Hislop, Lawrence, l/o Saltney, near Chester.

Pattinson, H. L., jun., l/o Felling-on-Tyne.

Rigg, Richard, l/o Fishing Cottage, St. Helens.

ERRATUM IN LIST OF MEMBERS.

"Knabe, F.," should be "Raabe, F.," 329, Ashton New Road, Clayton, Manchester.

Deaths.

Dyson, Geo., Hurworth-on-Tees. March 9th.

Macintosh, Dr. J. B., Consolidated Gas Co., 21st Street, New York, U.S.A.

Parnell, E. W., Dee Hills, Chester.

London Section.

Chemical Society's Rooms, Burlington House.

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S. Hall.	W. S. Squire.
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D. Howard.	T. E. Thorpe.
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R. Messel.	

Hon. Local Sec. and Treasurer:
T. W. B. Mumford, 1, Glendale Villas, Sylvan Road, Wanstead, E.

The names in italics are those of members of Committee who retire at the end of the current Session.

The following have been elected to fill the vacancies, and will take office in July next:—*Committee:* C. F. Cross, J. Heron, W. Kellner, G. N. Stoker, and F. Napier Sutton.

SESSION 1890—91.

June 1st:—
Dr. S. Rideal and Mr. W. E. Voule.—"Gum Arabic and its modern Substitutes."
Mr. J. W. Lovibond.—"The Quantitative Analysis of Light and Colour, founded on the Tintometer Colour Scales."

Meeting held Monday, April 6th, 1891.

MR. THOS. TYRER IN THE CHAIR.

THE ANALYSIS OF ILLUMINATING GASES.

BY VIVIAN B. LEWES.

During the past year I had occasion to make many analyses of coal-gas and water-gas carburetted with the hydrocarbons obtained by cracking various grades of petroleum oil, and at the outset of the work found so many difficulties that I conceived my experiences and the conclusions I arrived at may prove of practical utility to others employed on work of similar character.

The beautiful methods devised and perfected by Bunsen are undoubtedly far too tedious to allow of their being used for practical purposes, whilst many of the newer processes and forms of apparatus which have been introduced in order to supply the needs of commercial analysis are so fraught with error that the results obtained are more likely to create confusion than to serve any useful end. Careful consideration of the forms of gas analysis apparatus in general use led me to the adoption of the form devised by Mr. J. E. Stead, which seems to me to combine ease of manipulation with reasonable accuracy in the results obtained, if only rational methods of procedure be observed in its use.

This form of apparatus is so well known amongst commercial analysts that a description of its form and the method of using it is unnecessary, the main principle being a combined eudiometer and measuring tube, in which mercury is employed as the "trapping fluid," the column of mercury being balanced by a second column, whilst the gas under analysis is passed into separate laboratory vessels in order to undergo absorption by the various liquids used, and is then passed back for measurement or for combustion by explosion into the eudiometer tube.

In the first analyses I made with this apparatus I was struck by the insufficiency of detail to be found in the various works on gas analysis, and also found that very wide discrepancies existed in the results obtained on making several analyses of the same gas, whilst other troubles, such as the almost impossibility of preventing traces of the absorbents coming in contact with the mercury used and

so rendering it impure, became a serious trouble in rapid working. Taking an ordinary illuminating gas or carburetted water-gas, the important constituents to be determined are hydrogen, hydrocarbons, carbon monoxide, carbon dioxide, nitrogen, and oxygen, whilst under certain conditions it is important to know the percentages of acetylene, sulphuretted hydrogen, and carbon disulphide present. The ordinary directions given in such standard works as the "Select Methods"* are to first absorb sulphuretted hydrogen and carbon dioxide, then carbon monoxide, estimate ethylene by Nordhausen acid, and determine hydrogen, methane, and nitrogen by explosion, absorption, and difference. A far better process is given by Winkler in his "Handbook of Technical Gas Analysis,"† in which carbon dioxide is first determined by absorption with potassic hydrate, then the ethylene, propylene, butylene, &c. by bromine water, benzene by fuming nitric acid, oxygen by alkaline pyrogallate, carbon monoxide by cuprous chloride, and the hydrogen methane and nitrogen by explosion, absorption, and difference.

These two forms of analysis may be fairly taken as the types on which the analytical schemes given in all the text books are based, the chief variations being in introducing combustion of hydrogen by palladium asbestos or estimation of the residual gases after the absorptions, by explosion and calculation from contraction and carbon dioxide formed. None of these processes gave anything approaching concordant results in my experiments, and although with an ordinary coal-gas I was able to get two analyses of the same sample within a few per cent. of each other, carburetted water-gas gave such widely different results that it was evident that something was radically wrong. A consideration of the methods given above, and the results of the analyses soon showed that even with ordinary coal-gas the first method was absolutely useless, as the cuprous chloride used to absorb carbon monoxide was nearly as good an absorbent for unsaturated hydrocarbons and oxygen as the liquids usually employed for their determination, and that this was the case whether it be used in acid or ammoniacal solution; whilst a still more serious cause of error applies to all methods of analysis which I have seen suggested. All researches on the composition of coal-gas point to the presence of ethane, and probably of higher members of the marsh gas series; whilst in carburetted gases they are undoubtedly present to a far greater extent.

Ethane, propane, and butane have all been shown to be present in small quantities; and as ethane gives double, propane, three times, and butane four times its own volume of carbon dioxide, it is evident that exploding with oxygen and taking the volume of carbon dioxide as representing marsh-gas, will undoubtedly give too high results with ordinary coal gas, while with a carburetted gas it will render the whole analysis useless. Moreover, the free oxygen is next absorbed, and the remainder taken as nitrogen, whilst the hydrogen in the gas is determined by difference. The result is that the hydrogen is always far too low, not only because the volume of marsh-gas is too high, but because the residual nitrogen, having to bear the brunt of all the errors of analysis throughout some seven or eight absorptions, is also always too high. These palpable errors in the quantity of marsh gas and hydrogen also render worthless the calculations of the carbon and hydrogen density of the gas, on which great stress has been laid, as showing the composition of the hydrocarbons present.

In order to eliminate as far as possible these serious sources of error, I made a series of experiments with a view of determining the best order in which to use the various absorptive liquids, and also to find how far an absorbent could be found for the ethane, propane, and butane.

Preliminary experiments showed that these latter were taken up by alcohol, olive oil, or paraffin, the alcohol having the disadvantage, however, of giving off vapours, which had to be carefully removed, whilst the olive oil, from its greasiness, was inconvenient. Moreover, the paraffin, when properly prepared, is by far the best and quickest absorbent of the three, and has not these disadvantages.

In order to make the experiments as definite as possible solutions of known strength were employed, the following being found to be the most advantageous:—

Sodic hydrate.....	20 per cent. solution.
Alkaline pyrogallate..	10 grms. of pyrogallic acid in 150 cc. of 20 per cent. solution of sodic hydrate.
Bromine in potassic bromide.	Saturated solution of potassic bromide saturated with bromine and then diluted to twice its original volume.
Fuming nitric acid ...	Sp. gr. 1·56.
Nordhausen sulphuric acid.	Containing as much SO_3 as will dissolve in it at ordinary temperatures (15° C.).
Acid cuprous chloride.	Saturated solution.
Ammoniacal cuprous chloride.	The cuprous chloride precipitated by water from 200 cc. of the saturated acid solution is, after washing, dissolved in 150 cc. of water containing 10 grms. of ammonic chloride and 50 cc. of 0·880 sp. gr. ammonic hydrate.
Paraffin.....	A clear bright sample of Russian "Lustre" oil is heated over a water-bath for an hour to drive off any traces of oils volatile below that temperature.
Alcohol.....	90 per cent.

The gases for the experiments were obtained as nearly pure as was compatible with ordinary manipulative precautions and methods of purification, and the percentage of gas, as well as nature and percentage of impurities ascertained, the absorption figures given in the tables being in each case the amount of pure gas taken up.

The methane used was prepared from methyl iodide and alcohol with the zinc-copper couple, and was purified by passing through U-tubes containing copper zinc moistened with alcohol and concentrated sulphuric acid respectively.

Ethane was prepared from ethyl iodide and alcohol under the same conditions, whilst the ethylene was prepared by the action of heated sulphuric acid on alcohol, the gas being afterwards passed through caustic soda in order to absorb any acid fumes.

The carbon monoxide was made from potassic ferrocyanide and sulphuric acid with the usual precautions, and the oxygen from potassic chlorate. Water was used as the trapping fluid in all the experiments.

In each determination the gas was, after measuring in the eudiometer, run into the laboratory vessel and allowed to stand for 10 and 20 minutes respectively quietly over the absorbing fluid, the amount taken up being measured at the end of each period, whilst in a second experiment the absorbent liquid was kept agitated for the same length of time in contact with the gas. The results obtained were as follows:—

ETHYLENE.

Absorbent.	Still.		Agitated.	
	10 Min.	20 Min.	10 Min.	20 Min.
Nordhausen acid	6·2	7·8	97·0	100·0
Fuming nitric acid	9·4	9·87	93·5	93·5
Bromine in potassic bromide....	99·2	100·0	100·0	100·0
Alcohol.....	17·0	56·7	75·0	75·0
Paraffin	53·1	62·5	87·5	87·5
Acid cuprous chloride.....	44·6	55·5	94·4	100·0
Alkaline pyrogallate	Nil	Nil	Nil	Nil
Sodic hydrate.....	Nil	Nil	Nil	Nil
Ammoniacal cuprous chloride...	37·5	50·0	93·7	93·7

* Select Methods in Chemical Analysis, Second Edition, p. 641.

† Handbook of Technical Gas Analysis, C. Winkler (Lunge's translation), p. 59.

Absorbent.	Still.		Agitated.	
	10 Min.	20 Min.	10 Min.	20 Min.
Ethane.				
Alcohol	46·4	60·7	89·2	89·2
Paraffin	82·1	89·2	100·0	100·0
Olive oil	10·7	17·8	92·9	96·4
Bromine in potassic bromide	Nil	Nil	Nil	Nil
Fuming nitric acid	Nil	Nil	6·4	53·6
Nordhäusen acid	Nil	Nil	Nil	Nil
Acid cuprous chloride	Nil	Nil	Nil	Nil
Ammoniacal cuprous chloride	Nil	Nil	Nil	Nil
Alkaline pyrogallate	Nil	Nil	Nil	Nil
Sodic hydrate	Nil	Nil	Nil	Nil
Methane.				
Alcohol	11·2	16·9	43·9	57·8
Paraffin	19·6	36·9	64·2	66·7
Olive oil	2·5	2·5	11·5	25·5
Bromine in potassic bromide	Nil	Nil	Nil	Nil
Fuming nitric acid	Nil	Nil	5·78	11·5
Nordhäusen acid	Nil	Nil	Nil	Nil
Acid cuprous chloride	Nil	Nil	Nil	Nil
Ammoniacal cuprous chloride	Nil	Nil	Nil	Nil
Alkaline pyrogallate	Nil	Nil	Nil	Nil
Sodic hydrate	Nil	Nil	Nil	Nil
Carbon Monoxide.				
Acid cuprous chloride	83·1	90·0	98·8	100·0
Ammoniacal cuprous chloride	35·5	57·7	97·7	100·0
Nordhäusen acid	Nil	Nil	Nil	Nil
Bromine in potassic bromide	Nil	Nil	Nil	Nil
Fuming nitric acid	Nil	Nil	4·8	6·8
Alkaline pyrogallate	Nil	Nil	Nil	Nil
Sodic hydrate	Nil	Nil	Nil	Nil
Paraffin	Nil	Nil	Nil	Nil
Alcohol	Nil	Nil	Nil	Nil
Oxygen.				
Alkaline pyrogallate	84·2	88·4	92·6	100·0
Acid cuprous chloride	25·2	50·5	71·5	88·4
Nordhäusen acid	Nil	Nil	Nil	Nil
Bromine in potassic bromide	Nil	Nil	Nil	Nil
Fuming nitric acid	Nil	Nil	Nil	Nil

These experiments show that none of the absorbents used could be employed to separate ethane or other members of the paraffin series from the methane, as the latter gas is freely soluble in all of them, but further experiments showed that in mixtures of ethane and methane contact with paraffin with occasional agitation for from 20 to 30 minutes, removed all ethane and a large proportion of the methane, the remainder of which could be determined by explosion and estimation of the carbon dioxide formed, the volume absorbed by the paraffin plus the volume of carbon dioxide formed on explosion giving the total volume of saturated hydrocarbons.

Experiments with the unsaturated hydrocarbons also showed that it is not possible by any of the absorbents at present in use to effect a separation—the idea that the ethylene, &c. can be absorbed by bromine and then benzene by fuming nitric acid, being purely fallacious—any absorption by the nitric acid under these conditions only meaning that some of the mixed unsaturated hydrocarbons had escaped absorption by the small amount of bromine in the bromine water, or else that the fuming nitric acid was attacking the ethane and methane present, which it does on agitation. It is evident from this that the use of 1·56 sp. gr. nitric acid is inadmissible, whilst the use of a solution of bromine in potassic bromide gives undoubtedly the best results, being extremely rapid in its absorption and not attacking any of the other gases likely to be found. These experiments also clearly fix the order in which the absorptions must be made, but only give a general indication of the time necessary to complete the estimation of small quantities of any particular gas in the presence of a large volume of diluents.

This I have attempted to determine by making and analysing mixtures containing known volumes of the various gases, and the general scheme of analysis which has given me the best results is as follows:—

Two carefully calibrated* Stead's apparatuses are taken, one containing mercury as the trapping fluid, the other water, over which all the ordinary absorption analysis may be made, the mercury apparatus being kept for explosion and subsequent estimation of carbon dioxide.

1. Carbon dioxide and sulphuretted hydrogen are first absorbed by the 50 per cent. sodic hydrate solution, 10 minutes' agitation being sufficient to complete the absorption. If a highly purified illuminating gas with less than 1 per cent. of carbon dioxide and no sulphuretted hydrogen is being analysed, this determination may be done over water, but with an experimental carburetted gas which may contain much more, the mercury apparatus must be used.

2. The oxygen is next absorbed by alkaline pyrogallate, 20 minutes being as a rule needed to complete the absorption.

In using the pyrogallate, the solution must not be too freshly made, nor must it have been used more than three or four times, as after a certain proportion of oxygen has been absorbed it begins to give off carbon monoxide. On making up the solution it should be allowed to stand all night before using, and five absorptions are the most for which it should be used.

3. The unsaturated hydrocarbons are now estimated by absorbing with the solution of bromine in potassic bromide, and the action is completed in 15 minutes with gentle agitation.

Bromine vapour is absorbed before measurement by agitation with sodic hydrate.

4. Carbon monoxide is next absorbed by acid cuprous chloride, and the estimation of this gas is the least satisfactory of any, as it is almost impossible to get the last traces of it absorbed. The cuprous chloride must not be used more than twice with gases containing 20 per cent. or upwards of the monoxide, nor more than four times with an ordinary coal-gas. As much as can be absorbed will be taken up in 20 to 30 minutes with agitation.

5. The saturated hydrocarbons are now partly absorbed by paraffin oil, 30 minutes being required to ensure complete removal of the last traces of ethane, butane, &c., and a portion of the remaining gas is now run into the mercury eudiometer, measured, mixed with excess of oxygen, and exploded, the carbon dioxide formed being then absorbed over sodic hydrate, giving the volume of methane unabsorbed by the paraffin. In exploding, attention should be paid to

* This is a most important point to attend to as the tubes are often very unequal, especially near the top, the first five divisions sometimes not being equal to more than three of the lower ones.

the taps of the apparatus, which should be secured by an india-rubber band, as the shock sometimes loosens the cock and causes a leakage.

It is usual in exploding to either dilute or else to attenuate the mixture by reducing the pressure before passing the spark in order to prevent the force of the explosion being too great for the eudiometer. If, however, this is carried too far incomplete combustion takes place and a certain proportion of the hydrogen and marsh-gas escape being burnt, and one great advantage of absorbing the higher members of the paraffin series before explosion is, that a very slight reduction of pressure makes the explosion perfectly safe and yet ensures complete combustion, whilst the necessity of using a large excess of oxygen being done away with, there is not so much tendency for any of the nitrogen to unite with it.

6. Having now determined the gases soluble in sodic hydrate, the oxygen, unsaturated hydrocarbons, carbon monoxide, and saturated hydrocarbons, it would be quite allowable to absorb excess of oxygen by alkaline pyrogallate and take the residual gas as nitrogen, calculating the hydrogen by difference. It must, however, be borne in mind that in each operation some small error has crept in, and the total of these having to be borne by the residual gas brings out the nitrogen far too high, and it is no unusual thing to see two or three per cent. of nitrogen returned in the analysis of an illuminating gas which in all probability does not contain a quarter that amount.

In order to as far as possible eliminate this error, I now start with a fresh measured volume of the gas, mix it with a large excess of oxygen, and explode over mercury, and then treat the residual gas with strongly alkaline pyrogallate for 20 minutes, keeping it well agitated in contact with the gas. This absorbs both carbon dioxide and excess of oxygen, and an accurate determination of the nitrogen is obtained. The analysis has so far given:—

1. Carbon dioxide and sulphuretted hydrogen.
2. Oxygen.
3. Unsaturated hydrocarbons.
4. Carbon monoxide.
5. Saturated hydrocarbons.
6. Nitrogen.
7. Hydrogen (by difference).

And with ordinary manipulative skill in transferring the gases from the eudiometer to the absorption vessels and back again, the results will be fairly accurate, the carbon monoxide, however, being probably from 0·5 to 1·0 per cent. too low, and in consequence the saturated hydrocarbons the same amount too high.

The following example of a test experiment may be taken as a fair average illustration of the results obtained:—

	Gas taken.	Found.	Time of Absorption.
			Minutes.
Ethylene	17·5	17·3	15
Carbon monoxide	30·5	29·7	25
Ethane	17·2	52·8	Paraffin absorption = 30 mins.
Methane	34·8		
	100·0	100·0	

In order to complete the analysis with an ordinary coal-gas, and to trace the action going on in many forms of carburetting apparatus, it is necessary to be able to estimate the acetylene, sulphuretted hydrogen, and other sulphur compounds which are likely to be present in minute traces and which cannot be determined by any volumetric method of the above character.

In order to do this it is necessary to pass a large volume of the gas to be tested at a very slow rate of flow through various absorbents, and the method which I have found to yield the best results is one proposed by Winkler. The gas is measured by either passing through a delicate meter, or else is measured in aspirating bottles, and is made to pass through two Volhard's absorbing bottles containing 20 cc. of concentrated ammoniacal silver nitrate solution. This absorbs the acetylene with formation and precipitation of silver acetylide, and also absorbs the sulphuretted hydrogen with precipitation of silver sulphide, two absorbing vessels being quite sufficient to prevent any traces of these gases escaping absorption. The contents of the two bottles are filtered and carefully washed with water, and the precipitate of silver sulphide and acetylide is then treated on the filter very cautiously with dilute hydrochloric acid until all action ceases. Acetylene is given off and the precipitate then consists of a mixture of chloride and sulphide of silver. This after washing is digested with dilute ammonia and the ammoniacal solution after filtration is then treated with nitric acid to precipitate the chloride, which is then weighed in the usual manner, 1 grm. of silver chloride corresponding to 0·09068 grm. or 78·0314 cc. of acetylene. Winkler claims that the portion of the precipitate left unacted upon by the dilute hydrochloric acid and undissolved by the ammonia is sulphide of silver, and contains no metallic silver, so that the precipitate can be converted into silver by ignition in a current of hydrogen and the sulphuretted hydrogen calculated from the weight obtained. In my experience, however, this is not so, as all illuminating gases contain carbon monoxide which undoubtedly exercises a strong reducing action upon the silver solution, the rate of reduction depending upon the percentage of carbon monoxide.

In order to conclusively settle this point I made a mixture of the character of ordinary coal-gas and added known volumes of carbon monoxide, and tested these for reducing power by causing them to bubble slowly through the absorption vessels and noticing how long it was before metallic silver began to precipitate:—

Percentage of Carbon Monoxide in Mixture.	Length of time necessary to start visible Reduction.
Per Cent.	
2½	No action even after 5 hours.
5	1 hour and five minutes.
10	Nineteen minutes.
20	Fifteen minutes.
50	Ten minutes.

It is evident, therefore, that if there is more than a mere trace of carbon monoxide in the gas the sulphur must be estimated by complete oxidation and estimation as sulphate. In order to estimate the sulphur compounds other than sulphuretted hydrogen, the gas after leaving the second absorption flask is passed over platinised asbestos or pumice heated to about 400° C. in a small-bore combustion tube, which in the presence of hydrogen converts the sulphur compounds into sulphuretted hydrogen, which can be absorbed by a lead solution and estimated in the usual way.

Two absorption flasks for the acetylene and sulphuretted hydrogen are sufficient, as in test experiments with known mixtures it was found that 5 per cent. of acetylene taken rarely came out at less than 4·83 per cent.

By now taking the results of these two sets of analyses we obtain a fairly complete result which can be tabulated as follows, the gas analysed being a sample of South Metropolitan gas:—

I. Carbon dioxide	0·79
II. Sulphuretted hydrogen	Nil
III. Bisulphide of carbon	0·02
IV. Oxygen	0·26
V. Unsaturated hydrocarbons (containing acetylene 0·035)	4·38
VI. Carbon monoxide	2·63
VII. Saturated hydrocarbons	33·29
VIII. Hydrogen	57·08
IX. Nitrogen	0·45

At present I can find no reliable method for the separate estimation of the various hydrocarbons present in illuminating gases, and until this can be done, gas analysis cannot be

of its full value in helping to clear up many points which are still difficulties in the complicated question of carburetting gases. I hope, however, that the work I have brought before you will be a help to others who, like myself, have had to take up this subject, as although such a method as I have described leaves much to be desired, still it correctly gives the salient points of importance to the gas manufacturer and consumer.

Two such analyses can, with good management, be made in a day, so that the amount of time expended is not prohibitive, and I cannot help thinking that if some of those gentlemen who claim to be able to make an analysis of an illuminating gas in a couple of hours were to check their methods on known mixtures they would be considerably startled at the results.

In conclusion, I wish to thank my assistant, Mr. J. A. Foster, for the aid he has given me in working out some of the details of this paper.

Discussion.

Mr. A. E. Fletcher said that the thanks of the members were due to Professor Lewes for his admirable paper elucidating the methods of analysing complicated gases containing the heavy carbon compounds. The complications which the author had described had been found by many before him; but it was not everyone who had, like him, gone into the subject so thoroughly and carefully as to distinguish the reasons for their occurrence. He would not stay to discuss the details of the paper at that moment, but he should read it in the Journal with great pleasure. Much instruction would be derived from a study of the facts so ably brought forward.

Mr. T. S. Lacey feared that not many members were present who had made a study of coal-gas analysis; but if any such were there he hoped that they would do as much as possible to elucidate the question before the meeting. There could be no doubt that all who had had experience of this difficult branch of analysis would feel deeply indebted to the author for the work which he had brought before them. The text-books treated the subject as if it were of a very simple nature, passing very lightly over all its difficulties. One would imagine on reading the descriptions of the processes therein given that they could be carried out with marvellous accuracy, percentages of the various gases being given up to many decimal places. But when one came to do the work, especially if he attempted to repeat his experiments under varying conditions, he would find that serious discrepancies cropped up which had to be dealt with; and it was the discovery of the causes of those discrepancies which was the most important part of the work. One of the most difficult things was to decide how much oxygen should be mixed with any particular gas in order to cause its perfect combustion without acting on any of the nitrogen in the mixture. If Professor Lewes could give them some further information on that point, on the nature of the residual gases, the pressure employed, and the amount of oxygen used under different circumstances, it would be very valuable. This was a most important point, and he felt sure that the author's experiments had been so complete that he could give further information in relation to it. It was a source of difficulty with everyone who had experience of the subject. If too large an excess, or too small an excess, of oxygen were employed, the results obtained were vastly different. At the same time there was one possible mixture which would give tolerably accurate results. It was always difficult to tell whether complete combustion had been obtained or not; and one might make an analysis and get very inaccurate figures without knowing it, until the work was carefully repeated. As to the question of absorbing the gases of the ethylene series, it was well known that in using sulphuric acid one did not absorb any of the paraffins; and as they might constitute an important part of the mixture, and affect the illuminating power of the gas, he did not consider that a correct idea could be arrived at by simply absorbing the olefines by sulphuric acid. The figures which the author had given them would be of great use to those who had to perform analyses of gases; and if he would give some further details of his processes the paper would constitute a most valuable addition to the very limited amount of information at present obtainable on the subject. There was one further question which he would like to put, viz., could the process be used with mercury?

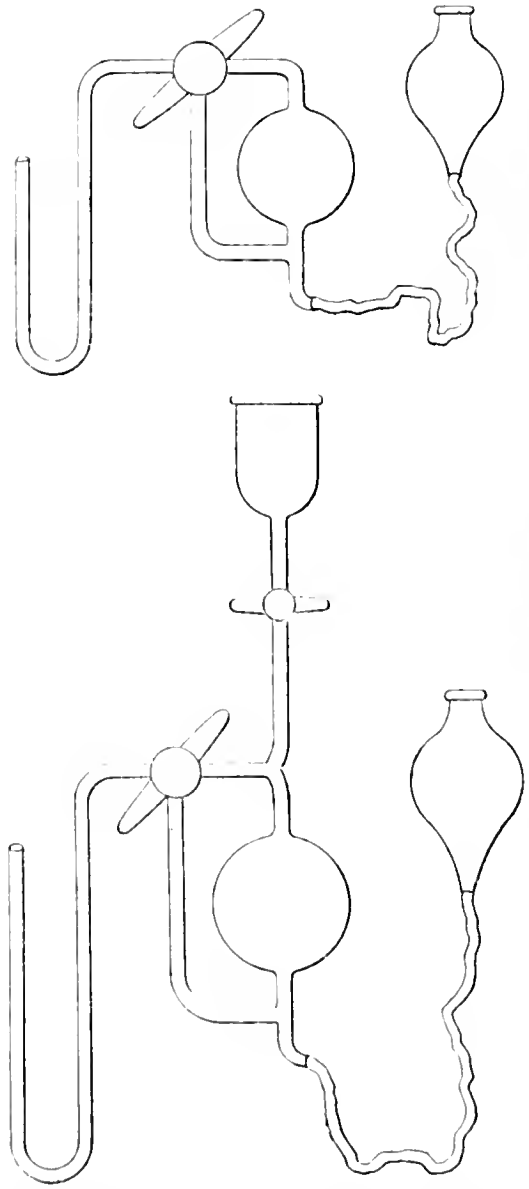
Professor V. B. Lewes replied that all the observations referred to by him had been made over water. He used the mercury eudiometer only for estimating the carbon dioxide, and for explosion. It was impossible in rapid working to use either cuprous or bromide solution without soiling the solution.

Mr. W. Foster had commenced his acquaintance with the difficulties of gas analysis some six years ago, and had found it refreshing to hear the author recount his experiences of the troubles which everyone had to encounter in dealing with the subject. He now found that he had a companion in his troubles, and he thought that it was extremely likely that they would be in company for a long time to come. He himself had gone through all the difficulties described by Professor Lewes and a good many more, and he thought that when the author had been at work for a year or two longer he would find it necessary to modify some of his assertions. Even in the case of so simple a reagent as pyrogallic acid, for the absorption of free oxygen, the text-books on gas analysis made no mention of the production of small quantities of carbonic oxide. And it was just that point which he believed had been mentioned by Bunsen, Russell, and probably others, that rendered it unfit to be used in the process for the removal of oxygen, except in cases where the quantity was relatively small. When he found a member presenting a report showing 11 per cent. of nitrogen in an analysis of a gas naturally containing but a mere trace, he could not but believe that he had used pyrogallic acid for the removal of excess of oxygen after an explosion. In such a case the carbonic oxide would show itself and be called free nitrogen. That difficulty alone had given him months of labour in the past. He had spent a considerable time in connexion with the endeavour to get rid of the use of Nordhäusen acid as an absorbent of the heavy hydrocarbons. Recently he had made investigations of the gases from various shale distilling works in Scotland, and that had led him to go thoroughly into the question of the reliability of different reagents as absorbents. He had come to the conclusion that it was possible to replace Nordhäusen acid by a reagent which was not so severe in its action on the mercury. A saturated solution of cuprous chloride in hydrochloric acid was used in the absorption of carbonic oxide. A gas rich in carbonic oxide after two liberal treatments would still show a further very slight diminution in volume on a third treatment. That was his experience after considerable experiment: and the inference he drew from his own work was distinctly in opposition to the recommendations of one well-known chemist. In other words the last traces of carbonic oxide were removed by cuprous chloride with difficulty. The fouling of the mercury by this reagent was notorious. No substitute had been proposed. Sulphuretted hydrogen could be got rid of by means of a number of absorbents. He had tried copper salts, lead salts, and mercury salts, and had come to the conclusion that mercuric chloride was very good and did not interfere with the mercury in use. He did not believe in water or saline solutions as the containing liquid. After getting rid of the sulphuretted hydrogen, one could get rid of carbonic acid by means of potash. He mentioned this because the author had referred to certain analyses which had been put forward, and he rather suspected that he was the author of them.

Professor Lewes: No, you are one of the few gentlemen who have not fallen into that error.

Mr. Foster continuing, said he was glad to hear that. He gave these explanations because, although they might be tedious, he felt that he was as it were on his "native heath," and had a right to speak. He had dealt with

sulphuretted hydrogen and carbon dioxide. Small quantities of oxygen could be safely removed by alkaline pyrogallate. Next came Nordhausen acid, which might probably be modified, as it was a nasty reagent, though a useful one. That gave one the volume of the heavy hydrocarbons. If, then, one knew the amount of oxygen needed for the heavy hydrocarbons and the carbonic acid which they produced, one had the means of working out an average molecular formula; and he did not think that gas analysis would ever get much beyond that. The volume of heavy hydrocarbons in ordinary coal-gas was between 5 and 7 per cent., and to hope to differentiate those bodies from small quantities of 100 cc. or so of original gas was, he would not say absurd, but impossible.



With reference to the removal of carbon monoxide, he was glad that the author had laid so much stress on that point, as it was one of the most objectionable constituents. It was a difficult gas to get rid of, and he did not know of anything better for the purpose than the acid saturated cuprous chloride. Then there were the paraffins (marsh-gas), free hydrogen, and free nitrogen. The determination of these was a point on which the author and himself were not in agreement. Professor Lewes was hopeful of devising a process whereby he could remove the various hydrocarbons of the paraffin series. His own method, however, had been to get at a measure of the free hydrogen in the mixture. He was glad that the author had put that matter before them so pointedly. Getting the free nitrogen was an easy matter; and if one could only estimate the free hydrogen by burning with palladium asbestos they would have an excellent process, and would then be able to get the amount of oxygen needed for the whole of the paraffins. He did not like to speak too definitely on the matter; he was, however, going over the work of Bunsen and others, and was rather hopeful. He was very hopeful at one time; but when one came to experiment with gases from many and diverse sources it was necessary to proceed carefully and not generalise in a hurry. If one could burn the free hydrogen, then ascertain the volume of the residual gas, and then explode it, one would have the very essence of a practicable process. He reserved the results of his experiments for the present, because he was not yet sure that they were to be trusted. If one gave a wrong representation to the free hydrogen in the volume, the paraffins would of course be out also in the inverse direction. Having got rid of every trace of carbon monoxide from his paraffin mixture, he was hopeful of getting rid of the free hydrogen without much, if any, combustion of the paraffins. Already the process had proved very valuable. There were many other points that he would have wished to refer to of a small order in themselves, but most important in connexion with the subject under discussion. Thanks to Mr. Lennox, who had made him a special form of eudiometer to which type he had adhered ever since, he had been enabled to get over some of his earliest difficulties. He now made them for himself with certain modifications on the original form, which he believed was introduced by Professor Dittmar. To calibrate an instrument and then use it as an explosion vessel was, he thought, wrong in practice, and therefore he always employed a separate vessel. He had also devised a special absorption apparatus, which those who had occasion to make gas analyses would, he thought, find very handy though probably it might not be novel. It enabled one to remove the gas sharply from the liquid absorbent. A modification of the absorption vessel had also been used. A funnel and stop-cock enabled one to remove the absorbent or introduce it. He used separate apparatus of this kind for potash, for cuprous chloride, and for the various other reagents in turn. These absorption apparatus had been made for him by Messrs. C. E. Muller and Co., of Charlotte Street, W.C.

Professor V. B. Lewes, in reply, said that he was sorry that he had not elicited more discussion, but one or two good points had been brought forward, the honour of which rested, he thought, with Mr. Lacey. He had referred to one of the most important points possible, namely, the conditions under which explosion best takes place, and how those conditions were to be modified so as to avoid any oxidation of nitrogen at the same time as the explosion. He thought that Mr. Lacey would agree with him that the absorption of the higher paraffins was a distinct step in that direction. If one absorbed the higher paraffins, and thus had only the marsh-gas to deal with, then, knowing approximately the proportion of that body, one could put in a slight excess only of the oxygen required to combine with it, and in that way get fairly concordant results. That was one of the advantages of the primary paraffin absorption. He felt relieved to find that Mr. Foster had met with the same difficulties that had occurred to him. With regard to Mr. Foster's remarks on carbon and hydrogen densities, he knew that Mr. Foster had been guilty of such things on several, indeed many, occasions; and he had already confessed that he had not much respect for his own carbon and hydrogen densities or anybody elses. But if Mr. Foster could differentiate between the higher members of the saturated hydrocarbons, he would confer a greater benefit on gas analysis than any that he had yet conferred, and he hoped that he would go on working in the direction he had indicated, and give them

the benefit of the process. He himself had not succeeded in doing so, and he had pointed out that, as far as his experience went, it could not be done by absorbents, and he very much doubted if any combustion process could be utilised for the purpose.

THE ANALYSIS OF THE PRODUCTS OF INCOMPLETE COMBUSTION.

BY VIVIAN B. LEWES.

The methods of analysis which serve to separate and estimate the constituents in an ordinary gas fail altogether to detect the presence of minute traces of such gases as methane, hydrogen, acetylene, and carbon monoxide when mixed with large volumes of inert gases such as nitrogen; and, moreover, as these four gases offer great difficulties of separate estimation by any combustion processes at present in use, the determination of them in the products of incomplete combustion escaping from flames which are used for heating purposes, has up to now proved unsuccessful.

At the last meeting of the British Association at Leeds, Mr. W. Thomson read a paper upon the products of incomplete combustion of gases given off from gas stoves, and attempted to separately determine the quantity of carbon monoxide and hydrocarbons found in the flue gases, but, like most other observers who have attempted to do this, he found it so beset with difficulties that he abandoned the attempt and contented himself with determining the total quantities of carbon and hydrogen escaping in an unburnt condition, experiments which showed that the combustion of gas in stoves for heating purposes is far less complete than had been imagined, but, unfortunately, they gave no idea as to whether the carbon and hydrogen were present with the products of combustion simply as such harmless constituents of the gas as methane and hydrogen, or whether they were there as the highly poisonous products of incomplete combustion, acetylene and carbon monoxide.

For some time past I have been trying to utilise the well-known property which finely-divided palladium has of causing the oxidation of hydrogen, but not of methane, when a mixture of these two gases with air are passed over it, as a separation between them, the carbon monoxide present, however, would have been a difficulty in the way of doing this had not experiments shown that carbon monoxide is oxidised to the dioxide under the same conditions as bring about the oxidation of hydrogen when passed over the heated palladium asbestos.

In the use of palladium asbestos for the combustion of hydrogen, it has always been customary to lead the gas with an excess of air or oxygen backwards and forwards several times over the surface of a single fibre of the impregnated material in a fine tube, but this would be practically of no use in the analysis of gases from incomplete combustion where the products of combustion would have to be led in a continuous stream through a series of combustion tubes and absorption vessels, and it was therefore necessary to try by experiment whether, during the slow passage of a large volume of mixed gases through a heated tube containing a large quantity of palladium asbestos, a satisfactory combustion of the carbon monoxide and hydrogen could be obtained without at the same time interfering with the methane present, as, if so, the acetylene can be absorbed first of all in the usual way by ammoniacal silver nitrate, the carbon monoxide and hydrogen estimated by combustion in contact with palladium asbestos, and the methane determined by a further combustion in contact with platinised pumice.

The palladium asbestos for these experiments was prepared by dissolving about 1 grm. of palladium in aqua regia, and evaporating the solution almost to dryness so as to get rid of excess of acid. About 1 grm. of asbestos fibre was then introduced into the concentrated palladium solution, and when it had soaked up most of the liquid, a few cc. of a concentrated solution of sodic formate and enough sodic carbonate to make the solution strongly alkaline were added.

In this way the palladium is precipitated between the fibres of the asbestos, and, after drying and igniting, the residual salts are dissolved out by washing with boiling distilled water, and, after being dried, the palladium asbestos is ready for use.

The platinised pumice stone was made in the ordinary way by taking ignited pumice stone, broken into small pieces, and soaking in a concentrated solution of platinic chloride, the pumice being afterwards dried and ignited to drive off the chlorine.

Methane, carbon monoxide, and hydrogen were prepared as in the experiments described in the previous paper, and the percentage of true gas in each having been carefully determined, a mixture was made containing—

	Per Cent.
Hydrogen	3·60
Air	71·31
Oxygen	20·00
Methane	4·30
Carbon monoxide	0·79
	100·00

This mixture was confined in a carefully graduated glass bell jar over water, and after being carefully freed from any trace of carbon dioxide by passage through caustic potash and dried by calcium chloride, it was then passed through a small combustion tube 10 in. in length, containing the palladium asbestos, heated by three spirit lamps placed 3 in. below it, the carbon dioxide and water so produced being collected in a series of absorption tubes, giving the carbon monoxide and hydrogen present in the gas, whilst the residual gas passed on over the platinised pumice, heated to a high temperature by a series of Bunsen burners, the products of combustion being collected in another set of absorption tubes. The results, however, obtained in this way were not very satisfactory, three analyses of the mixture giving the following results:—

	I.	II.	III.	Taken.
Hydrogen	3·00	3·84	3·28	3·60
Methane	4·32	4·40	4·33	4·30
Carbon monoxide	0·30	Nil	0·58	0·79

In these experiments the methane and hydrogen agree fairly well, but the carbon monoxide results are unsatisfactory. Other experiments were then tried, in which the distance of the spirit-lamp flames from the tube containing the palladium asbestos were varied, and the results obtained showed that up to a certain degree increase of temperature gave an increase in the accuracy of the results, but when the heat was too strong traces of methane were decomposed, and made the carbon monoxide and hydrogen results too high. It was evident, therefore, that in order to obtain a reliable process of analysis means must be taken to accurately regulate the heating of the palladium asbestos, and this was done by bending the tube containing it into a V shape, and heating it in a bath of melted paraffin wax. After many experiments at various temperatures it was found that 200° to 220° C. gave the best results; as for example:—

	Taken.	Found.
Hydrogen	1·83	1·86
Methane	1·71	1·76
Carbon monoxide	1·50	1·47

Having thus got a reliable method for analysing small traces of these gases, the process was employed for determining the composition of the gases escaping into the

atmosphere when the flame of an atmospheric burner is brought into contact with the bottom of a vessel which is kept cool by water between the temperatures of 0° C. and 100° C.

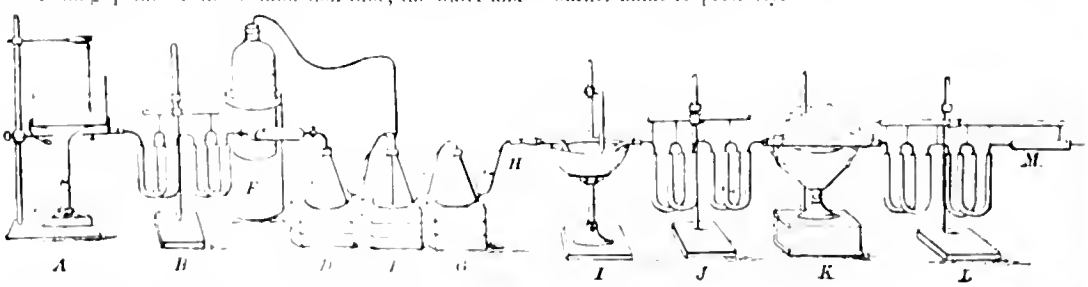
No flame is in contact with the substance which it heats unless the latter be at the same temperature as the flame itself, and this is due to the fact that the substance being heated, by conducting away the heat from the flame, practically plays the same part as the gauze of a safety-lamp, and so cools down the flame that the ignition point of the gas is not reached in the immediate neighbourhood of the heated surface, and the flame is thus extinguished for a certain distance from the bottom of the vessel; these extinguished flame gases then creep along the cooling surface and finally escape into the air.

In making any experiments on the composition of these checked products of combustion, it is evident that the smaller the admixture of air with the products of combustion the better, as the difficulties of analysis increase with dilution. After many attempts to devise a form of apparatus which would allow the products of combustion to be collected, without at the same time giving too great an admixture of air or interfering with the process of combustion going on, I at length came to the conclusion that the best form of apparatus to use was a tin-lined copper pot, filled with a false bottom which gave a space of 1 in. between the two bottoms. A circular aperture 2½ in. in diameter was then cut in the centre of the false bottom, whilst a small exit tube one-eighth of an inch in diameter was fitted into the side of this lower compartment. On now putting a known volume of water at 0° C. into the vessel and placing a Bunsen burner with a flame of carefully regulated size below it, so as to allow the flame to pass through the hole in the false bottom and impinge upon the bottom of the vessel itself, it was possible to draw off the products of combustion from the exit tube at the side without having a larger volume of air than necessary mixed with it. The gases on leaving this tube were first passed through carefully prepared fused calcic chloride, which had been previously treated with carbon dioxide to prevent any free alkali being present, and the increase in weight of these tubes give the water vapour produced by the combustion. The gas then passed on through tubes containing caustic potash to absorb carbon dioxide, and then through a tube in which a sample could be taken for determination of the oxygen, whilst the acetylene was next estimated by passing the gas through two absorption flasks containing ammoniacal silver nitrate,* an absorption flask containing sulphuric acid to take up any ammonia, and a drying tube. Next to these came the palladium-asbestos tube heated to 220° C. in a paraffin bath and the last tubes containing the calcic chloride and caustic potash for estimating the water vapour and carbon dioxide formed, whilst again beyond these came the platinised pumice heated by a flat-flame burner nearly to the softening point of the combustion tube, the water and carbon dioxide formed by the combustion of the methane being estimated in the usual way; beyond these tubes came a trap tube of calcic chloride, and finally aspirating vessels in which the volume of gas sucked through could be measured, and after correcting for temperature and pressure, the volume of gas absorbed in the experiment could be added, giving the total volume of products of combustion drawn through. An experiment tried with this apparatus on a mixture of known composition showed that an excess of oxygen must be mixed with the products of combustion in order to give satisfactory results, with such low forms of combustion as those taking place in the palladium-asbestos tube, and a carefully measured quantity of pure oxygen was therefore made to flow in at a steady rate to the second acetylene absorption bottle, so as to mingle with the products of combustion before passing over the palladium asbestos, the gas being kept in a carefully graduated glass gasometer, so that the volume used could be subtracted from the total volume of gases after correcting for the amount used in the various combustions; in this way the products given off when the vessel was heated at a point half an inch above the inner zone of the flame, and also at the tip of the flame, were determined with the following results:—

GASES ESCAPING DURING CHECKED COMBUSTION.

	Bunsen Flame.		Luminous Flame.	
	Inner.	Outer.	Inner.	Outer.
Nitrogen	75·75	79·17	77·52	69·41
Water vapour...	13·17	14·29	11·80	19·24
Carbon dioxide .	2·39	5·13	4·93	8·38
Carbon monoxide	3·69	Nil	2·45	2·58
Marsh-gas	0·51	0·31	0·25	0·39
Acetylene.....	0·04	Nil	0·27	Nil
Hydrogen.....	3·55	0·47	2·08	Nil
	100·00	..	100·00	100·00

These figures are of considerable interest, as they show that the extreme tip of an atmospheric burner is the only portion of a flame which can be utilised for heating substances cooler than itself without giving rise to deleterious products of incomplete combustion, these results being also corroborated by analysing the gases escaping unburnt from the outer zone of a luminous flame and an atmospheric burner flame respectively.



A. Tin-lined copper vessel with false bottom containing water to be heated.

B. Tubes for absorption of the carbon dioxide and water vapour in products of combustion.

C. Collecting tube for sample of mixed gases to be analysed for oxygen.

D, E. Absorption vessels for estimation of acetylene.

F. Graduated glass gasometer for supplying excess of oxygen for combustions.

G. Absorption vessel with acid to take up any ammonia carried from D, E.

H. Drying tube.

I. Paraffin bath with tube containing palladium asbestos.

J. Tubes for absorption of the carbon dioxide and water vapour from combustion of hydrogen and carbon monoxide.

K. Combustion tube containing platinised pumice.

L. Tubes for the absorption of carbon dioxide and water vapour from combustion of the methane.

M. Trap tube of chloride of calcium in connexion with aspirator.

* If, after estimation of the acetylene of silver, any metallic silver is left, it shows that the percentage of carbon monoxide in the gas has been large enough to bring about reduction, and the silver must be estimated and carbon monoxide so used calculated and added to that found by combustion.

Gases escaping from the Outer Zone of Flame.

——	Luminous.	Bunsen.
Nitrogen	76·612	80·242
Water vapour	14·702	13·345
Carbon dioxide	2·201	1·966
Carbon monoxide	1·189	0·006
Oxygen	2·300	1·430
Marsh-gas	0·072	0·003
Hydrogen	2·888	0·008
Acetylene	0·036	Nil
	100·000	100·000

Which shows that the air mixed with coal-gas in the atmospheric burner produces a far more complete combustion than in the case of a luminous flame, where the air, mixing with the partially-burnt coal-gas, so dilutes it and cools it down at the edge of the flame, that large quantities of even the inflammable hydrogen escapes unburnt. In the analyses of the products of incomplete combustion, the large proportion of carbon monoxide in the outer tip of the luminous flame is due to the carbon dioxide being reduced by the deposit of red-hot carbon on the bottom of the vessel to the lower oxide, and these results are in very fair accord with what one would have expected from the experiments of Dr. Blochmann upon the composition of the gases present in various parts of the Bunsen flame, the result he obtained by withdrawing gas at various heights above the burner being as follows:—

Height above Tube.	In Tube.	1 Inch.	2 Inch.	3 Inch.	Complete Combustion.
Air with 100 vols. of gas	253·9	284·7	284·5	484·3	608·8
Hydrogen	48·6	36·4	17·7	16·1	Nil
Marsh-gas	39·0	40·1	28·0	5·7	Nil
Carbon monoxide	2·9	2·2	19·9	12·7	Nil
Olefiant gas	4·0	3·4	2·2	Nil	Nil
Butylene	3·0	2·5	1·6	Nil	Nil
Oxygen	52·7	52·0	21·7	Nil	Nil
Nitrogen	199·1	223·8	225·9	382·4	482·3
Carbon dioxide	0·8	3·5	13·0	41·7	62·4
Water vapour	3·1	11·8	45·8	116·1	141·2

These figures also tending to show that the flame of an atmospheric burner cannot be used for any heating purposes without the escape of deleterious products except at the extreme tip where combustion is completed, and that, therefore, in all forms of gas-heating apparatus it is the hot products of combustion and not the flame itself which should be employed as the source of heat, unless through ventilation can be obtained and none of the gases from the checked combustion allowed to find their way into the atmosphere of the room. In conclusion, I wish to thank my assistants, Messrs. J. A. Foster and Warden, for the help they have given me in the work entailed in this paper.

Discussion.

Dr. L. T. Thorne felt that he was only expressing the sense of the meeting when he said that they were grateful to Professor Lewes for the interesting experiences which he had communicated in the paper he had just read. The subject was of immense importance, and perhaps more so at the present time than it had ever been before, when the use of gas for heating purposes was being so much extended, and, if one could judge by appearances, would become still more extended in the near future. The whole question of incomplete combustion was one of the most serious points in the use of gas as a heating agent. He supposed that there were very few heating stoves at present in use that were perfectly innocent in that matter. In fact, a great number of the stoves that were sold for heating purposes were simply abominable in that respect; and the prejudice against using gas for heating purposes was very largely due to the fact that the question of incomplete combustion had either been ignored or only insufficiently recognised. Manufacturers of stoves had taken little or no account of the conditions that should be carried out to produce a stove free from the danger of contamination of the atmosphere of the room in which it was used. Professor Lewes's results were, he thought, most interesting, and the apparatus employed seemed to him to be not only very neat, but exceedingly well fitted for the work which he had carried out. He had obtained analyses of the products of combustion at the surfaces of flames in a different manner from that usually followed, and had thus been able to differentiate the products at the various parts of the flame in a way which would prove to be of the greatest importance. Personally, he felt that this was one of the most important papers presented to the Section.

Mr. Bertram Blount, while fully endorsing all that Dr. Thorne had said as to the sins of the average gas stove, would point out that Professor Lewes had not given them any data on which to condemn it. His experiments dealt with the incomplete combustion of gas in contact with surfaces at a low temperature. But gas stoves that had any right to the name depended for their efficiency upon the incandescence of refractory substances, the gas, after that incandescence had been brought about, playing upon the surfaces of the refractory body, its combustion being thereby probably rendered more complete. If the author could give them analyses of gases drawn from the neighbourhood of the flames of a well-made gas stove, or any other form of heating apparatus; if he could give them analyses of the gases given off at the point where the Bunsen flame played upon a refractory substance, then they would have some data for saying that gas stoves did or did not incompletely burn the gas that they used. And in addition, the author's experiments were open to this objection. In order to collect the gases, he had had recourse to the device of a false bottom, and he (Mr. Blount) did not know that a better plan could have been adopted. But it appeared to him that even with the careful regulation which the author had exercised, and the necessity for which he had so strongly insisted upon, there must be some checking of the combustion, and the Bunsen flame would in consequence show worse than if it had been allowed to burn freely, without any such restraining influence.

Mr. T. S. Lacey could confirm Mr. Blount's remarks as to the great importance of the method in which the products of combustion were collected. If the flame were at all affected by the casing, as he certainly thought it must be, inasmuch as the amount of air passing in under ordinary conditions would be limited by it, then of course the results would not be the same as would be got if the gas were burnt in the ordinary way. The same objection applied to some extent to the difficulty of collecting gases from any flame without in some way or other interfering with the normal action of that flame. Considering how great those difficulties were, it appeared to him that the author had exercised every care in trying to avoid all such errors as were avoidable. He had shown them a method by which they could analyse those gases; and although he thought it probable that the normal action of the flames had been interfered with by the method of collecting the products of combustion, still that in no way detracted from the value of the paper as indicating to others researches which they could continue in any way they might think proper. Professor Lewes's method could be easily applied by anyone having a reasonable knowledge of chemistry; and its application would give an impetus to these investigations, and so fuller knowledge of the subject would result. It would have been more satisfactory to have

taken the actual products of combustion from, say, a gas stove (of which he had not a very high opinion) or from a gas burner, as they went into the air. But as the author had said, the immense volume of air made the difficulties of that method of working almost insuperable. Nevertheless he hoped that eventually they would be able to collect the products of combustion without interfering with the action of the flame and in such a way that they would be in the condition in which they were given off under ordinary circumstances. It was startling to be told that such gases as hydrogen and marsh-gas could come off without combustion, passing through a strongly heated flame, where one would imagine that they would always be in contact with an excess of oxygen. The whole paper was full of food for reflection, and would well repay the careful study of the members, who were much indebted to the author for the immense pains which he had bestowed on the researches which it described.

Mr. W. Foster said that the whole value of a communication such as this was that it directed attention to a most pertinent question, the use of gas for heating purposes. Briefly stated, the condition of affairs was this. Whether oxygen was present in excess or not, a flame in the course of its combustion was surrounded with something at a temperature below the combustion temperature. That was the essence of the question. Whether it was a kettle, or the cold cylinder of a gas engine, it mattered little; the same effect resulted. The temperature of combustion was lowered; and the coefficients of chemical affinity of the different factors being different, the one which was the greatest, viz., the hydrogen, was consumed first and the other factors followed according to the nature of the mixture. This subject came under the notice of Mr. Dibdin and himself some years ago, during an exhibition at the Crystal Palace; and it was a matter of regret to both of them that they had not had an opportunity of fully studying the conditions of the combustion products in various heating apparatus, for there were appliances there on that occasion which had not been brought together since. The nature of the mixtures of course determined the character of the effluent gases; the more hydrogen in the mixture the less would be the carbonic acid and carbonic oxide produced. That led him to the question of the experiments made. The author confirmed him in the hope that the employment of palladium asbestos would give him the means of solving all his difficulties in connexion with the estimation of free hydrogen in mixtures of paraffins. He had not yet subjected palladium asbestos to treatment with mixtures of known volumes of paraffins, but he found that the author used it in the tube to burn his marsh-gas. If his hopes were realised, and this proved a practicable means of ascertaining the amount of free hydrogen, one of the greatest difficulties of gas analysis was solved, for it would enable the analyst to know the quantity of paraffins present. With reference to combustion products and their character generally, he might relate an anecdote. Not many weeks ago he was in the presence of a gentleman holding an official position in the gas industry. He asked him what he was heating the room with. "A sanitary stove" was the reply. "But where is the flue?" he inquired. The reply was: Don't you know? It is a sanitary stove. It has water underneath, which absorbs all the products of combustion." "But what about the carbonic acid?" "My dear sir," said his friend, in the greatest surprise, "that is absorbed along with the water." That, continued Mr. Foster, being the position of a gentleman who was enlightening the British public, it was evident that we all did not view combustion products in the same light; and he feared therefore that such facts as had been brought before them by Professor Lewes would be very differently received by his hearers and readers.

Dr. C. R. Alder Wright wished to call attention to one point. Among the various forms of gas stoves made for household purposes were some wherein the products of combustion came into contact with strips or wires of iron instead of lumps of fireclay or asbestos fibres. In such cases the iron became in time coated with a film of oxide. He had not carried out many observations on the subject, but such few as he had made led him to believe that a much more perfect combustion was obtained under those circumstances than when the flame was made to play upon clay or such like bodies. The improvement might perhaps be attributed to a "catalytic" or surface action of the oxide of iron, analogous to that of the platinised asbestos in the case before them. He would like also to ask, in reference to the column of figures which appeared to the left of the author (see Table, p. 414), what had become of the oxygen which was associated with the nitrogen in the air which was used to burn the gas. In the first three columns they had from 75 to 79 parts of nitrogen; but the water vapour and carbon dioxide, &c. present did not contain the amount of oxygen that ought to have been present associated therewith. It looked as if more oxygen had gone to one part of the flame, and less to another; but there was doubtless some other explanation.

Professor V. B. Lewes, in reply, said that he had started with a paper on gas analysis, and the discussion, after wandering through the groves of gas-stove manufacture, had come back to the subject in an able question by Dr. Wright on a point which he ought to have explained in his paper. He would answer that question first. In the diagram referred to (see Table, p. 414) the oxygen was estimated from the amount taken in the tube, and the amount of nitrogen belonging to that oxygen as air was deducted, so as to give the products of combustion without mixture with air. The proposition of heating iron coated with magnetic oxide with the flame appeared to him to be reasonable, but he had had no opportunity of judging of it yet. In opening the discussion, Dr. Thorne had treated him very kindly; but he could not help thinking that he had dealt somewhat harshly by gas-stove manufacturers. There were several points to be considered in reference to the manufacture of gas stoves. The gas-stove maker would no doubt like to be a public benefactor if he could; but he had at the same time to make his living. The public expected him to give them a stove which would heat a room to a nice high, stuffy, comfortable temperature in a short time; and the maker found himself obliged to produce a stove which would fulfil that condition. It was of no consequence to him whether his customer got a headache or not. In order to have a gas stove which would give off harmless products of combustion, one must use only the extreme tip of the Bunsen burner; and if one asked a maker to make a stove on that principle, he would simply laugh at the idea. To secure rapid heating, the body to be heated must be well down into the flame, and the natural consequence was a crop of noxious products given off into the room where people did not know better than to use such stoves. Not a single stove was made in which the products could be allowed to escape. If people were to use gas stoves satisfactorily they must have absolute ventilation, and lead away all the products of combustion, by pipes or otherwise. Mr. Blount had said that he had not given any analyses of the heating effect upon flames of refractory materials. He would remind him, however, that he had not been talking about the products of incomplete combustion themselves, but about their analysis. But, in fact, it did not much matter whether one heated asbestos or any other material to the point of ignition. In every case products of incomplete combustion were given off, though to a different extent, the percentage of products falling as the temperature rose, but never ceasing entirely. There was no stove existing which he would use and allow the products to escape into the room. Mr. Lacey had made an admirable remark as to the limitation of combustion which must take place in such a vessel as he had shown. But he had pointed out in the paper that that difficulty was strongly in his mind. Nevertheless, if Mr. Lacey would consider the matter, he would see that the products were not increased to such an extent as might at first sight appear. If one took a flat-bottomed saucepan without a false bottom, and heated it with a Bunsen flame, one would have the products of checked combustion making a layer between the saucepan and the flame. The products would creep along the bottom of the saucepan, and at no time would they get far enough away from it to undergo combustion. And it would be found that by using a small

flame in the way he had described, so as not to fill up the hole too much and thus check the sucking in of the oxygen, but leaving a free way for it, then the amount of interference with the flame was as small as it could well be. He had tried many methods, but none had so well fulfilled his requirements as the one he had described.

Meeting held on Monday, April 20th, 1891.

MR. THOS. TYRER IN THE CHAIR.

ON THE ADAPTATION OF STONEWARE TO CHEMICAL APPARATUS.

BY W. P. RIX.

Introduction and Scope of Paper.

It may possibly seem that the subject I have to bring before you is only cognate to the inquiries and researches which usually occupy the attention of this Society, and that it hardly comes within the scope of its transactions.

It must be remembered, however, that many extensive chemical operations are possible only through the important development of stoneware apparatus in later times; and we cannot but conclude that the subject is worthy at least of some slight notice on the part of a society including so large a number of chemical engineers within its ranks.

It was also in the hope that something more than passing interest might result, that I have attempted to-night some description of the methods employed in the production of apparatus in this material.

An experience of over 20 years in connexion with Lambeth Pottery has led me to believe that a considerable number of chemists have but limited knowledge of these details.

The failure of some in obtaining satisfactory results when erecting chemical stoneware plant has sometimes arisen more from a want of appreciating the requisite form of construction than to any inferiority in the material of the apparatus set up.

Success in all constructive arts can only be ensured by studying closely the capabilities of the material to be dealt with. Those who minimise these difficulties by meeting the exigencies of the material, even at the cost of some modification of the original design, will succeed far better than others who, insisting rigidly on some special form or arrangement not inherently superior, add greatly to the risk and expense in producing the apparatus. Undoubtedly there are many notable exceptions, and among those connected with this Society are a large number whose experience has already enabled them to arrive at results that are examples of the highest constructive skill, and to such anything I may have to say will possibly appear somewhat elementary and trifling in its detail.

If, however, the following remarks assist any of my fellow members in realising that it *is* possible for the potter and the chemical engineer to study the requirements of modern science with more intelligent unity of purpose than hitherto, I shall have accomplished at least one object I had in view.

It is not within the purpose of this paper to deal with the history and progress of the manufacture itself. It is therefore only necessary to remark in passing that although for the last century or more Lambeth has been the seat of the production of salt-glazed stoneware, it is only within the last 50 years that this material has been adopted for chemical apparatus. It is true that salt-glazed wares at one time were largely made in Staffordshire, but in this district, the manufacture having been confined to smaller domestic and ornamental goods, finally died out about 50 years ago, and it was left to the Lambeth potteries to develop and improve the production of strong and heat-resisting wares of larger capacity, and in this way to meet the requirements of the chemical manufacturer. The rapid extension of scientific research at this time and the astounding expansion of manufactures based upon that research, involved the adoption of chemical processes requiring the use of materials suitable to resist heat and acid and rapid changes of temperature. These processes and the apparatus required soon became more complicated and the dimensions more extended. Glass and porcelain were no longer available with increasing size, and in stoneware the manufacturing chemist found a material well suited to his enlarged operations. About the year 1811 Waters took out a patent for the fabrication of various articles of considerable magnitude by moulding. Some years later the Lambeth potters commenced to give attention to this section, and among others we find the name of Green and Singer engaged in the manufacture. Messrs. Doulton and Watts were perhaps among the earliest to produce such goods and did much to develop the quality. In fact, so much energy and enterprise was expended in discovering suitable materials and enlarging the capacity of the vessels produced on the wheel, that a practically new industry was the result.

Up to the year 1840 about 8 gals. was the limit of size—as it was the limit of power over a single lump of clay upon the potter's wheel. It was a proud achievement when, later on, 100 gals. capacity was reached, and a vessel of 300 gals. for more than a decade remained true to its description as being the largest stoneware vessel in the world. At the present time, care and experience has made it possible, in certain forms, to attain nearly double this capacity.

A. *Definition.*—Stoneware may be defined as a densely vitreous material, non-absorbent, and impervious to acids and other corrosive compounds. The imperviousness of most other ware is due only to the glaze, the body itself being absorbent. Stoneware, however, is vitrified throughout the entire mass, the glaze being merely added to produce a smooth surface.

B. *Body.*—To obtain this result, stoneware is formed of a natural clay, extremely plastic, approximating to the composition shown on the diagram (Table A.).

Table A.

	1.	2.	3.	4.
Silica	72·23	71·34	71·12	65·49
Alumina	23·25	20·32	20·90	21·28
Ferric oxide	2·54	1·34	0·68	1·25
Calcium oxide	Trace	0·06	0·38	4·72
Magnesium oxide	1·78	..	..	7·25
Alkalis		3·94	3·92	

Such are the clays of Devonshire and Dorsetshire, which are highly prized for this purpose.

The vitrifaction of the body is produced by intense heat, carried to a point beyond which it is impossible to go without causing the entire collapse of the form itself. In this respect stoneware differs from porcelain and china, the vitrifaction of which is obtained by the addition of fusible materials to the clay.

This fact is most important in the designing of stoneware plant for chemical purposes, and from it largely arises the tendency to warpage and unequal contraction, one of the greatest difficulties with which the stoneware potter has to contend. The temptation is great to avoid extra risk at the sacrifice of a highly impervious body, by reducing the temperature of firing or merely continuing it for a time sufficiently prolonged to vitrify the surface.

It is hardly necessary to point out the importance of this complete vitrifaction of chemical apparatus, especially when the same vessel is used for various products, and is thus liable to absorb some portion of each into its mass.

It is therefore necessary to obtain a clay which, though maintaining form at high temperature, is sufficiently fusible at that heat to become dense and impervious in body. Nevertheless, it must be plastic and easily formed, even

though it be tempered with sand or other non-plastic material to increase its power of giving up moisture in drying. It must be capable of allowing considerable thickness for strength, and yet not liable to crack either in firing, cooling, or during subsequent use.

The number of clays that will answer all these requirements is very limited, though the compositions produced from them may be greatly varied to give prominence to different qualities needed in the resulting wares.

The composition of such mixtures may be seen on the diagram (Table B.).

TABLE B.

	1.	2.
Silica	70·05	65·25
Alumina	25·80	31·08
Iron oxide	1·20	1·12
Lime	0·60	0·30
Alkalis	1·25	1·25

I have also here specimens of bodies possessing these various qualities:—

a. Suitable for heating and cooling up to 400°.

b. Very impervious, but useful for cold liquors only.

c. Capable of resisting heat, yet can be made thick without cracking.

d. For boiling acids over fire.

e. Suitable only for dry materials heated to low redness.

It is here necessary to remark that these materials are in no sense chemical compounds, and are at best carefully adjusted mixtures, arranged to suit some special use to which the vessels are to be submitted. It must also be remembered that there exists no natural clay absolutely uniform in its composition. Recipes and mixtures have therefore to be constantly readjusted to maintain such uniformity in the mass.

In proportion as the clay is fusible, the resulting vessel will be more vitreous and will suffer greater contraction in firing. This contraction is often irregular from various causes, and the consequent distortion can only be obviated by the admixture of a certain amount of infusible material, such as sand, fireclay, or ground burnt ware. This addition essentially reduces the contraction and density but increases the porosity and the capacity to withstand changes of temperature. The physical condition of the materials themselves and the homogeneous state of the mass before use are, however, of the greatest importance, and require long experience in their adjustment. It has also been long since demonstrated that there is great advantage in allowing the material to lie for a great length of time in its mixed condition before use, the "weathering" process, as it is termed, being often extended over many months or even years. The actual change which takes place during this period has never been clearly ascertained, but the resulting benefit is a well-established fact.

C. *Glaze.* The body of well-burnt stoneware being almost impervious, the glaze is not greatly needed, and in some cases it is an actual hindrance to ready expansion with change of temperature. A glaze is, however, desirable for many purposes, as it presents a smoother surface for cleaning and enables crystals and precipitates to be more easily detached from the surface.

The glaze being more vitreous than the body of the vessel, there is some difficulty in equally adjusting the expansion and contraction of both, and this difficulty is much increased when the layer of glaze is thick. Here is an instance in which the contraction of the two are so unequal that the first application of heat has caused the vessel to recal in all directions.

In the manufacture of earthenware or porcelain it is usual to fire the vessel previously to the glazing process and afterwards to dip into a liquid glaze. The slight porosity of the ware at this stage causes the absorption of some of the water into the body and the consequent deposit of a layer of glazing material on the surface of the vessel.

In the case of stoneware it is usual to omit the first or "biscuit" firing and to glaze the ware in the clay state after it is thoroughly dry—the glaze being adjusted to vitrify at the same temperature as the body. The risks of this operation are, however, considerable, and with the larger vessels almost impossible. It will be seen that the method of salt-glazing has peculiar advantages over all others for this purpose. It is intensely hard, and will scratch almost all other glazes. It is very thin and therefore does not affect the expansion. It is produced automatically during the firing process and thus all risk of injuring the vessel by pouring or dipping of liquid glaze is obviated.

By this plan the vessels when fairly dry are placed in position in the kiln, due care being taken that each stands on a firm basis, yet capable of contraction in the burning equal to the vessel itself. After the kiln is filled, the doorway is bricked up and the firing proceeds very gradually but steadily increasing in temperature and usually extending over several days.

When the greatest heat has been attained and while the whole contents of the kiln are in a glowing condition, common salt is ladled through small apertures provided on the roof of the kiln. The decrepitation causes the salt particles to fly into all parts of the kiln, and these are immediately vaporised by the great heat, being forthwith decomposed. The soda combines with the silica of the surface of the ware, forming a highly vitreous glaze, while chlorine and hydrochloric acid are evolved in a thick white vapour from the outlet of the kiln.

The reaction is as follows:—

$$2\,NaCl + SiO_2 + H_2O = Na_2OSiO_2 + 2\,HCl.$$

By this process, however, the penetration of the vapour to the interior of closed vessels with narrow orifices is only partial, and if glaze is needed it must be added to the interior surface by the liquid process previous to firing.

It is, of course, desirable that this liquid glaze should be as free as possible from ingredients liable to be attacked by acids, &c., and for this reason the ordinary earthenware glazes, which usually contain large quantities of lead and borax, have especially to be avoided.

The composition of glazes suitable for chemical purposes is given on the diagram (Table C.).

TABLE C.

	1.	2.
Silica	61·81	65·05
Lime	13·44	13·68
Alumina	10·71	13·14
Alkalis	11·05	7·24
Iron oxide	0·82	0·89

D. *Formation.*—We have now to consider the formation of the ware itself. The methods are various, chiefly the following:—

1. Throwing on the potter's wheel.
2. Moulding in plaster moulds.
3. Machine moulding.
4. Slip moulding.
5. Expression, as in pipes.
6. Dust pressing, as in tiles.
7. Plastic die pressing.

Of these the simplest and most important is that of—

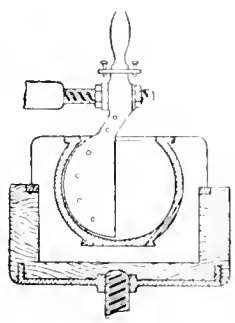
1. *Throwing.*—Notwithstanding its simplicity this is one of the most difficult of operations, and cannot fail to fascinate all who see it for the first time, owing to the rapidity with which the revolving mass of clay receives almost magic changes of form by the deft motion of the potter's hand entirely unaided by tools of any sort. Smaller vessels up to 6 gals. or 8 gals. are formed out of one ball of clay, but in the formation of large vessels, the mass being great has to be manipulated more steadily and with much care, a long experience being needed to obtain

complete uniformity in the tension of every part. Were it not for this care the superincumbent weight would cause the lower portion to collapse. The process is therefore arrested a few hours at various stages to allow the half-formed vessel to stiffen, and a further quantity of clay is afterwards built up and gradually shaped till the whole is complete.

2. *Moulding.*—It is obvious that only vessels which are cylindrical or at least circular in all their cross sections can be formed on the wheel. For other shapes moulding has to be used. By this plan thin layers of soft clay are carefully laid and pressed into a plaster mould of the desired form. The mould may be in separate parts, which are then closed together and the seams or joints completed by addition of clay at the lines of juncture. Some part of the moisture is absorbed by the porous plaster, thus shrinking and hardening the vessel, and it can in a few hours be removed for drying.

3. *Machine Moulding.* — A combination of the two processes of moulding and throwing has for some time been introduced in Staffordshire in forming small open vessels. The mould is made to revolve rapidly, and the mass of clay being thrown in, a forming profile mounted on handle or radius is brought downward into the mould. This forces the clay up and against the sides giving it the required thickness. (See Fig. 1.)

Fig. 1.



The uses of this method for large vessels are, however, limited, and it is to be doubted if the evenness of tension is as complete as in thrown ware. The torsion of the clay obtained upon the wheel is most effective, and this spiral formation of the mass gives greater elasticity to the ware in expansion with rapid heating. In order to illustrate the direction assumed by the particles of clay in the formation by both methods, I have prepared examples in stratified coloured clays, from which it is evident that the movement of the clay in the two methods is altogether different, torsion or welding of the interior of the mass in the case of machine moulding being very limited.

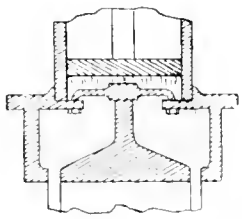
4. *Slip Moulding.*—For small articles in which extreme lightness is required, "slip moulding" is resorted to. By this plan the plaster mould is entirely closed except one small hole, through which clay about the consistency of cream is poured until the mould is filled. The porosity of the plaster causes some of the moisture of the liquid clay, "or slip," to be absorbed, and a small quantity adheres to the walls of the mould. The rest is poured out. In a short time the thin vessel resulting is stiff enough to be removed for drying. This method is chiefly useful for articles of simple form, any details in the mould being rapidly worn away.

5. *Expression.*—This method is so well known in connexion with drain pipes that it hardly needs description.

The clay is usually filled into a chamber which is afterwards closed by a piston (see Fig. 2). Pressure on this is exerted by hydraulic, steam, or screw power, and forces the clay either laterally or vertically through an orifice of any required section. A great variety of sectional form is thus possible, but only articles with parallel sides can obviously be produced by this method.

With the introduction of improved machinery and experience it has been possible to turn out pipes of large diameter, and at some of Messrs. Doulton's works pipes of 3 ft. diameter, suitable for condensing towers, have for some years been successfully manufactured.

Fig. 2.



An interesting application of this process may be here noticed in the form of *spiral expression*. It furnishes a method of obtaining a very large condensing surface, and can be applied in various ways.

So far, manufacture by expression seems simple enough, and provided the section is one which allows an equal thickness of clay in all parts, almost any required form can be made.

In the case of bends and curves, however, the matter is not so easy. To produce a bend, the cylinder is filled with more clay on one side than the other. The flow of the clay through the die is consequently greater on that side. The workman, taking hold of the end of the pipe as it exudes, gently supports it in its curved direction (Fig. 3), but

Fig. 3.

without force. In proportion to the unequal filling of the cylinder, the angle of the bend will be more or less. It is, however, difficult to regulate exactly the flow of the clay, and there is always a tendency in the material to deviate from its original form in drying and burning. Correct angles cannot be maintained by this plan, and if accuracy is required, resort must be had to moulding.

The difficulty of making pipes of the form of Fig. 4 is, therefore, greater than that of Fig. 5 when accurate

Fig. 4.

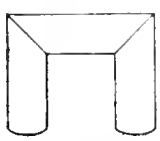


Fig. 5.

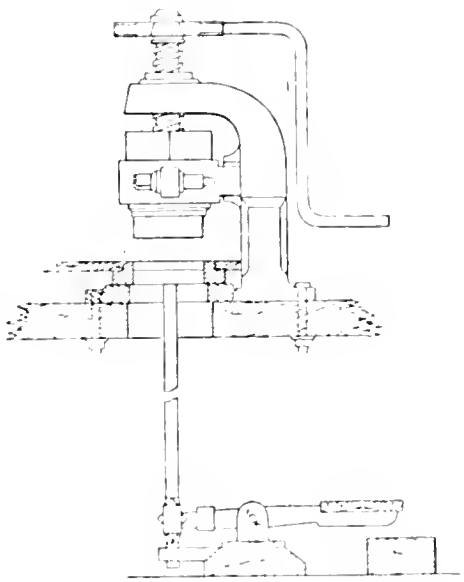
dimension of span is wanted. Thus, in the case of long-armed connectors, though the flow of gas in 4 is easier, the uncertainty of dimension in 5 is less.

I wish also here to refer in passing to the admirable system of forming channels or half-pipes, by the "opercular" method introduced many years ago by Sir Henry Doulton. The pipe, as it leaves the die, is partially severed on each side through its whole length. Sufficient mass is, however,

left uncut to allow the pipes to be fired without separation. A sharp tap after leaving the kiln splits the pipe into two semi-circular channels.

6. *Plastic Die Pressing (as in Draining Tiles).*—By this method the rough slab of plastic clay is placed in a metal die or box of any given form, and a plunger exactly fitting the same is caused to descend by a screw. The clay, unable to escape, is pressed tightly into the box, thus taking its exact form. The plunger is now lifted, and the bottom of the box, being loose, is raised by a lever, so that the formed article supported on it can be carefully removed. (See Fig. 6.)

Fig. 6.



7. *Dust Pressing.*—An interesting modification of the above is obtained by filling the box with clay dust slightly damped, instead of the plastic clay. With heavy pressure the particles of dust will adhere, and at one blow of the plunger a solid tile may be obtained. The shrinkage and warping are much less by this process, and the accuracy of form, therefore, greater; but the body is far more porous than if plastic.

8. *Grinding.*—The mechanical engineer who is able to turn his metal to any given size with the accuracy of 100th part of an inch knows none of the disappointment of the potter. Fitting is the "bugbear" of a pottery. After an article is formed it will shrink nearly three-quarters of an inch in every foot in drying and nearly as much more in the firing. But varying circumstances in the drying and firing will make a varying shrinkage, and an element of uncertainty is thus introduced, which it is impossible entirely to control, especially with large vessels fired in huge kilns at a very high temperature.

To obviate this, recourse is sometimes had to grinding, as in taps and pumps. This is done after the article is completed by means of emery and a revolving bed or lathe. The extreme hardness of the ware, however, makes the plan difficult and costly.

It need hardly be pointed out that all these methods have their own advantages, and it is necessary to choose the method according to the form.

We have next to devote our attention to some of the—

E. *Difficulties of Manufacture*, as related to the form itself. The great object to be attained is *uniformity of tension* in drying, in firing, and in use. Though many other matters tend to assist this, equality of thickness is perhaps the most important for this result.

1. IN ARRANGING THE FORM OF THE VESSEL the following points should be noted:—

(*a.*) *The shape should be such that if possible it has a suitable base to stand on in drying and firing.*

Thus the form shown at Figs. 7 or 8 should be adopted and not 9. In large vessels, say of 50 gals. and up, forms 10 and 11 would be almost impossible.

Fig. 7.

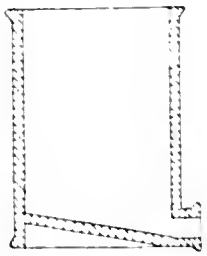


Fig. 8.

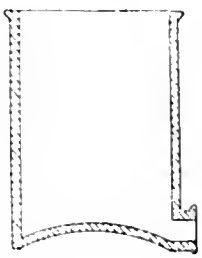


Fig. 9.

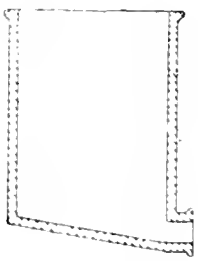


Fig. 10.

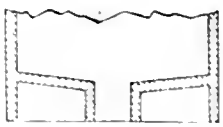
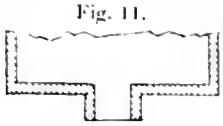


Fig. 11.



(*b.*) *The form should not tend to collapse.* Thus form Fig. 12 not 13 should be adopted.

Fig. 12.

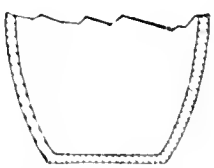
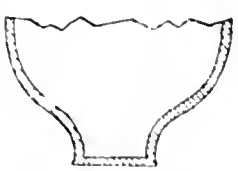


Fig. 13.



(*c.*) *The position of fittings should not be made to depend on accuracy of form*; thus, the connections of Fig. 14 may become as 15 through sinking in firing.

Fig. 14.

Fig. 15.

(*d.*) *Nor upon freedom from torsion in ware* as with a gauge glass socket. (See Fig. 16.) In this case the twist of the clay through making on the wheel causes the position of the sockets to shift from the perpendicular in the firing.

(*e.*) *It must also be noted that forms thrown on wheel and cut are to be avoided*: thus Fig. 17 would be sure to twist (see Fig. 18), also still-head dip-arm in one piece would be very uncertain, as in Fig. 19.

Fig. 16. Fig. 17. Fig. 18.

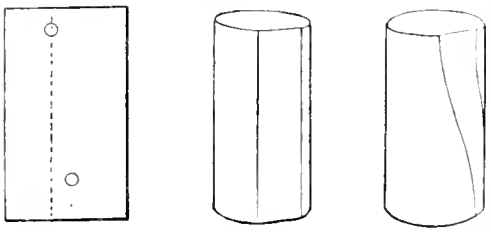
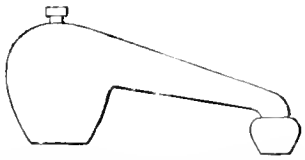


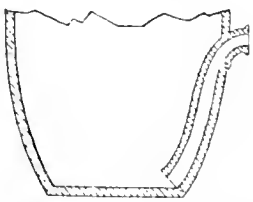
Fig. 19.



(*f.*) Parts necessarily made by different methods have different shrinkages and cannot be struck without risk.

Thus, pipes stuck inside thrown vessels are to be avoided on account of both torsion and shrinkage, as in Fig. 20.

Fig. 20.



2. In Drying.—The following should be avoided:—

(*a.*) *Unequal thickness.*—The contraction takes place more rapidly in the thinner parts and cracking results.

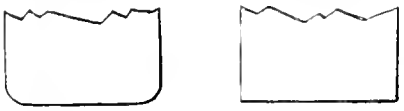
Thus, a thin copper may be suggested for economy of fuel and easy expansion, and if this is of large size additional thickness of flange might be asked for as adding to strength, but it is necessary to avoid the unequal contraction caused by this arrangement, and substitute 22 for 21.

Fig. 21. Fig. 22.

(also do not bolt through a flange but outside it).

(*b.*) *Unnecessary Width of Base.*—The large diameter of base should be avoided and reduced as much as possible, especially in large vessels, as the great weight prevents the mass from contracting at the bottom and cracks result in drying. Thus Fig. 23, not 24, should be adopted—

Fig. 23. Fig. 24.

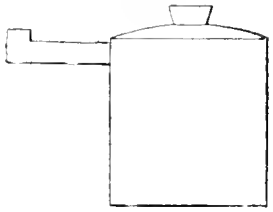


3. In Firing.—The following should be noticed:—

(*a.*) *Projecting Parts* requiring support entail great risk.

The whole kiln when at full fire is in a state of semi-fusion, and the sinking of projecting parts can only be avoided by most careful adjustment of clay supports, the shrinkage of which must be precisely the same as that of the vessel, or cracking ensue. (See Fig. 25.)

Fig. 25.



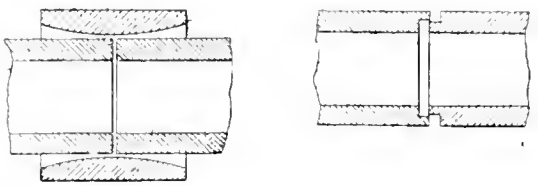
(*b.*) *In Pipes great length means great risk.*—The method of placing in the kiln may be either vertical or horizontal. In the former the play of fluctuating fire-draughts direct on the ware causes warping. In the horizontal setting, allowance for free contraction of length is very difficult.

It would of course be possible to point out many other examples of undesirable form, but the principles of construction are perhaps already sufficiently indicated.

F. *Connections.*—The efficient connections of chemical apparatus is a matter of great importance to the chemical engineer. The means being greatly varied, it may be of interest to note the most important of these.

1. *Butt and Collar.*—The chief difficulty is in packing this joint, and it is most suitable for a run or cast joint, a small hole being left in the collar for the purpose. It is, however, very rigid, and a modification suitable for many purposes at moderate temperatures can be arranged by using an india-rubber collar bound with wire.

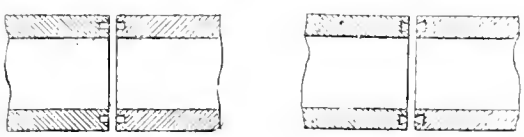
Fig. 26. Fig. 27.



2. *Butt Socket.*—A very compact joint where space is confined, but the manufacture of the ware is troublesome, being liable to warpage and chipping of the outer wall of the socket owing to the thinness of this part of the pipe on which it has to stand in drying and firing.

3*a*. *Butt Grooved.*—This is also open to the same objection of weakness in the socket butt. Besides this, in case of warping the grooves do not coincide and a bad joint results.

Fig. 28. Fig. 29.



3*b*. *Butt Grooved Keyed.*—The groove may be countersunk, but this is even more difficult in manufacture and further weakens the butt. By leaving two small holes in the outer edge of the pipe a run joint of great strength and rigidity can be obtained.

4. *Spigot and Faucet* is undoubtedly the best joint for ordinary purposes and easily connected by unskilled workmen.

Fig. 30.

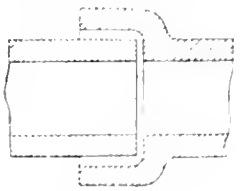
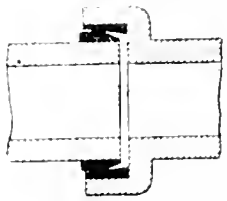


Fig. 31.



5 (Stanford's Patent) and 6 (Doulton's Patent) are most useful modifications of the above for purposes which do not require a temperature above 100° F. The spigot and faucet have cast on and in them a lining of tar or asphalt composition by means of accurately fitting dies which produce a true spherical joint. The pipes can therefore be fitted together perfectly tight without luting or cement, yet are able to be adjusted to slight curves of line and can be rapidly removed if necessary.

6. The faucet is cylindrical and the spigot spherical. The joint can thus be kept tight though the length of the run may spread slightly, which is not the case with No. 5.

Fig. 32.

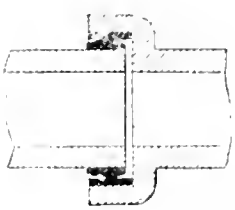
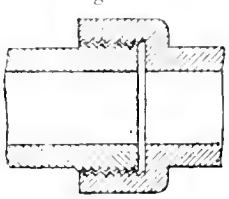


Fig. 33.



7. *Screwed Socket.*—This can only be successfully applied to connexions of small diameter, say up to 1½ or 2 in. It should be noted that the allowance for warpage must be less than the depth of the thread, and this is not usually sufficient in larger sizes for so vitreous a material as stoneware. For this reason also coarse threads are desirable.

8. *Taper and Fillet* is only suitable for long pipes used vertically and of diameters under 9 in., as the joints cannot be made tight if the pipes are warped.

Fig. 34.

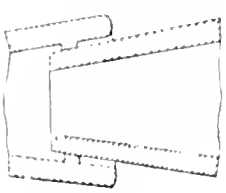
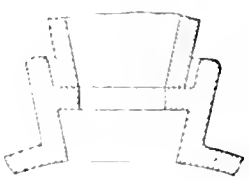


Fig. 35.



8a. *Butt Ground and Luted.*—This method is chiefly applied to jointing of stills and still-heads.

Fig. 36.

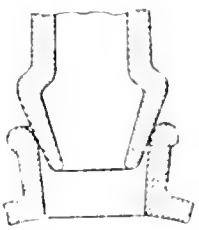
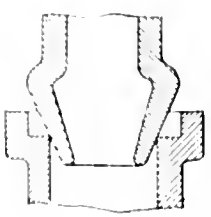


Fig. 37.



9. *Clay Lute.*—This is the usually accepted joint for receivers and stills, and for all arrangements where rapid disconnection is required nothing can excel it. It is capable of easy adjustment to irregularity of level, and if suitable luting is used there is little danger of this falling into the vessel.

9b. *Socket Clay Lutes* are preferred by some, but on the whole there is more difficulty in keeping out the luting by this plan.

10. *Water Lute* sockets need little explanation. The greater the depth, however, the more risk of warped and ill-fitting connexions.

Fig. 38.

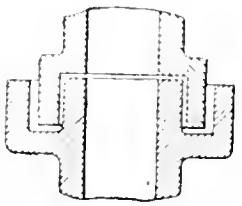
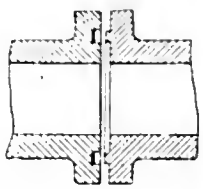


Fig. 39.



11. *Fillet and Groove* is a good serviceable joint and very tight under pressure with india-rubber rings in the hollow. The flanges need to be very strong and the bolts should pass through the clips outside and not through the flanges.

12. *Ground Flange and Groove.*—In this case the strain on the flange is greatly reduced and india-rubber flange can be placed between the two ground surfaces which thus get a true bearing all over when screwed up. The india-rubber expands sufficiently into the groove to prevent it from blowing out under pressure.

Fig. 40.

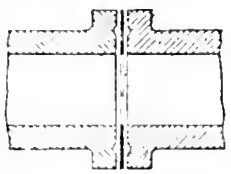
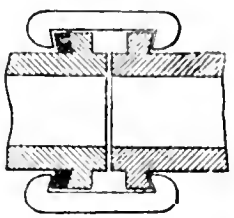


Fig. 41.



13. *Butt Ground Flanged.*—This patent joint (made by Messrs. Doulton) is very useful where rigidity is not an objection. The butt ends are ground true and the pipes held together with wooden wedges and iron clamps.

14—15. *Packed Gland Joint* (as in pumps). This needs no explanation, but in all cases the bolts should be carried outside the ware.

The greatest care is needed in screwing up bolts with so rigid a material as stoneware, and no undue strain should be thrown suddenly on any one point.

Fig. 42.

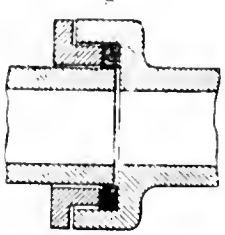
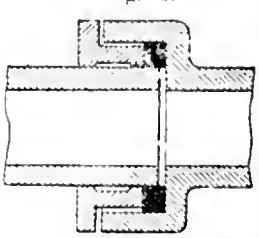


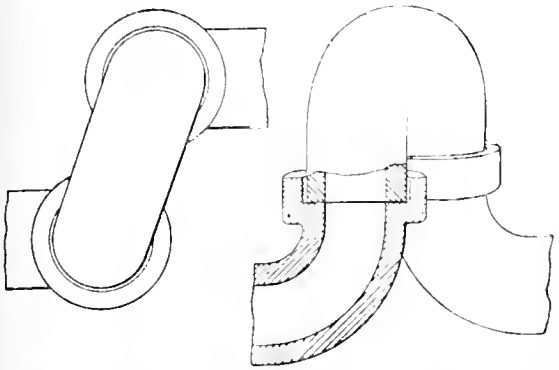
Fig. 43.



It should be noted that extreme accuracy in jointing, such as is sometimes attempted with ground surfaces and bolts, is liable to defeat its own purpose by its undue rigidity.

Each joint being butt ground, no play in position or length is possible, and the whole apparatus, when screwed up, becomes rigid and incapable of adjustment to levels or even to the slight warping of pipes which is inevitable with all stoneware. A more serious objection is that no opportunity for expansion and contraction in length is possible, and it is therefore important in all such arrangements that *expansion joints* as shown at Fig. 44 should be introduced.

Fig. 44.



Plan. Elevation with part Section

G. *Methods of Heating.*—The application of heat to stoneware vessels requires considerable care, and successful results in its use depends much on suitable arrangement.

The power of conduction in stoneware is very limited. It is needful, therefore, to distribute any sudden change of temperature over the whole surface of the vessel as much as possible. If this is not done the heat directed on one portion causes this to expand before the transmission of the heat to other parts has taken place and fracture is liable to ensue. For this reason any method which allows rapid circulation of the heat to all parts is to be preferred. Therefore a steam jacket or a water-bath is much better than a sand-bath.

It is true that the latter allows of a higher temperature being transmitted to the vessel, but the heating is less uniform and cannot be so readily diffused through the sand.

In working with jacketed vessels much care is needed to protect the stoneware from the direct action of the inflowing heat, by a "baffling" piece.

In cases where the jointing of the vessel to the jacket is by means of a flange it is necessary to remember that the additional thickness at this part prevents the equal expansion. Also that the part, if any, above the flange being generally exposed, and therefore colder, will not expand to the same extent in heating.

For these reasons the heat should be applied somewhat lower down in the jacket so that the undue strain may not occur in the first application.

Some experiments were made several years ago, in which I assisted, under Coffey's patent, when stoneware vessels were heated to high temperatures by means of heavy paraffin oils circulating in closed jackets. The results were considered satisfactory and a temperature of 520° F. was obtained in the vessels without fracture. The oil itself was worked up to 800° F. on leaving the furnace. Considerable care, however, is required to obtain oil free from resins which clog the pipes, and it is needless to say that very steady circulation has to be maintained to prevent the oil being overheated.

Another method of heating is by steam coils inserted in the vessel, the heat being transmitted through the coil to the liquid. If the nature of the operation will allow it, and a suitable material can be obtained for the coil, this plan is very satisfactory.

A more risky plan is the introduction of steam into the vessel itself. The concussion resulting from this arrangement is very liable to cause fracture, and every means should be taken to lessen the vibration, if it is resorted to. The vessel may be enclosed in a wooden or cast-iron jacket and filled up with cement, concrete, loose sand, asphalt composition, or sulphur and sand mixed in suitable proportions according to the temperature required.

The temperature which it is possible to apply to stoneware is only limited by the fusibility of the material itself. Any temperature up to this point can be successfully used, providing it can be applied equally to all portions of the vessel at once; and also that the application is sufficiently gradual to allow of the penetration of the heat through the mass as well as its action over the surface. It is, however, usual at the ordinary thicknesses and by the methods now in use, to recommend the employment of stoneware up to about 400° F. Beyond this point other bodies are to be preferred and special mixtures need to be introduced partaking more of the nature of fireclay in their composition.

The capability, however, of rapid expansion and contraction without cracking is a quality not so easily obtained. It can only be secured:—

1. By making the material very thin, so that there is not a great mass for the heat to penetrate.

2. By making the body coarser, so that the heat may penetrate more rapidly.

3. By the most careful annealing of the vessel during firing, so that the particles of the mass are not in any undue state of tension.

4. By using such materials as in themselves are liable to comparatively small contraction or expansion.

It is therefore only by the consideration of each chemical process according to its requirement that the best adjustment of the above methods can be arrived at. The coarser the body, the more porous the vessel. The thinner the vessel the weaker for use and the more risk of warping and breakage in manufacture. The less the contraction of the material, the more friable the body of the vessel itself.

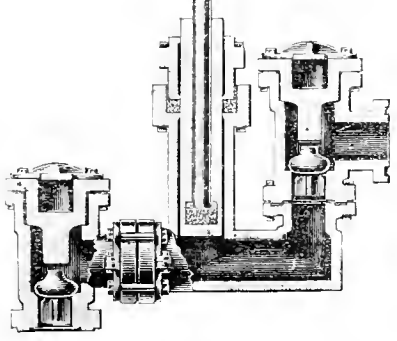
H. *Pressure and Resistance*—I regret that the length of the present paper does not permit of my placing before you to-night any important facts in relation to this part of the subject. I hope, however, to have this opportunity on some future occasion. Meanwhile I wish to draw your attention to the following table, which gives the result of some few materials, although not directly relating to chemical stoneware.

It is, however, clear that the variation in the bodies used for chemical operations is so considerable that no definite information can be tabulated as to the strength, this being also partly dependent on the thickness and form of the vessels. (See Tables D., E., F.)

It is important to note that the thickness possible is limited, and cannot be increased proportionately with the size of the vessel. The pressure allowable, therefore, rapidly diminishes with increasing circumference. For this reason, if practicable, the strength of large vessels should be supplemented by the additional support of bands or jackets, and when these can be so arranged as to prevent the undue expansion of the vessel, and also equalise the strain, in this respect a very important result has been attained.

The comparison of the figures in Table F., Nos. 1 and 2, shows that even a partial support greatly increases the stability of the vessel.

J. *Special Apparatus.*—It has not been the intention of the present paper to enter on so wide a subject as the special



application of various constructions or to describe the great variety of forms in which this material is manufactured. I may perhaps, however, be pardoned for bringing to your notice one such arrangement in evidence of the progress made, and which I think you will allow is a creditable instance of technical difficulties successfully overcome. I refer to the stoneware acid force pump. Some years ago I conceived the idea of producing pumps in stoneware, and after making such modifications as experience showed to be necessary, we have been able to turn out for some time past acid pumps up to 6-in. bore such as you see before you. The plungers are accurately ground, and the packing is of asbestos or india-rubber, as may be most suitable. The valves are of stoneware, and the valve boxes are interchangeable, being also removable without detaching the pump.

I have also ventured to call your attention to the stoneware slabs for sectional acid tanks. By means of powerful and accurate machinery the edges of these slabs are ground to a true face, and can be used for lining tanks of other material or bolted together with care in a similar way to cast iron. For some purposes this system is very useful, and is the only method under which stoneware can be applied to the manufacture of vessels too large for producing in one piece. Much of the success of this plan, however, depends on the use of suitable cement and considerable care in the arrangements for bolting up the structure.

TABLE D.—INTERNAL PRESSURE.

Terra Cotta.

160 Terra Cotta Glazed Pipes, 4 in. diam., ⅝ in. thick, 36 in. long. Tested to 100 lb. per sq. in.

Bursting pressure	20 lb.	30 lb.	40 lb.	50 lb.	60 lb.	70 lb.	80 lb.	90 lb.	95 lb.
Number of pipes broken	10	15	11	6	4	6	6	2	2
Percentage, total	6·2	15·6	24·3	28·1	30·0	34·3	38·2	39·3	40·0

Note.—Some pipes tested beyond burst at 120 lb.

TABLE E.—INTERNAL PRESSURE.

Stoneware.

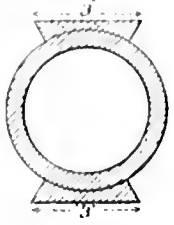
Bore.	Thickness.	Length.	Pressure per Sq. In.	Remarks.
In.	In.	In.	Lb.	
6		24	30	10 pipes stood.
6		24	35	1 pipe burst.
6		24	15	1 pipe burst.
9		24	30	10 pipes stood.
9		24	20	1 pipe burst.
12	1	24	30	10 pipes stood.
12	1	24	29	1 pipe burst.
12	1	24	20	1 pipe burst.
15	1¼	24	28	1 pipe burst.
15	1¼	24	30	1 pipe burst.
21	1½	24	30	3 pipes burst.

TABLE F.—EXTERNAL PRESSURE. (LONGITUDINAL.)

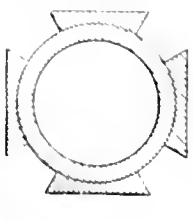
Stoneware.

No. 1.			No. 2.		
Diam.	Thickness.	Crushing Pressure.	Diam.	Thickness	Crushing Pressure.
Inches.	Inches.	Cwt.	Inches.	Inches.	Cwt.
6		28	6		44
6		18	6		50
6		25	6		52
9		32	9		47
9		30	9		51
12	1	23	9		52½
12	1	26	12	1	64
12		22	12	1	64
15	1	25½	12	1	64

No. 1. Tested with 3-in. wide bearing at top and bottom throughout length.



No. 2. Tested with one-half the circumference supported. Four segmental blocks, one above, one below, two at sides.



DISCUSSION.

The CHAIRMAN having invited discussion on the paper:

Mr. DAVID HOWARD thanked the author for his clear exposition of the conditions under which stoneware chemical apparatus was produced—which conditions ought to be constantly borne in mind by the chemists who used the apparatus, in order to successfully carry out operations on a large scale. Few of them were such adepts in the subject that they would not gather much that was useful from the paper. One point which came out very clearly was that they must not insist strongly on perfection of form in such apparatus, for when secured it was generally at the expense of the quality of the ware. The great advances recently made by potters in adapting the character of their wares to various purposes was a striking illustration of the modern development of this most ancient of manufactures. But to attain that end it was essential that the potter should be fully informed as to the uses to which his wares were to be applied. One result of the reading of the paper would be to make chemists far more careful how they applied stoneware apparatus to unexpected purposes.

Mr. W. CROWDER inquired whether the author had any experience of the use of the acid pump exhibited, in dealing with sulphuric acid. Seeing that there were several valves in the apparatus, he would like to know how long they might be expected to last, and also whether the valve seats were likely to wear out. It seemed to him that even if the worn-out valves could be replaced by new ones the leakage of the seats was likely to cause trouble. Again, in the case of the plunger of the pump, it hardly seemed possible that any provision could be made for keeping it tight after it had begun to wear. He understood that at present the pump was principally used for hydrochloric acid; but if Mr. Rix could reassure him on the points he had raised he thought that the pump might be used with great advantage for dealing with sulphuric acid, and for many other similar purposes.

Mr. WATSON SMITH agreed with Mr. Crowder's remarks. In 1873, a firm with which he was then connected purchased a stoneware hydrochloric acid pump, and during the process of erection, part of a flange, including portion of a bolt-hole, was broken off it. On inquiring whether the pump could be repaired, his firm was informed that no cement then existed which would repair the apparatus satisfactorily, and that consequently it would be necessary to buy a new pump. That unpleasant experience led him to inquire whether there was at the present time any effective material for cementing together the parts of stoneware apparatus for chemical uses. If not, was it possible to obtain new portions of such a composite piece of apparatus as an acid

pump, for example, to replace those portions which might be slightly broken, so as to avoid the expense of repurchasing a whole pump or other apparatus?

Mr. G. D. MacIndoe wished to know what amount of pressure the acid pump might be relied upon to stand. Pressures of 40 to 50 lb. were common in dealing with acids. Would the pump shown stand a pressure of 80 lb.?

Mr. W. P. Rix, in reply, said that great progress had been made since 1873 in the manufacture of such apparatus as the acid pump shown, its whole arrangement having been entirely remodelled to meet the difficulties which experience had shown to arise. The pump now stood on its own base, and as the body was not now cylindrical in form, like the pipes exhibited, it could easily be bolted to any suitable foundation. The valve boxes were now made interchangeable, and formed no portion of the pump itself. It was also possible to grind the valves with emery, and fit them on the spot. With regard to the leakage or breakage of the valve seats, he could assure Mr. Crowder that they were now made sufficiently strong to bear any strain that was likely to be put upon them. With respect to the breaking of flanges, he had already pointed out that extreme care was necessary in bolting stoneware. It being absolutely rigid, more rigid even than cast iron, unless the bolts were carefully screwed up all round, so as to avoid any undue pressure on one part, fractures would occur. Such breakages were generally due to the fact that the workmen were accustomed to deal only with metal apparatus, and forgot the extra care that was required in the case of stoneware. With regard to Mr. Crowder's question as to the arrangement of the plunger, he would point out that it was ground only into the stuffing gland, and not into the barrel, a small space being allowed between. The strain thus fell only on the packing, which could be renewed. If, however, the stuffing gland became worn, all that was necessary was to send it to be ground to a new plunger. The question of the pressure to be put on such a pump was, of course, of great importance. In the case of the 6-in. pump, the pressure on the valve box cover was considerable, and there was need of great caution in using high pressures; but there was no such difficulty in pumps up to 4 inches. In pumping such a dense liquid as sulphuric acid it would not be possible to attain so high a pressure as in dealing with hydrochloric acid. They were accustomed to test their acid pumps up to 35 lb. to the square inch when required, but he would not like to undertake a pressure much above 20 lb. unless it were specified, in which case the valves and other parts would have to be made extra strong for the purpose. But for ordinary purposes, and with pressure up to 25 lb., there should be no difficulty in using these pumps. He trusted that the explanations he had given would be sufficient, and that an examination of the pump by the members would convince them that it was a useful and efficient apparatus.

TANNING BY THE AID OF ELECTRICITY.

BY DR. S. RIDEAL, F.I.C., F.C.S., AND A. P. TROTTER, B.A., A.M.I.C.E., A.I.E.E.

The slow rate at which a hide is converted into leather in the ordinary process of tanning has induced many inventors to devise methods by which the chemical change might be accelerated without deterioration of the quality of the leather produced, but the want of any definite knowledge as to the precise nature of the interaction which takes place between the gelatin of the raw hide and the various tannins employed in this industry has been a serious obstacle in the development of these methods, and many of the proposals after having been tried on a small scale have been abandoned in favour of the old and slow process. It is necessary to refer to some of these proposals in order to understand the position of the industry a few years ago, when the first important steps towards the employment of electrical energy for hastening the tanning process took place.

One of the earliest patents for accelerating the process of tanning by mechanical methods is that of Francis G. Spilsbury of Walsall, Staffordshire, and is dated 1823. He used oblong frames of wood and stretched the hides on these, placing a frame between and thus forming a vessel, having stretched hides for its sides. Into this vessel the tanning liquor was run through a pipe from an elevated tank, pressure being regulated by the hydrostatic head. The hides became distended and the liquor oozed out forming drops like dew. By this process it is said that the hides could be tanned in six weeks, or in some cases in eight or nine days, instead of a year. The process was abandoned, owing to the trouble entailed in closing any holes or tears in the hides and the considerable waste caused by cutting the hides to fit the frames. Another early invention for hastening tanning was that of T. J. Knowles, who employed an air-tight vat. The hides were suspended in the liquor from hooks at regular intervals, and were provided with leaden weights to keep them uniformly stretched. The air was exhausted by a pump, and after an interval the liquor also was removed and the air admitted. This process was repeated until the tanning was accomplished.

One of the first applications of mechanical motion was that of W. Brown, of New York, who employed a reel or cylinder, composed of two heads and a number of longitudinal bars with pins on the outer surface on which the hides were fastened. He also threw them loose into the cylinders, which were slowly rotated by means of ratchet gear. In America, a rocking bar was used, the hides hanging from it and alternately dipped into the liquor and withdrawn from it. A modification of this consisted of a frame moving up and down, dipping the hides in the vat. These and other mechanical methods were used for the simple purpose of obtaining a continually fresh application of the tanning liquor to the surface of the leather, instead of the ordinary daily handling of the hides. These mechanical processes may be broadly divided into two classes: those in which the hides are allowed to hang or are stretched on frames, and those in which they are rolled or churned loose, in bulk. In the former class, the stirring of the liquid is practically as efficient as in the latter, but there is no tendency to remove the soluble or soft gelatin and albumen by kneading and churning, and the hides being always surrounded by the liquor, the tannage proceeds uniformly in every part.

So far, the mechanical processes are designed for an obvious purpose, but when we come to the application of electricity to tanning, we find that the inventors are groping in the dark, using a powerful operator, but with no rational principle or motive. The only *à priori* reasons for applying an electric current to a hide in a tan pit are, that some electrolytic action *may* liberate some tanning agent in a nascent state, and that dialysis is accelerated by the passage of a current, and that there is a relation between osmosis and electrolysis.

As early as 1849 a tanner named Crosse proposed to utilise "electricity or galvanism for tanning purposes." The electrodes consisted of sheets of zinc and lead, immersed in an ordinary tan-pit in which water and the hides were placed, bark or other tanning material being added from time to time, after the skins had been subjected to this action for some days. Ward, in Lancashire, some years later, passed a current of electricity through the tanning liquor in ordinary tan-pits. In 1861 Rebu made several experiments on electrical tannage, employing various metallic salts as well as ordinary liquors in his pits. In 1874 de Mertens, of St. Petersburg, turned his attention to the subject, and has for some years adopted in nearly 600 pits the following plan of electric tanning. A layer of carbon connected with the positive pole of a dynamo is placed at the bottom of each vat and it is then filled with the alternate layers of moist skin and tan, a plate of zinc forming the negative pole at the top of the pit.

In 1876 Lucien Gaulard and Kresser proposed another process in which they used two parallel plates of carbon, and immersed the hides between them in tanning liquor, passing a continuous current of electricity through from plate to plate. Leather made by this process was exhibited in London in 1883. The process of Laudin and Abou has been worked for more than two years in the tanyard of

Messrs. Nielson of Norrköping, in Sweden. Here, the hides are attached to wooden frames and are placed in a pit. Large copper electrodes are provided, and an alternating current is passed.

A simple combination of motion and electrical treatment was patented in France by Worms and Balé in 1887 (this Journal, 1888, 41, 587), and consists of a large drum, some 11 ft. in diameter, mounted on a horizontal shaft and filled one-third full of tanning liquor, together with some turpentine, and in this half a ton of hides are placed loose in bulk. The drum is set in motion by steam power, and a current of about 10 ampères is passed through the contents by means of copper electrodes placed on the interior surface of the ends of the drum. Nicholson and Palmer (Eng. Pat. 9776, 1889) have also described a similar process, in which the hides are suspended on the positive electrode within the rotating drum, and the current of electricity is caused to flow mainly through the hides.

Another distinct process is to be found in the Groth system of tanning (this Journal, 1888) a description of some of our experiments on which forms the subject of the present communication. In Groth's apparatus there is a combination of motion and electrical treatment, but the motion is of such a nature that the hides being left stretched and suspended in the liquor, are not churned about or rubbed one on the other as in Worms and Balé's process.

The two practical forms in which Groth's invention has been worked at the Grange Works, Bermondsey, are first, a round vat containing a revolving frame carrying the hides, and secondly, a rectangular tank in which a similar frame is carried to and fro, running on wheels, and moved by a crank. One of the circular vats placed at our disposal was 7 ft. 3 in. in diameter and 6 ft. 4 in. deep. The cubic contents were thus about 315 cub. ft. or nearly 2,000 gallons. The sectional area in a vertical plane is about 43½ sq. ft., the superficial area in plan is 42 sq. ft. A strong central shaft turns in bearings and is driven by bevel gear, the arrangement being precisely like a brewer's mash tun. Wooden arms are attached to the shaft and carry cross pieces. These are provided with a number of brass hooks, by means of which the hides are hung vertically, about an inch apart, all the metal work in contact with the liquor being brass or copper.

Electrodes are placed against the sides of the vat. These consist of strips of copper arranged gridiron fashion. Four strips 4 ft. 3 in. long by 2 in. wide are placed 8 in. apart, and are connected at the top and at the bottom by strips of similar width. The whole surface exposed is therefore about 4 sq. ft. Experiments were also carried out in a rectangular vat in which the hides were moved backwards and forwards longitudinally.

The tanning liquors were made of the usual materials, and during the tannage were strengthened from time to time in the usual way, and the hides were prepared for tanning by liming, unhairing, fleshing, and colouring as practised by most tanners.

The current was varied in different experiments according to the nature of the hides and strength of liquor. This is important in order to obtain satisfactory results. Previously to our investigation a series of experiments, in which the current varied from 1 to 30 ampères, was employed; best results were obtained with the weak currents, and the considerable loss due to electrolytic action when a greater current was employed, was thereby avoided. With a current from 1½ to 4 ampères, the density is from ·375 to 1 ampère per sq. ft. of electrode, and from ·0345 ampère per sq. ft. of transverse sectional area of the contents of the vat to ·092 ampère per sq. ft.

For currents from 1·3 up to 2·3 ampères, the total resistance of the liquor at 9° C., sp. gr. 1·01, expressed, for convenience, in ohms, was 8·7. On another occasion, at 7° C., sp. gr. 1·019, the resistance was 7·7 ohms, with 2·3 ampères. In each case the resistance was measured by observing the current and the volts between the electrodes. The quotient gives the sum of the ohmic resistance and of the polarisation. Exploration of the vat by means of a movable electrode showed that the flow of current was very uniform.

In our earlier experiments the current and voltage were observed, the vat being full of tanning liquor up to a certain mark. The hides were then put in, displacing a certain quantity of liquor. This was removed until it stood at the same mark as before, and the resistance was again determined. The results obtained in this way, however, did not give us any very definite information as to the variation in the resistance of the hides during their conversion into leather, but were sufficient to show that the hides when just immersed did not offer any material additional resistance to the electric current. Arrhenius (B. A. Electrolysis Report, 1887, 345) has previously pointed out that the resistance of solidified gelatin is not different from that of gelatin solution.

A more careful and accurate series of observations were subsequently made on the electrolytic resistance of the tanning solution, from which the following curves were obtained.

The temperature coefficient was, as might be expected, negative. The resistance decreased ·9 ohm for a rise of 1° C. or 1·32 per cent. at 16° C., falling from 75 ohms per cubic inch at 8·6° C. to 59 ohms per cubic inch at 26° C. The liquor was a strong solution containing 4·25 per cent. of tannin, obtained from mimosa bark and gambier, such as was employed during the later stages of the tannage. The same sample was tested for the purpose of ascertaining the true ohmic resistance and the fall of volts due to polarisation with different current densities on the electrodes. The resistance of the given sample of the liquor at 8·5° C. was 82 ohms per cubic inch—11 d where d is the density in ampères per square foot of electrode. This is shown by the straight falling line in Fig. 1—

$$v = 82 - 11\,d$$

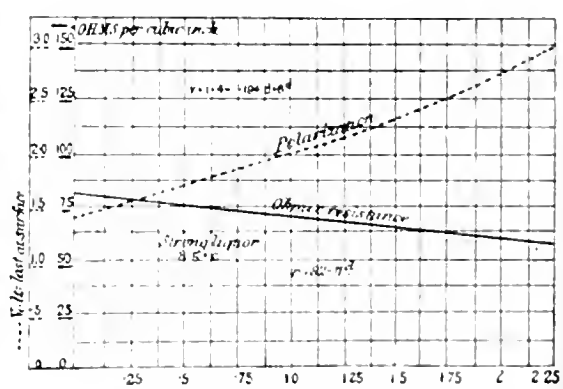
The voltage lost at the surface of the electrode is not so simple a quantity. It tends to a minimum of 1·4 volts for a minimum current, and the two following empirical formulæ closely approximate to the observed curve—

$$\text{Volts} = 1{\cdot}4 + 45\,d^{1{\cdot}2}$$
$$\text{or} = 1{\cdot}4 + {\cdot}194\,d + 8\,d^2$$

where d is the density of current in ampères per square foot. This is shown by the rising curve on Fig. 1.

Fig. 1.

Polarisation Effect.



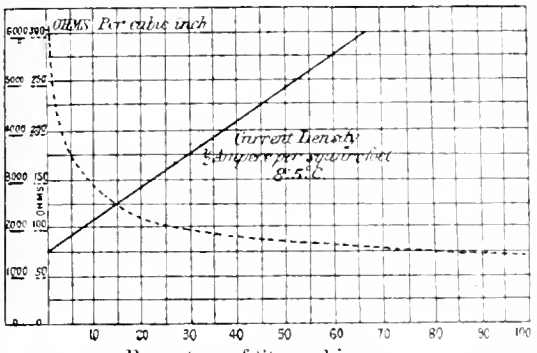
A third series of tests were made to determine the change of resistance produced by dilating the liquor with water.

The curve of the results of the observations, shown in Fig. 2 by the dotted curve, which evidently bears a strong resemblance to a rectangular hyperbola, and on analysing it by plotting the relation of the product of the resistance into the strength, with the strength (taking the normal strong liquor of 4·25 per cent. of tannin as 100) the result

is a straight line, shown on the diagram, the slope of which is 63, and it cuts the axis of the abscissæ at 1200. The curve is, therefore, a rectangular hyperbola, that is to say, the resistance is inversely proportional to the strength of the liquor plus the resistance to which the curve is asymptotic, that is, the resistance of the saturated solution per cubic inch would be 63 ohms per cubic inch. The formula is therefore $r = \frac{120}{s} + 63$ where s is the strength of the liquor per cent., 100 being the normal solution referred to.

Fig. 2.

Variation of Resistance with Strength of Liquids.



Percentage of Strong Liquor.

With the view of ascertaining whether the mechanical stirring of the liquor had any oxidising or other effect upon the liquor, a vat was filled, and the frame was kept rotating as in ordinary work, but without any hides, for 24 hours. Analyses of the liquor before and after this treatment gave identical results as far as the practical point of the percentage of tannin is concerned, thus showing that the stirring has no effect other than that of continually bringing fresh liquor to act on the surface of the hides. A similar experiment was made to determine the effect of passing an electric current of ordinary working strength for 9 hours through the vat simultaneously with the motion of the frame. At the end of the experiment the liquor contained the same percentage of tannin. This result was to be expected, as the electrical power is remarkably small and the current density in the liquor is far below that of any ordinary electrolytic operation. Taking the mean volts and ampères of the second test already mentioned, and deducting 1·6 volts for polarisation, we have 36·8 watts expended in the liquor. It is obvious that this very small power, about $\frac{1}{21}$ of a horse power, can have but little effect on 2,000 gallons of liquor. The electrolytic effect is negligible when such weak currents are employed, since a current of 2 ampères will only liberate from water ·075 grm. of hydrogen and ·6 grm. of oxygen per hour, or during the whole process considerably less than 10 grms. of hydrogen would be evolved.

In our earlier chemical experiments with this process, our efforts were directed towards establishing the rate at which the tannin is taken up by the hides with and without the use of motion and an electric current. It was also of interest to determine whether the rate of tannage in the circular vats, in which the hides were suspended on a rotating frame, was similar to that obtained when a square vat was employed, and the hides suspended on a frame to which a reciprocating motion was imparted as already described.

In these first experiments the rate of tannage was determined by noting the loss of tannin from the liquor after given intervals of time, and from the data so obtained calculating the average rate of loss per hour from the liquor.

The following table summarises the results obtained in three complete tannages in which the process was discontinued at night, so that the electrical current and motion was only applied to the experimental vat for from six to eight hours per diem :—

Table I.

Experiment.	Loss of Tannin per Hour per 10,000 Parts of Liquor.	
	Day.—With Motion and Electricity.	Night.—Without Motion and Electricity.
Circular vat 1, 1,600 gallons...	·62	·344
Circular vat 2, 2,400 gallons...	·612	·349
Reciprocating vat.....	·533	·338

The experiment in the circular vat 1 extended over a period of 26 days, during which time the machine was in motion for 167 hours, and a current of electricity applied for 98 hours to the 20 butts tanned in this experiment.

The second experiment in vat 2 lasted for 33 days, during 209 hours of which the hides, 30 in number, were in motion and a current of electricity passed for 115 hours.

In the reciprocating vat 40 bellies and 20 shoulders were in the liquor for 27 days, the machine was in motion for 181 hours, and a current of electricity simultaneously applied for 82 hours. In each experiment the hides were completely tanned when they were taken out of the vat, and when finished were reported to be leather of excellent quality.

Daily temperature readings of the liquor were taken, but on no occasion was the temperature markedly different from that of the surrounding air, 15 C. being the highest reading recorded, and on some days the liquor being as low as 5 C.

The following table gives the actual experimental numbers obtained in the second of the above tannages, from which the average numbers given in Table I. for this experiment were obtained.

Table II.

Circular Vat 2.

Strength of Liquor in parts per 10,000.		No. of Hours.	Total Decrease per 10,000.	Decrease per Hour per 10,000.
Machine Started.	Machine Stopped.			
A. With Electricity and Motion. Day.				
92·8	89·4	5	3·4	·68
93·8	90·0	7	3·8	·54
84·6	81·2	5·5	3·4	·618
139·2	134·15	8	5·05	·63
127·8	123·05	8	4·75	·593
Average ·612 parts per hour per 10,000.				
B. Night, at Rest.				
89·4	84·4	14	5·	·357
99·4	93·8	15	5·6	·373
90·0	84·6	14	5·4	·385
105·6	100·2	14	4·4	·38
135·8	129·6	14	4·2	·3
282·2	268·3	45	13·98	·301
Average ·349 parts per hour per 10,000.				

The concordant nature of the above figures, as well as similar ones obtained in the other two experiments mentioned in Table I. at first led us to imagine that the hastening due to the combined action of motion and the electric current

was expressed by these numbers. Further experiments to be referred to later, however, proved to us that the rate of absorption at night, after the action of the electric current had been continued for some hours during the day, was much greater than that observed when the hides had not previously been subjected to this influence; in other words, the increased rate of absorption continued after the machine was stopped and the current was switched off. This effect may in all probability be attributed to the fact that as the hides pass through the liquor, the pores of the skins become distended and thus facilitate the passage of the liquor through the hides, which remain in this distended state for some time after they are brought to rest and the electric current cut off. When the machine is at work the hastening is further increased by the motion of the hides in the liquor augmenting the frequency of contact of the tannin molecules with uncombined gelatin, and when the current is passing a further hastening is no doubt due to the increased motion of the tannin molecules through the liquor which such current imparts to them and its disposition on the suspended hide. An endeavour was also made to trace the change taking place in the hides during the absorption of the tannin, and from the series of numbers obtained it was noticed that the percentage of water present in the well-drained hide gradually diminished as the tannage became more complete; the fleshed hide containing approximately 77 per cent. of water and the leather as taken out from the vat from 45—55 per cent. according to the part of the skin examined. A gradual increase in the specific gravity of the dried skin was noticed, 1·062 being the lowest and 1·119 the highest specific gravity obtained. Samples of the leather obtained in these three experiments were subsequently tested by the Kjeldahl process and nitrogen contents ranging from 7·35 to 6·99 were obtained. Very little is apparently known as to the nitrogen contents of finished leathers, and although Bottinger (Ann. **244**, 229) has shown that the compound of gelatin with oak bark tannin contains 9·4 per cent. nitrogen, and oak-bark tanned leather from 9·03—9·24 per cent., he has pointed out that both of these bodies are decomposed on heating with water, yielding a soluble compound of greater nitrogen content and an insoluble body containing only 7·79 per cent. nitrogen in the former case and 6·17 per cent. in the latter.

It is obvious that if the nitrogen content of a leather can be regarded as an indication of the completeness of the change, that simultaneous determinations of the actual quantity of tannin taken out of solution by an unknown weight of hide substance and their average nitrogen content, would give data which would be of value to the tanner and enable him to predict the weight of his finished leather, and at the same time tell him the cost of the tanning material consumed in the work. Considerable difficulty was at first experienced in obtaining samples of the hide from time to time during the tannage that would represent the average composition of the leather. By taking the precaution, however, of taking the samples from a thick hide along the median line of the back from day to day, the error due to the varying thickness of different hides was reduced to a minimum, and the samples taken were then divided into two portions, one of which was dried at 100°, rasped, and the filings analysed, whilst a second portion was frozen, reduced to fine shavings by means of a microtome, dried, and analysed, and thus gave a check on the former value. As these are probably the first experiments in which a thick sole leather has been produced in a time sufficiently short as to render it possible to trace the gradual diminution in the percentage of nitrogen in the hide with its absorption of tannin from the ooze, we give a table showing the results obtained in a recent experiment.

Thirty specially selected green hides were marked and weighed, limed in the usual way for six days, unhaired and fleshed, but not scudded, washed and coloured in a weak liquor for two days. Their total weight was 2,322 lb., of which the horns, &c. weighed 104 lb., giving a net weight of 2,218 lb. used. The wet fleshed hides when introduced into the vat weighed 1,673 lb., and after the tannage was completed on the 22nd day, the wet leather taken out weighed 2,010 lb. The leather has since been finished and the weight in the dry and finished state was 986 lb. The hair sold weighed 714 lb. and the flesh 569 lb. The following table gives the composition of the leather at different stages of the tannage and the amount of tannin disappearing from the solution.

Table IV.

Date.	N. Per Cent.	Weight of Tannin absorbed in lbs.
Fleshed hides:		
February 26th	16·5	..
February 28th	14·43	103·3
March 2nd.....	12·14	258·4
March 4th	10·56	490·3
March 9th	8·95	656·4
March 12th	..	760·0
March 20th	7·50	775·2

It will be noticed that the absorption after 12th March was very slow, and that the total gain in weight estimated from the tannin absorbed during the following eight days only amounted to 15 lb., or about ½ lb. per hide. This slight increase in the weight, unless it markedly affects the quality of the leather, cannot possibly compensate for the extra time and power spent after the 14th day. In this experiment the 775 lb. of tannin consumed were obtained from mimosa bark and gambier, and for estimating the cost we may assume that 625 lb. were obtained from the bark, and 150 lb. from the latter. A 35 per cent. bark at 16*l.* 10*s.* per ton would furnish 625 lb. of tannin for 12*l.* 9*s.*, and a 50 per cent. gambier at 34*l.* per ton would furnish 150 lb. for 4·55*l.*, making a total cost for the tannin materials consumed in tanning the 30 hides, 17·45*l.* Other materials would, of course, work out to a different cost, and if valonia or oak bark had been employed the cost of tannage would be considerably less.

It will be seen from the above figures that a very large amount of tannin was absorbed during the experiment which was not present in the finished leather obtained. We believe that this result is due to the large portion of the tannin consumed being deposited on the surface of the semi permeable membrane, and subsequently being removed when the leather is washed and during the finishing process. The difference between the amount found in the finished leather and the amount lost by the liquor during the tannage can, of course, be utilised for further work. Ostwald (Zeits. Phys. Chem. **6**, 71) and Tammann (Zeits. Phys. Chem. **6**, 237) have recently drawn attention to the deposit of copper in this way from a copper solution on the surface of a semi-permeable membrane of copper ferrocyanide, and it would seem probable that after the gelatin tannin compound is formed the deposition of tannin continues, but on the surface only of the leather. If the experiment had been stopped earlier, the quantity of tannin absorbed would have been less, and the amount removed from the surface in the finishing process also less.

Bottinger's experiments already alluded to point to a direct condensation of the gelatin and tannin taking place in the conversion of hide into leather, but so far as we are aware, there have hitherto been no direct experiments that this absorption took place gradually, and that there was a definite relation between the tannin lost by the liquid and the nitrogen content of the hide.

From analyses of the fleshed hide and finished leather the decrease in the nitrogen value and increase in the oxygen per cent. has been repeatedly pointed out, but by those who held that no definite compound was produced, this change was attributed to the direct oxidation of the hide substance and loss of nitrogen as ammonia. The above experiments go far to establish that when tannin is employed the conversion of the hide into leather is due to a combination or condensation of the gelatin and tannin.

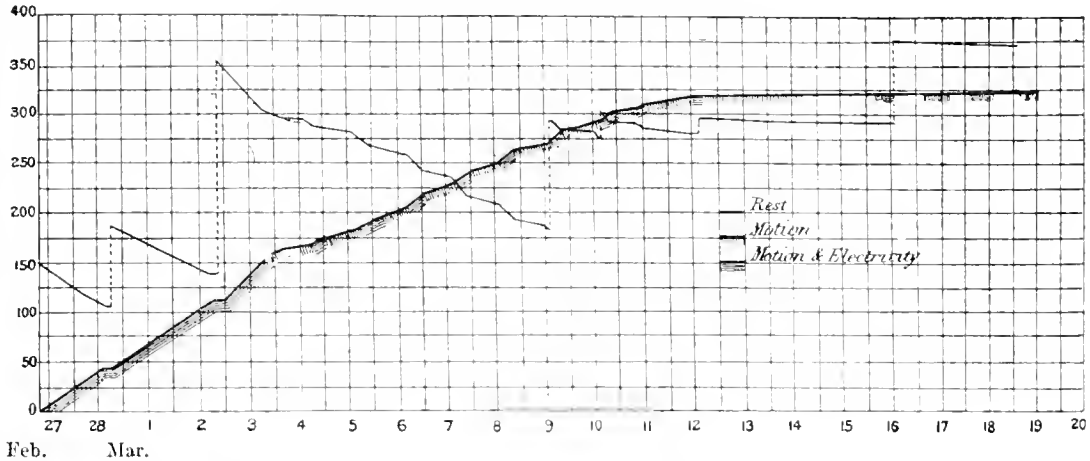
We have not been able to ascertain what is the maximum amount of tannin which a given weight of hide will chemically absorb, but many of the samples of leather prepared by the ordinary process contain less tannin than the above. It is obvious that, provided the quality of the leather is equally good, the tanner, instead of aiming at the maximum yield of weight, should strive at the minimum yield, when tannin is worth more per pound than fleshed hide and conversely, when the economic conditions are reversed. The limits for a good leather appear to be approximately 40—60 per cent. hide substance, in union with 60—40 per cent. "tannin."

At present it is customary to judge of the quality of the leather from its appearance and colour; a hide is, however, frequently struck through when it has only absorbed a comparatively small quantity of tannin, and the colour of the finished leather varies considerably with the kind of tanning materials employed.

In Fig. 3 the daily absorption of tannin from the liquor in the above experimental tannage by this process

Fig. 3.

Diagram of Complete Tannage. Groth's System.

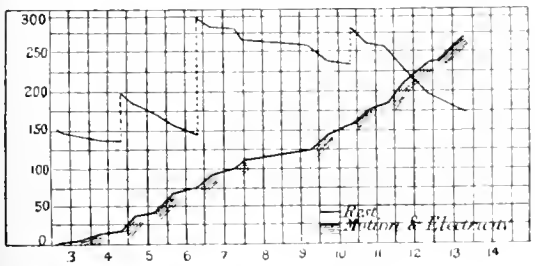


is shown, in which it will be seen that the rate of absorption as already shown in Table IV. gradually diminishes as the hide becomes saturated with the tannin, and finally the rate becomes so small that the ordinary permanganate valuation of the liquor is useless for estimating the change.

In Fig. 4 the daily readings for a similar experiment are plotted out and show analogous results. The readings were, however, discontinued on the 11th day, although the

Fig. 4.

Diagram of Complete Tannage.

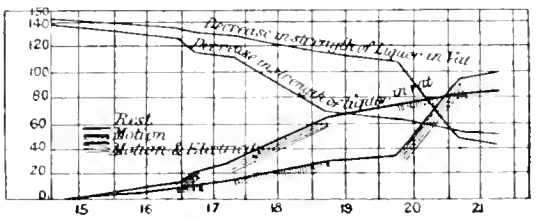


quantity of tannin absorbed by the hides used in this experiment was not sufficient to completely tan them. They were subsequently finished in another vat. From the foregoing results, we have sufficient data to establish the qualitative fact that the combined action of the motion and the electric current considerably hastened the rate of tannage. It was of interest, however, to ascertain, if possible, what was the average rate obtained when the hides were slowly rotated in the pit and when no current was passed through the liquor.

A comparative experiment was made to establish this point, the results of which are given in the accompanying diagram (Fig. 5). Two circular vats were employed, A. and B., containing 1,600 and 2,400 gallons of liquor respectively, made up to approximately the same strength. A batch of hides which had previously been limed, unhaired, and fleshed under the same conditions, was divided into two portions, whose weights were in the ratio of the volumes of the liquor in the two vats, so that the loss of tannin per unit volume of the liquor is equal to the absorption of tannin per unit weight of hide in each vat. The liquor in both vats

Fig. 5.

Diagram of Comparative Tannages.



was analysed at the commencement of the experiment (Feb. 14th, 4 p.m.), and the hides remained suspended in the liquor, without any motion or electric current being applied to them, for 44 hours. Samples of the two liquors were analysed and the rate of absorption in each vat deduced and found, as might be expected, to be practically identical. The subsequent treatment of the hides in the two vats was so arranged that the hides in vat 1 should be subject to the joint influence of motion and electric current, whilst those in vat 2 were under the influence of motion alone. The experiment was then repeated for a longer time, and after an interval of rest the conditions were reversed, the hides in vat 1 being subjected to motion alone and those in vat 2 to the joint action of motion and electric current.

The results are plotted together in Fig. 5, where the upper curves show the gradual loss of tannin from the liquor and the lower curves calculated from them to show the quantity absorbed by the hides (as during these experiments the liquors were not strengthened, the lower curves are the images of the upper). From the slope of the lines the relative rates can be obtained.

The following table summarises the above results:—

Comparison of the Rates of Tanning.

Kind of Tanning.	Total Loss in Parts per 10,000.	Total Time in Hours.	Rate.
Ordinary tannage	12·8	88	·145
Rest after motion and electric current	15·3	56	·273
Rest after motion alone	15·7	56	·280
Motion after electric current	8·6	24	·36
Motion alone	1·8	38	·049
Motion and electric current	53·6	38	1·42
Electric current after motion	59	24	2·47

Thus, while the initial rate in vat 1 was ·163 parts per 10,000 per hour, and ·101 parts per 10,000 per hour in vat 2, when a current of electricity and motion was applied to vat 1, and motion only to vat 2, the rate of loss in vat 1 rose to 2·43 parts per 10,000, and in vat 2 to ·63 parts per 10,000. After an interval of rest, vat 1 showed a rate of 1·36 parts per 10,000, and vat 2 a rate of ·52 parts per 10,000. It is to be noted, however, that the apparent falling off in the rate in vat 1 may be due not only to the gradual diminution as the tanning proceeds as already referred to, but to the electric current during the night of this experiment being smaller than during the day, or possibly interrupted for some time, as no electrician was controlling the experiment during the night in question. After an interval of rest the conditions were reversed, motion being alone used in vat 1, and motion and a current of electricity simultaneously in vat 2. The rates of loss were then found to be ·36 parts per 10,000 per hour in vat 1 and 2·46 parts per 10,000 per hour in vat 2, thus confirming the previous figures and proving that the vats or proportions of liquor and hide employed in each were not affecting the comparison.

The average values thus obtained are in the proportion of—

Ordinary Tanning.	With Motion.	With Motion and Electricity.
·133	·503	2·08

or the rate of tanning under the combined influence of electricity and motion is four times faster than the rate when motion alone is employed, and 16 times faster than when neither are used.

We have not tried the effect of a current of electricity on the hides when at rest, although no doubt the tanning rate would be similar to that obtained when motion is employed, as the hides when at rest would not be uniformly influenced by the flow of the current through the vat, and the leather produced would therefore be unequally tanned. It ought also to be noted that these rates were obtained with the motion of the kind produced by the first kind of machine, and that no doubt other rates of tanning would be observed under the influence of other kinds of motion, and if no provisions were adopted for preventing the hides from being in contact with another, it is safe to assume that the rate would be considerably less, as the circulation of the liquor to every part of the hide would be prevented.

Theoretical Conclusions.—The original suggestion of Grothius in 1805, with its chain of molecules and bonds, its pairing and unpairing, formed a very fair working hypothesis, and has been gradually developed and elaborated until we are to-day confronted with a very serious complication of theories. Helmholtz has suggested that there is no tearing apart of the molecules, but that work must be done in separating an atom from its electrical charge, or in removing electricity from an atom of high specific attraction, and giving it to another lower in the scale. Clausius considered that the molecules are always changing partners, that dissociation, in fact, is always present to some extent, and that the effect of the electro-motive force is to give direction to movements which are already going on. Arrhenius considers that dissociation is complete in very dilute solutions, but Traube maintains that such a view upsets our conceptions of chemical affinity, and makes the convenient assumptions as to the nascent state impossible, and flatly contradicts the theory of hydration. The idea of a nascent state has been to a large extent given up by chemists, but the ions undoubtedly are occasionally liberated in a form in which, although they do not readily combine with the other matters in solution, and are in a self-combined state, *e.g.*, ozone, they are in a very energetic condition. From *à priori* considerations, as we have observed, this nascent state or the resulting facilities for combination which arise from the cause whatever it is called, might be expected to facilitate the operation of tanning in the same way that it affects the operations of bleaching and treatment of sewage. But although the tannins are molecules of some complexity there are no grounds for supposing that dissociated molecules react with the gelatin of the hides, and we have no proof whatever that any such dissociation takes place in the tanning process. Turning to the question of dialysis and osmosis, we find dialysis to be a form of diffusion to which electrolysis has been compared by Wiedmann, who showed that the conductivity of an electrolyte may be considered as depending on the coefficient of diffusion of the components through each other. Dialysis is a selective diffusion, and is undoubtedly facilitated by the passage of an electric current, and it is easy to see that such an action must be extremely advantageous in the slow process of tanning, which is probably retarded enormously by the superficial coagulation which takes place almost at the moment of first contact of the green hide with the tanning liquor.

Theories of dialysis are at present incomplete, but Van t'Hoff's law of osmotic pressure and our knowledge of the migration of ions indicate the direction from which a satisfactory theory of the process may be looked for.

In the meantime the facts which have been established are of a very different order, so widely different indeed that hypotheses of osmosis and observations of the migration of ions are alike useless. Dr. Oliver Lodge's experiments with dilute H_2SO_4 give a velocity of about $\frac{1}{2000}$ cm. per sec. for H, and $\frac{1}{5000}$ cm. per sec. for SO_4. With jelly and a slope of potential of 1 volt per cm. the velocity of Ba was $\frac{1}{8000}$ cm. per sec. and Cl and Br $\frac{1}{11000}$ cm. per sec. But with a slope of one-tenth of this, *i.e.*, about 1 volt per cm., the rate of progress of tanning is only about ·025 cm. in 100 hours, or $\frac{1}{1200000000}$ cm. per sec. or $7\frac{1}{2}$ inches per annum.

It thus seems necessary to attribute part of the hastening effect to the direct action of the electric current upon the suspended hide.

Helmholtz and Ostwald have given considerable attention to the resistance of electrolytes, and it is pointed out that the degree of dissociation can be determined from the conductivity. Arrhenius concludes that the resistance is greater as the ions are more complex, and the tannin molecules are considerably more complex than any compounds that have yet formed the subject of careful experimental work. Not only have we a complex solution, but it is admitted that with weak currents secondary actions are likely to take place at the electrodes, and it is only with strong currents that the real ions are liberated. The fact that the rate of absorption of tannin distinctly diminishes with even four ampères shows that if any chemical action be involved it is probably some secondary action of considerable complexity, and that therefore there is no need for attempting to explain the process by an electrolytic breaking down of the tannin molecules.

Although it is difficult to advance any definite theory as to the effect of the passage of the electrical current upon the process of tanning, the increased rate is obviously due to the current hastening the chemical union between the bodies which are in a condition to combine. It is well known that chemical combinations which only take place

at elevated temperatures, can be induced to occur at ordinary temperatures, when an alternating current is passed through the mixture of the two bodies. Amines combine with aldehydes in this way, and Meritens (Eng. Pat. 16,947, 1889) has proposed to bring about etherification, and so effect the quick ageing of spirits by the help of an alternating current.

Dr. S. Ehrmann of Vienna has also recently shown that a moist skin absorbs salts very rapidly from their solution when an electric current passes, and Wagner has also proposed to administer cocaine by a similar process of cataphoric medication. In Ehrmann's experiments, in which a current of 10—20 milliampères was passed from zinc electrodes through a solution of methylene blue, in two cups in which the hands of the observer are immersed, blue spots appeared on the back of the hand in the anode vessel and none on the other hand in the other vessel. The absorption was most marked where the hair and fatty glands are situated, and thus throws light on the fact that in tanning the process is most rapid on those parts of the skin and that the electric current has no doubt a distending effect upon the pores of the skin as indicated by our earlier experiments. Lithium chloride is similarly absorbed by endosmosis through the skin, and Edison has shown that gouty secretions in the fingers are speedily dissipated by the prolonged action of currents of 20 milliampères. H. N. Lawrence and Dr. Harries have obtained similar results (Soc. Arts March 11, 1891). We believe that the hastening of the tanning process is of a similar character, and we draw attention to these experiments as analogous, if not confirmatory of the explanation of the process which we tentatively advance in this paper.

We have to thank Mr. Bawden, one of our assistants, and Mr. Fox Bourne for help in carrying out part of the experimental work of this paper.

Discussion.

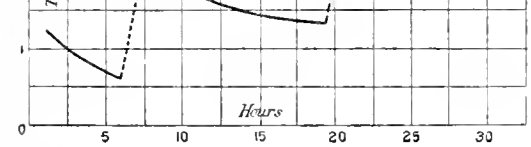
Mr. B. Hooper, speaking as a practical tanner of 50 years' experience, could corroborate Dr. Rideal's statement with respect to the difference of time required for tanning by Groth's electric system and by the ordinary process. He had been daily at the tannery whilst five parcels of English hides had been working under Mr. Groth's system, and had regulated the application of the tanning materials used, which were all the usual vegetable substances, and no chemicals. He would challenge any tanner now working the same class of hides to produce leather such as they saw before them in less than six or eight months by the old process, whereas this leather was tanned in three weeks. All the other processes of quick tannage which had come under his notice had failed to produce leather equal in weight to that made by the old process; but tanning by the aid of electricity gave results as to weight of leather produced, colour, and quality fully equal to those produced by the ordinary method; and it was clearly demonstrated by Dr. Rideal that the saving in time was effected only by the aid of electricity.

Mr. W. F. Anderson was under the impression that the effect of electricity was to distend the skin, thus causing the fibre to be more open than usual. Perhaps that accounted for the advantages of the process. At the same time, he understood that electricity had a contractile effect on muscular tissue. He would be glad if Dr. Rideal could explain that point, for although it might not appear to have much to do with the subject, yet the fact remained that they had these two kinds of tissues on which it would seem that electricity had directly opposite effects.

Mr. J. Swinburne congratulated the authors on attacking so difficult a subject with so much success. He thought that the first thing to settle was whether tannin was an electrolyte or not. He would suggest that its penetration through some such neutral substance as agar jelly should be tried, with and without a current. The authors had argued that the electric current deposited tannin in the same way as it deposited copper in Ostwald's experiment. He thought there was no analogy; copper was the electro-positive radicle of an electrolyte; tannin, if not a colloid, was either the whole electrolyte or the electro-negative radicle re-combined with hydrogen. Copper was frequently deposited on the porous pots in Daniell cells; but he was informed, this occurred only when the zincs touched the pots; in which case it would not be the same phenomenon as Ostwald's. The authors had been led to look for mysterious actions because they assumed that such a small current as that used could work such a quantity of tannin into the leather. They argued that one coulomb could only urge one electrical equivalent of tannin into the leather. The matter seemed to admit of very simple explanation. Suppose a dozen skins to be stretched across the vat at a given time, and an equivalent of electricity to pass, it would work not one, but 12 equivalents of tannin into the skins. But if mechanical agitation were applied, it would work tannin into the interstices of the skins, and if then electricity were applied it would cause the tannin to diffuse, or penetrate into the various mechanically impervious walls of the interstices of the hides. The result was, that when combined with mechanical agitation, a very small current was necessary to tan a large quantity of hide. There was no need to rely on obscure actions, such as deposition of films, or the suggested opening action of electricity on the pores of the hides.

Mr. Conrad K. Falkenstein said that during the last two years he had been working on the subject of electric tanning by a different process to that employed by the authors of the paper, and was therefore pleased to see the way in which they had worked out the problem. He had travelled over much of the same ground, especially with respect to the results given in Figure 3: and his results were almost identical with theirs, except with regard to the small absorption curves showing the variation in the strength of liquor during the progress of the tannage; the difference being due to the greater rapidity of the method employed in his experiments. A point in which he differed from the authors was in respect to the distribution of potential in the liquor of the drum employed in the Worms and Bale process. His own experiments showed that at any given point in the liquor the potential was proportional to the distance of that point from the electrode, and that there was a perfectly even distribution of the potential right across the drum. (Diagram given illustrating this point). With respect to the variation

Falkenstein's Absorption Curve.



of resistance with the current density, his experience agreed fairly well with that of the authors. In a four hours' test, the current remaining the same, the potential dropped to nearly half the amount, the drop reaching its maximum at about half time, and then remaining fairly constant to the end of the experiment. He considered that the effect of the current on the liquor was undoubtedly electrolytic, but the amount of electricity passing being very small, the effect was but slight. But it was certain that there was a definite relation between the amount of electricity passing through the liquor and the amount of tannin that became inert or was oxidised by the oxygen evolved at the positive pole. He very much admired the way in which the authors' experiments had been carried out, and the manner in which they had thrown light on the subject.

Mr. A. P. Trotter, referring to Mr. Swinburne's statement that the particles of the leather being in series, the action which took place in one hide would follow naturally in another hide with the same current, pointed to the very small quantity of hydrogen evolved, and stated that only fifteen millionths of the liquor was decomposed, so that it was hardly possible to imagine that the action was electrolytic. An idea had been put forward that dialysis or osmosis might explain the effect produced: but the calculated speeds of the migration of ions were of such a different order that that theory would not hold. He was inclined rather to the old-fashioned idea of dialysis which had been ousted by the recent hypotheses of osmosis. But all that could be said was that dialysis was hastened by the passage of a current. He therefore thought that both the electrolytic and the osmotic theories must be put aside until we had more knowledge about the subject. The results shown on the lower diagram (Figure 5) indicated that it would be better to apply motion first and electricity afterwards, in order to get the most rapid tanning effects. The current density was so small that it could hardly account for the physiological effects referred to by Mr. Anderson.

Mr. J. Swinburne thought Mr. Trotter had misunderstood his argument. It depended not so much on the hides being in series, as the various particles of each hide being in series. At the slow rate at which radicles moved it was impossible for the tannin to be driven through a hide in the time, but if it were worked mechanically into contact with a cell, electricity would drive it in. Curve 5 showed that the current should not be turned on till the liquor had been thoroughly worked into the interstices of the skin. The electricity then took particles or fibres into the interior of the various cells and tanned the hide. If the electricity were turned on at first it tanned the outside and partially hardened the skin so that mechanical agitation then failed to work the liquor farther in.

Dr. S. Rideal, in reply, said that with respect to the question put by Mr. Anderson, he could not see that the two effects were in any degree comparable, as the microscopical structure of skin showed that it was different to that of muscular tissue. In the paper they had referred to recent physiological experiments which seemed to bear on the phenomena under discussion. He was glad to hear from Mr. Swinburne that, speaking as an electrician, there was no difficulty in accounting for the deposition of the tannin upon the hides. He had not known that Mr. Falkenstein had been working in the same direction as they had: and it was all the more satisfactory therefore to find that their results were mutually corroborative.

Erratum.

This Journal, April number, page 299, col. 1, the figure representing the Glover Tower Denitrator is accidentally printed upside down.

Liverpool Section.

University College, Brownlow Street.

Chairman: *A. Norman Tate.*
Vice-Chairman: *F. Hurter.*
Committee:

J. Campbell Brown.	C. L. Higgins.
H. Brunner.	A. H. Knight.
T. Fletcher.	D. McKechnie.
H. Gaskell, jun.	E. K. Muspratt.
F. Gossage.	Henry Tate.
W. D. Herman.	A. Watt.

Hon. Treasurer: W. P. Thompson.
Hon. Local Secretary:
Dr. Chas. A. Kohn, University College, Liverpool.

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

The names in italics are those of members of Committee who retire at the end of the current Session.

The following have been elected to fill the vacancies and will take office in July next:—*Chairman:* H. Brunner; *Vice-Chairman:* A. Norman Tate; *Committee:* E. Carey, V. C. Driffield, and F. Hurter.

Meeting held on Wednesday, May 6th, 1891.

MR. A. NORMAN TATE IN THE CHAIR.

THE MANUFACTURE AND INDUSTRIAL VALUE OF ALUMINIUM.

BY J. H. J. DAGGER, F.I.C., F.C.S.

It is little over five years ago since I had the pleasure of being present for the first time as a member of this Society, and then listening to a paper read by our esteemed treasurer on what he very truly termed a new departure in metallurgical science—the application of electricity to the reduction of metals from their ores. As in all things new, greater expectations were formed than have been realised; still the electrical furnace then described marked the first step in the production of aluminium at a cost that would place it in the market beside the common metals, and also the raising of electrolytic and electrothermic methods from laboratory and lecture-table experiments to the rank of manufacturing processes. Before passing to a description of some of these, it will be interesting if for a moment I give you in outline the history of this, one of the most beautiful and destined to be most useful of the metals.

History.—Its name is from *Alumen*, the word given by the Romans to all bodies having an astringent taste, hence, alum, which is alluded to by Pliny and Vitruvius as being used as a mordant in producing brilliant dyes. Most probably this was "kalinite," a potash alum which occurs in large quantities in the Solfatara, near Naples, probably formed by the action of volcanic gases on felspathic trachyte. It was not until 1716, however, that Pott first stated the base of alum to be an argillaceous earth, and eight years later Margraff distinguished alumina from lime with which up to that time it had been confounded. In 1807 Davy made an unsuccessful attempt to decompose alumina with the electric current. In 1824 Oersted obtained a grey powder which oxidised rapidly in the air by heating aluminium chloride with potassium amalgam. Three years later, 1827, Wöhler, by decomposing the anhydrous chloride with potassium, obtained a metallic powder which became bright under the burnisher, but it was not until 1845 that he produced the metal in the form of globules large as pin heads. From these he, with infinite patience, determined for the first time the physical characteristics of aluminium. In 1854 Deville and Bunsen, working independently, obtained aluminium by electrolysis of the fused chloride, and the same year Deville, substituting sodium for potassium,

obtained the metal in quantity for the first time by the well-known process which, until the recent development of electrolytic methods, has formed the basis of the operations for the production of aluminium at Salindres, and the more recent developments of the industry at Newcastle and Birmingham in our own country. It will perhaps not be forgotten that the first aluminium in this country was produced in 1855 in the laboratory of the Royal School of Mines by Messrs. Dick and Smith, under direction of Dr. Percy, by the action of sodium on cryolite. Gerhard established a factory at Battersea in 1859, and Messrs. Bell Brothers at Newcastle, 1865, produced aluminium by the Deville method, but neither of these undertakings proved successes commercially, and after a time were abandoned. The next stage in the development of the aluminium industry was the improvement and simplifying of the sodium methods by Castner and Netto, both of which processes have been described in the Journals of this Society, as also the well-known Cowles process for production of alloys, which I described at length in a communication to the Society in September 1889.

The advance of electrical science has given us an increased knowledge of the laws of electrolysis, and the improvement in dynamos and electrical machinery has within the last two years reduced the cost of aluminium from 15*s.* to 5*s.* per lb. The price of aluminium having fallen from 360*s.* 1855, 103*s.* 1857, 62*s.* 1860, 20*s.* 1862 to 1887, 15*s.* 1888, 5*s.* 1890—91. Any further reduction in price will be rather from improved methods in the production and purification of alumina, for the exceeding difficulty of obtaining the metal free from silicon and iron has been and still remains an obstacle in the way of its cheap production, greater than we have to deal with in the case of other metals. Although aluminium is one of the most widely distributed of the elements, the necessity of using alumina free from impurities reduces the number of minerals available in our present state of knowledge to very few. These are :—

Bauxite, preferably that from Beaux, in the Department of Var, of which the following are typical analyses :—

	Red.	White.
Al_2O_3	60·73	64·83
Fe_2O_3	20·08	·65
SiO_2	3·62	12·69
TiO_2	1·91	3·44
P_2O_5	0·39	..
H_2O	13·27	15·47
	100·00	99·99

Corundum.—Very hard crystalline mineral, sp. gr. 3·909, occurs massive in Northern Georgia, and in India, often as water-worn pebbles in débris from river torrents ; here is an anylsis of such pebbles from Ceylon and of rock from India, locality unknown :

	Pebbles.	Rock.
Al_2O_3	89·23	84·26
FeO	0·77	..
Fe_2O_3	..	0·73
SiO_2	5·55	11·77
TiO_2	4·88	3·31
CaO, MnO_4	Traces	..
	100·43	100·00

Cryolite.—This mineral, a double fluoride of aluminium and sodium, is found in large deposits in one district in Greenland, from which nearly all that is used is obtained ; it is found in smaller quantities at Miask in the Ural Mountains, and near Pike's Peak, California. An average analysis of the Greenland mineral is as follows :—

Al	13·23
Na	32·71
F	54·19
Mn_2O_3	0·83

This mineral is not used as a direct source of aluminium, but as a flux in the manner I am about to describe.

Grabau's Process.—Before passing to a description of the electrolytic process for the production of aluminium, I will say a few words about the sodium process as modified by Grabau, of Hanover, in which the difficulties arising from the action of molten alkaline fluorides are overcome in a very ingenious manner, and an aluminium of a high degree of purity is produced. In this process the sodium and aluminium fluoride are heated in two separate iron vessels, the one containing the sodium is provided with a suitable cock for discharging the molten metal, and that containing the fluoride has a drop-bottom, or is fitted with a slide that can be readily drawn. A reducing vessel which is kept cool with a water jacket, and which swings on trunnions, is arranged underneath the two vessels. The aluminium fluoride is heated to a temperature of about 600°, at which it remains pulverent ; the sodium is then melted and run into the reducing vessel. When the metal has all run in, the slide is withdrawn and the pulverent fluoride is allowed to fall on to the sodium ; the reaction which ensues produces much heat, and the contents rapidly become fluid ; the cryolite produced, however, solidifies on the cool sides of the vessel, and the crust thus formed is not attacked by either the fluid cryolite or the aluminium. The aluminium is collected by rapidly shaking the vessel to and fro, and after a minute or two the vessel is tilted and the contents flow into a lower vessel lined with cryolite or aluminium, leaving a crust of solidified cryolite in the reducing vessel. Notwithstanding the very great improvement in the mechanical arrangements and the cheapening of sodium by the recent improvements of Castner and others, it is, I think, only a question of time when the old chemical methods will be superseded altogether by the newer electrolytical processes for the production of aluminium ; even at the present time it is not possible to produce aluminium of equal purity by the use of sodium at anything like equal cost. I now come to describe the electrolytic processes in operation on a commercial scale for the production of aluminium. They are, first, the Herault process in operation at the works of the Aluminium Industry Company, Limited, at Lauffen-Venhausen, on the Rhine fall, and those of the Société Electro-Metallurgique at Froges, near Grenoble. In this process the electrolysis is conducted in iron pots or tanks lined with carbon, the pot is raised on insulating supports, and connected with the cable from the dynamo, so that the lining forms the negative electrode, or else this is made of a piece of metal, iron or copper, fixed in the bottom of the pot. The positive electrode is of carbon and so arranged that it can be lowered or raised in the molten charge. The first charge is a small quantity of cryolite, which is rapidly melted by the heat generated by the resistance to the current ; as soon as it is fluid the current passes and alumina is fed into the molten flux. The process is continuous and the aluminium which accumulates in the bottom of the pot is tapped every 24 hours. The purity of the metal produced varies from 97 to 99 per cent. During the operation the oxygen combines with the carbon of the positive pole and producing carbonic oxide which burns at the vent in the cover to carbonic acid gas.

At Froges the electric current is supplied by four dynamos, each 6,000 ampères, with a voltage of 15, worked by two large turbines of 300 horse-power each.

At Venhausen are two dynamos constructed to develop 14,000 ampères at 30 volts, and a smaller one of 3,000 ampères at 65 volts. The total horse-power of this plant is about 1,500.

In the Hall process, alumina is dissolved in a fused bath of the double fluoride of aluminium and potassium, or of aluminium or sodium. The salts are mixed in a proportion corresponding to the formula $K_3Al_2F_6$ (Al_2F_6.169.KF.116). An excess of the potassium salt will increase the solvent power of the bath, but decrease its fusibility. A larger quantity of alumina fluoride renders the bath more fusible, but diminishes the alumina dissolved. The operation is conducted in iron tanks arranged in series. They are lined with carbon, and form the negative electrodes or cathodes. The positive electrodes or anodes are carbon rods, 3 in. diameter, attached by $\frac{3}{4}$-in. copper rods to the conductors or leads by means of suitable clamps. The current of 5,000 ampères and 50 volts in one series, and of 2,000 ampères and 20 volts in the other series is turned on. The mixture of fluorides in the tanks or pots is melted by the heat generated by the resistance they offer to the current. In about two hours' time the mixture becomes fluid, and alumina is added. The resistance of the electrolyte falls from 15 to about 8 volts, and electrolysis commences, the liberated aluminium sinks to the bottom of the tank, the oxygen going to the positive electrode, combining with the carbon, and escaping as CO_2. During the operation the bath is kept covered with fine carbon dust, and on this is placed the powdered alumina. When the voltameter indicates a rising resistance, the attendant stirs in more alumina from the surface of the pot, the carbon dust rises again to the surface, when fresh alumina is placed upon it. The metal produced is dipped out with cast-iron ladles, any entangled electrolyte being skimmed back into the pot. The operation is a continuous one. The metal produced by this process is very pure. The first "run" of metal carries with it all the iron and silicon of the electrolyte, the only remaining sources of impurity being the alumina added, and the ash of the carbons which are consumed in proportion of a little less than weight of carbon to weight of metal produced.

The electrical energy expended is calculated at 22 E.H.P. per hour per lb. of aluminium.

Comparison of Aluminium with Iron and Copper.

	Aluminium.		Iron.		Steel.	Copper.	
	Cast.	Rolled.	Cast.	Wrot.		Cast.	Rolled.
Colour	Bluish white.		White.	Grey.	..	..	..
Density	2·5	2·7	7·5	7·1—7·8	7·7—7·2	8·96	
Weight per cubic foot in pounds	162		450	485	490	555	
Melting point	1,300° F.	..	2,780° F.	above 4,000° F.	4,000° F.	1,990° F.	
Tensile strength in pounds per square inch.	20,000 to 25,000.	30—35,000	15,680 lb. (7 tons)	15—30,000 (13—27 tons)	60—90,000 (40—45 tons)	20,000 (does not cast as well as Al.)	30—40,000 lb.
Elongation per cent.	14	3·0	..	7—22	5—15	..	20—40
Specific heat*	0·218	..	·1138	..	..	·0952	..
Electrical conductivity	34·0	..	16		..	99	
†Thermal conductivity	33·7	..	11·9		..	75	

* Higher than any metal except lithium and glucinum.
Al.—Atomic weight, 27·1, sp. heat equal weights, 0·2143, sp. heat atomic weights, 5·87.
Li.—Atomic weight, 7, sp. heat equal weights, 0·9408, sp. heat atomic weights, 6·59.
† Ag. = 100.

Properties of Aluminium.—The pure metal, free from silicon and iron, is said to be perfectly white, but as produced, it has a bluish-white tinge; when burnished it is exceedingly beautiful; under all ordinary conditions it is unacted upon by air and moisture, sulphuretted hydrogen, ammonium sulphide and cold dilute sulphuric acid have practically no action on it, when free from silicon. The non-corrodibility, however, depends entirely upon the freedom of the metal from silicon and iron. It is not affected by cold nitric acid, and only slowly when heated. The organic acids and salts, as acetates, tartrates, and citrates have practically no corrosive action on it; though in presence of salt action is set up, though very much less than in the case of copper or tin. The salts of aluminium formed are also non-poisonous, and this would make it valuable for cooking utensils, tins, and cases for preserved foods and meats, &c. Another point in its favour is that following on its high specific heat, it takes much longer for the internal heat to penetrate an aluminium vessel, and so food heated in an aluminium pan would keep warmer for a longer time. If a plate of aluminium be heated and then withdrawn from the fire, it will retain its heat for a sufficient time to cook an egg. Its lightness, too, would make it the ideal metal for travellers' and soldiers' equipments, water bottles, canteens, &c. It would also be most valuable for surgical instruments and tubes.

It is extremely malleable, following after gold in this respect, and may be drawn into fine wire. It can be rolled into sheets about ·0007 in. thickness, and drawn, spun, and stamped. It, however, becomes hard by working and requires frequent and careful annealing at low temperatures; the best temperature for working is 100—150° C. Its hardness equals that of silver. Bars of the metal give a clear musical sound if struck, but the presence of even a small proportion of impurity destroys the resonance.

Castings can be made in ordinary dry sand moulds, gates should be somewhat larger than for brass, but great care should be taken not to heat the aluminium much above the melting point, for otherwise it will absorb gases and become spongy and unsound. The shrinkage is about $2\frac{1}{4}$ per cent. of the length of the mould and ample provision must be made for this in the cores. 100 lb. casting in Al would be equal to 290 Fe, 360 Cu, 280 Sn or Zn, 420 Ag, 48 Pb, 770 Au, 860 Pt.

Aluminium is readily corroded by alkaline solutions forming aluminates, and also by hydrochloric acid and chlorine, and is acted upon more or less by solutions of the chlorides. Very much has been written and said about the properties of aluminium, sensational leaders appear daily in the press, describing wonderful bridges and machinery, ships and houses of the aluminium age, or as one note put at the head of an article, besides which Jules Verne is dull reading, "A Dream of Aluminium." Aluminium is given the most exaggerated properties, and much harm is done to the real value of the metal.

What are the facts, to begin with? Aluminium can never possibly take the place of iron and steel for structural purposes, such as in bridges and heavy machinery; it is not a rigid metal; a bar supported on bearings 24 in. apart was deflected $\frac{5}{64}$ in. with 100 lb. load, $\frac{1}{16}$ in. with 200 lb., and $2\frac{53}{64}$ in. with 300 lb. The permanent set with this load was $2\frac{27}{64}$ in., showing the low elasticity: and again, although aluminium is only one-third the weight of iron, it has less than one-half the tensile strength of the best wrought iron, and

only one-third that of mild steel. These facts would prevent it ever replacing these metals in shipbuilding and for structural purposes. But aluminium is beyond all doubt one of the most valuable of metals, and is, I believe, destined to displace almost entirely some of our older metals, for instance, copper, which its superior power in resisting corrosion, its great lightness, will enable it to replace in light machinery and fittings, gas and water fittings, steam pipes, electrical machinery. It would also be invaluable for all art work and decorative purposes. Aluminium plating would supersede both tin and nickel plating; it would largely take the place of tinned ware and German silver and electro-plate for table ware. It would also be invaluable to the chemist for many of his laboratory fittings, replacing brass and iron, which corrode so rapidly in such atmospheres. Now, bringing this paper to a close, I regret its imperfect character arising from its being put together amidst presence of other duties. I hope at some future time to bring before you a further account of the development and uses of this valuable and beautiful metal.

Discussion.

The Chairman, in thanking Mr. Dagger for his valuable paper, invited discussion thereon. He himself would like to know whether aluminium would be of value for making gas pipes and fittings and whether the coal-gas was likely to affect the metal?

Dr. Kohn remarked that in Mr. Dagger's paper there were many points of especial interest to chemists. Personally, he was extremely interested in the details of the electrolytic process itself. They had been told in the description of the method what sort of apparatus was employed and under what conditions the electrolysis was effected. As he understood the process, the alumina is introduced from time to time into a molten flux consisting essentially of the fluorides of sodium (or potassium) and aluminium. He wished to know what percentage of the alumina was obtained as metallic aluminium; whether the reduction was anything approaching the theoretical amount, and also whether the flux remained in its original state at the end of the operation? Did any decomposition of the fluorides take place, and, if so, had any action on the carbon electrodes been noticed, due to the decomposition products of the fluorides? Fluorine might possibly be liberated under these conditions, and since Moissan had prepared two fluorides of carbon, CF_4 and C_2F_4, it would be of interest to know whether any attacking of the carbon had been observed that might be due to such a decomposition. As to the properties of aluminium, the melting point was stated to be about 1,300° F. He would be glad to learn at what temperature the metal softened. Platinum began to soften at about 1,400° C., and this rendered it useless for certain chemical operations at very high temperatures; his object in putting the question was to learn within what temperature limits aluminium could be employed with safety. The importance of aluminium vessels for various operations was one that had always been attractive, and perhaps in the aniline colour industry there might be demands for it. Enamelled iron vessels had so far proved to be the best in most cases for the operations involved; but he presumed, from what Mr. Dagger had told them, that even at 40° to 50° C. aluminium might be employed with safety in presence of sulphuric acid. He would be glad to know whether this was so. At the same time the flexibility of the metal itself would prevent its being employed otherwise than as a lining to baths or the like. Its application to steam pipes was also a question which might be discussed, and it would be interesting to know whether Mr. Dagger had got results or tried experiments with running water on aluminium pipes, and, if so, whether the pipes corroded at all. In the case of water passing through lead pipes, corrosion increased or decreased according to the nature of the water that passed through them.

Dr. S. G. Rawson asked what mineral was, on the whole, the most applicable for general use in these different electrolytic processes and furnaces? Bauxite, corundum, and cryolite were all mentioned, and it would be interesting to know the reasons which caused any one of these to be selected in preference to any other. Corundum, for instance, was purer but dearer than bauxite, would corundum therefore be employed only when a specially pure product was required, or were there other considerations involved, such as fusibility, conductivity, &c.? The electrodes used were of enormous dimensions, up to 3 in. in diameter, were these cut in one solid piece, or built up of prisms? In the former case what material or form of carbon could be taken, for in such large blocks it would be expected that, without some previous form of treatment, the carbon would be soft and porous. The seemingly almost complete insolubility of aluminium in sulphuric acid was very interesting, and Dr. Rawson inquired whether stills for the distillation of sulphuric acid could not be made from this metal. At present both glass and platinum vessels were employed, but there were grave disadvantages attendant upon the use of both these materials, and it seemed possible that these might be removed or lessened by constructing the stills of aluminium.

Mr. Knight asked if it were possible to solder aluminium, as he believed it was somewhat difficult to make joints.

Mr. Jones believed that a small admixture of aluminium had been found to have a beneficial effect in iron castings, as rendering the metal less liable to the presence of blow-holes. In laboratories aluminium would have a great advantage over iron and copper, *e.g.*, in the case of an air-bath. The aluminium air-bath would retain its heat more evenly, and resist better the acid fumes which so soon destroyed copper or iron. He had heard of aluminium being used in making surveyors' instruments, and had been told by an engineer, who had been on the Panama canal, that the difference in weight was most advantageous in that hot climate for those who had to carry the instruments from day to day.

Mr. Rhodes inquired whether aluminium could stand the action of weak sulphuric acid; if so, it might be of use for making floats, such as are used in sulphuric acid works, and are of great service in taking measurements.

Mr. Dagger, replying to Dr. Kohn's question regarding the liberation of fluorine by decomposition of the cryolite, and the part it played in the process, said that in the operation as described no fluorine was liberated. The alumina was decomposed by the electric current, and the action of the fluoride seemed to be merely that of a flux when comparatively small quantities of fluoride were used. If, however, those proportions were departed from, and the pot was allowed to get out of "ore," or alumina ceased to be added in excess, the fluoride would begin to decompose, and that meant the formation of an infusible mass filling up the pot and ending the operation.

In the process conducted by the Pittsburg Co., practically nothing of this kind took place, and the run was continuous. The softening temperature of aluminium would take place between 600° and 700° F.; at that temperature it would begin to get crumbly and work a little. In contact with most other metals aluminium in presence of moisture oxidised. If a plate were taken and bound round with platinum wire alumina would gradually be formed at the contact. In the case of copper and iron vessels, corrosion would take place at the juncture of the two metals. For steam pipes, since the softening of aluminium took place at a low temperature, its action would be uncertain for steam under high pressure, and would therefore not be a reliable metal to use. Out of a yield of 2 lb. of alumina containing 53 per cent. aluminium there would be a loss of about 3 per cent. of the aluminium, so that 97 per cent. of the theoretical amount would be about the yield obtained. Dr. Rawson had asked which would be the best mineral to use in the electric furnace, and he (Mr. Dagger) believed that corundum, if it could be obtained cheap, was certainly the best, having 87 per cent. —93 per cent. Al_2O_3; but for making the alloys he preferred bauxite, as it was easier to obtain and softer. Cryolite was simply used as a flux. It had been found that using cryolite as in the sodium process the quality of metal fell far short and did not repay for the trouble taken. In reply to Dr. Rawson whether bauxite reduced the amount of iron, he

would point out that it was the rule now to prepare alumina from bauxite, and in that case bauxite was a far better mineral to use than corundum, but he would deal with that question at another time. About the carbons, there was rather a difficulty in obtaining them. The great trouble, as a rule, was that they were far too soft. He had found that the best were those which they had obtained from the United States from the mineral oil carbon, and was exceedingly pure, the ash going down to about ·01 or ·02 per cent. The carbons used were solid, and varied from 1½ in. to 3 in. or 8 in. made in sections, and in plates banded together. Mr. Knight had raised the question as to soldering aluminium. It had not been properly overcome, but he (Mr. Dagger) would give him the formula, which might be of interest to others, and which he had found to give fairly good results. The difficulty in soldering arose of course from the formation of a film of unreducible oxide, which prevented the contact of the solder with the aluminium surfaces. For ordinary work the solder containing Al 6 parts, copper 4, zinc 90, would be used, but the zinc had to be free from iron. For heavy soldering a mixture of Al 12, copper 8, and zinc 80. In reply to Mr. Jones's question, aluminium had a beneficial action on iron in preventing the formation of blow-holes, and in giving sounder castings. Its action was most probably deoxidising and thus enabled it to destroy the oxides and various impurities which were entangled in the molten iron, and which rose to the surface, leaving a much purer and better metal underneath. He had seen it stated that aluminium lowered the melting point of cast iron, and he had himself taken it for granted and stated so in previous papers on aluminium; but from recent observations he rather doubted the statement, although given on high authority. For air baths, the trouble of aluminium softening at 600 was felt, and it was not considered a suitable metal. The action of sulphuric acid on aluminium would be slight at 55 C. In answer to Mr. Norman Tate, the action of coal-gas on aluminium fittings caused no danger, and he could not say that they would be affected to any extent by the impurities contained in ordinary coal-gas, certainly not to the degree to which iron fittings were corroded.

Glasgow and Scottish Section.

Chairman: E. C. C. Stanford.

Vice-Chairman: A. Crum Brown.

Committee:

G. Beilby.	J. Falconer King.
Wm. Boyd.	G. McRoberts.
J. Christie.	T. P. Miller.
W. J. A. Donald.	*E. J. Mills.*
D. B. Dott.	*T. L. Patterson.*
C. A. Fawsitt.	J. Pattison.
Wm. Foulis.	E. Smith.
J. Gibson.	R. R. Tatlock.

Hon. Treasurer: W. J. Chrystal.

Hon. Local Secretary:

Dr. G. G. Henderson, Chemical Laboratory, University of Glasgow.

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

The names in italics are those of members of Committee who retire at the end of the current Session. The following have been elected to fill the vacancies, and will take office in July next:—*Committee:* C. J. Ellis, R. A. Inglis, R. Irvine, and J. B. Readman.

SESSION 1890-91.

June 1st (Glasgow):—
Dr. E. J. Mills. "Destructive Distillation," Part II.

Meeting held at the Societies' Rooms, 207, Bath Street, Glasgow, on Monday, April 6th, 1891.

MR. E. C. C. STANFORD IN THE CHAIR.

ON THE PHYSICAL CONDITIONS EXISTING IN SHALE-DISTILLING RETORTS.

BY T. J. ROWAN, C.E.

The physical conditions existing in shale retorts have not hitherto been very accurately or minutely observed. A good deal seems to have been taken for granted, and in particular the language generally used with reference to the temperatures employed in shale distillation indicates that it was the prevailing belief that a similar temperature existed inside the retorts to that which was applied to the outside with, at the most, a slight allowance for loss by conduction.

From theoretical considerations Dr. Mills (in his "Manualette of Destructive Distillation," 3rd Ed., p. 15) fixed a definite limit to the temperature *required* in shale retorts for oil distillation, and he thus discriminated, to some extent, between external and internal temperatures. Dr. Mills says: "Paraffin oil can be prepared from coal, bituminous shale, lignite, wood, peat, Kimmeridge clay, and the like, on the one condition that a very low red heat is employed. It is certain that the greater part of the decomposition and distillation takes place below 427 C. (800° F.). The highest possible boiling point of any normal paraffin is 555 C. (1031 F.) the extreme limit therefore *required* in a shale retort." (See also *op. cit.* pp. 12—13.)

This, it will be observed, speaks only of the temperature *required* in shale retorts for the production of paraffins, not of the temperatures actually employed, but subsequent investigation goes to prove, in general, the correctness of the deduction by Dr. Mills. At the same time it must be remarked that the temperature of the boiling point of paraffins is not necessarily the temperature of their formation from organic matter.

In the course of a recent inquiry the author was able to make several series of observations on the actual conditions existing in shale retorts during the process which yields oil and ammonia, and as the results of these observations possess a wider importance than that of the immediate occasion of their being collected, he has been permitted to communicate them to this Society. They were obtained for the most part in the working of the retorts constructed by the Messrs. Armour, of Hermand Oil Works, but they throw some useful light, not merely upon the action of the Hermand retorts, but also upon the course of action in retorts constructed according to other plans, and thus upon the general subject of shale distillation.

It will be well, in the first place, to compare the Hermand retorts with their predecessors, so as to indicate the main features of their design and method of working.

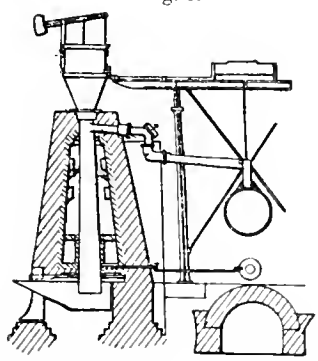
1. The original or "old" vertical retort.

The retort introduced by the late Mr. James Young, F.R.S., about the year 1851, was a cast-iron cylinder, slightly tapered lengthwise, 2 ft. diameter (the section being usually circular but sometimes oval) and 9 to 10 ft. long in the part exposed to heat, with a hopper and drum at the top for charging, and a tray with a water-lute at the bottom for withdrawing the spent shale. Such retorts, which are illustrated in Fig. 1, were usually placed vertically and set in groups of six to one fire or furnace, the flame and fire-gases from which passed to and fro horizontally by three flues or passages, gradually ascending, and thus travelled over the larger part of the exterior surface of the retorts.

The temperature of the exterior of these retorts was kept as high as was consistent with their safety, but frequently reached the point at which the cast iron became soft, when it bulged out or the retort collapsed (or "sat down," as it was sometimes described) by reason of the superincumbent weight of iron and the column of shale. This softening point of cast iron has been fixed at about 1,500 to 1,600 F. (815 to 871 C.), so that these

retorts, containing each its charge of about 10 cwt. of shale, had their lower portions exposed to temperatures ranging from 1,000° F. (538° C.) to 1,500° F. (815° C.) during the

Fig. 1.



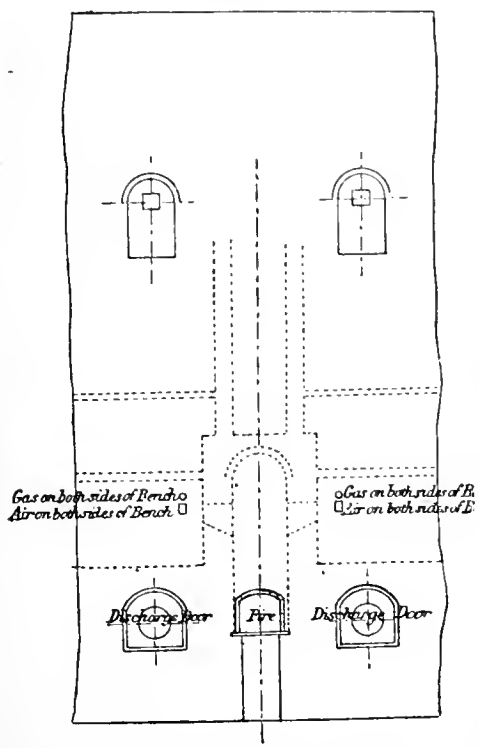
Old Vertical Retort. Small Size.

12 to 20 hours* which, it is stated, were required to work off a charge. Even under these conditions the oil was usually not fully extracted from the shale.

2. I have been informed that some observations of temperatures which, it is to be regretted, have never been published, were made at Bathgate Works in or about 1870 by Mr. Glen and the works chemist, with a view to determine, if possible, the most favourable working temperatures for retorts of different lengths, and that at these and at Uphall Works the vertical retort was gradually lengthened, first to 12 and then to 15 ft., with the result that an increased yield of both oil and ammonia was obtained, apparently in consequence of exposing the shale for a longer period of time to the action of heat.

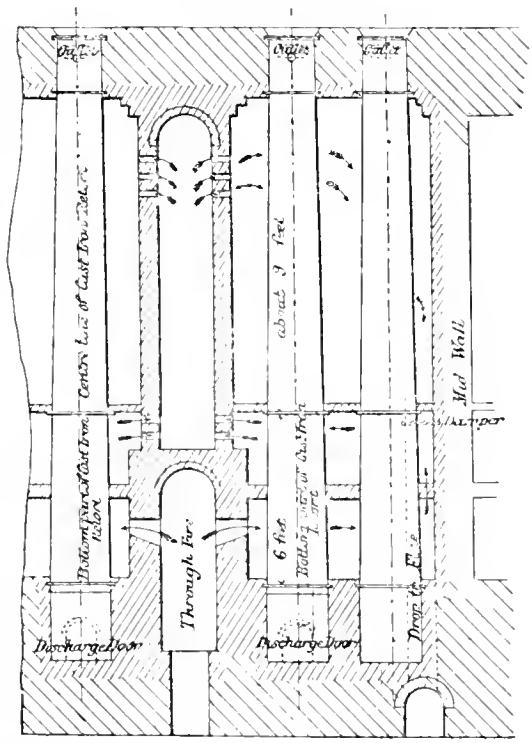
Mr. W. Fraser, of the Pumpherston Oil Co., has been kind enough to give me a tracing (Fig. 2), showing the

Fig. 2.



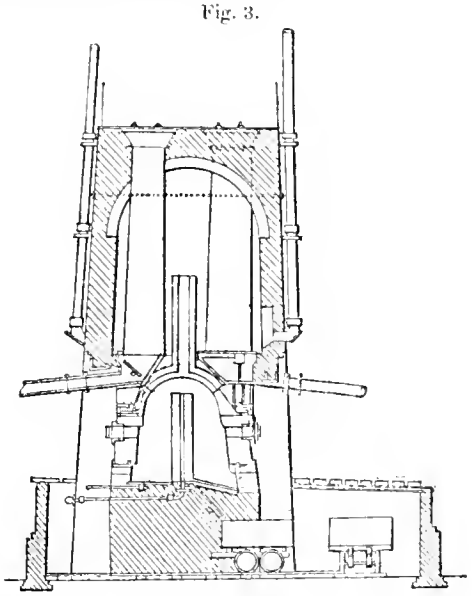
* See G. Beilby, Jour. Soc. of Arts, Vol. XXXIII., p. 315.

Fig. 2.—*continued.*



method of construction adopted in the lengthened vertical retorts alluded to, the flues for the fire-gases being so arranged that the lower 6 ft. in length of the retorts were exposed to a higher temperature than the upper lengths of about 9 ft which were heated uniformly. It is also said that longer retorts were used in the old West Calder Oil Works. In addition to these modifications, the records of the Patent Office show that many different forms and sizes of retorts were proposed, but those which were introduced into practical work and have continued in use for any length of time, are, prior to the Armour's retort, the Henderson and the Young and Beilby forms.

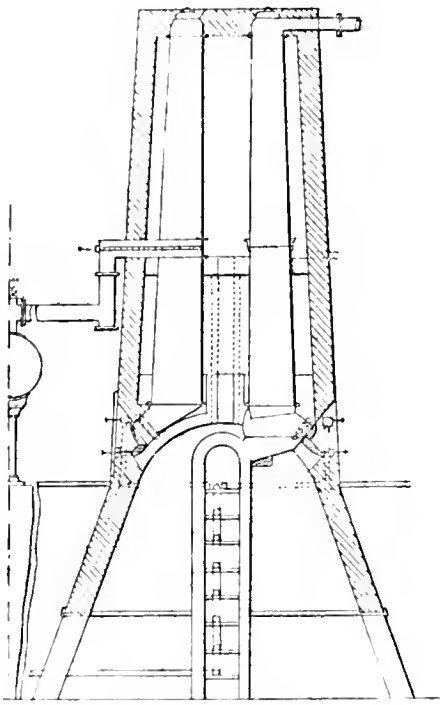
Fig. 3.



Henderson's Retort.

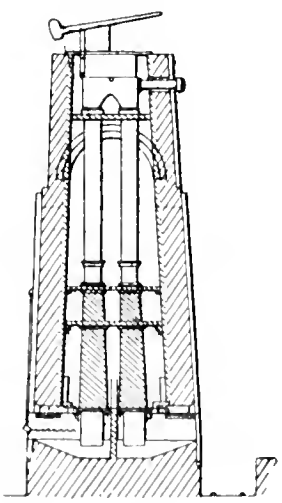
3. *The Henderson Retort.*—This retort has been so recently described by Mr. D. R. Steuart (this Journal, **8**, 100, 101), that I shall merely refer to the illustration (Fig. 3), and note that it is said to be constructed of

Fig. 4.



Young's Retort, 1881.

Fig. 5.



Beilby's Retort, 1881.

cast iron, in length 15 ft. and of oval section 2½ ft. by 1 ft. It contains 18 cwt. of shale, and is worked intermittently, the charge being exposed to heat in the retort for 16 hours, when it is dropped hot into the furnace placed below the retorts. The spent shale is said to contain when thus drawn 12 per cent. of "combustible matter," which I suppose means fixed carbon, and this, with any residual hydrocarbons which it contains, makes it useful for fuel especially as when charged into the furnace it is already heated to the temperature of combustion. The fire-gases are led up to about half the height of the retorts before being brought into contact with them, and are then made to descend to a chimney flue. The effect of this arrangement no doubt is to maintain the whole of the interior of the "oven" at a uniform temperature.

Mr. Steuart records (in the paper quoted) one or two observations of temperatures obtained during working. He says, "the temperature of the oven is from 900° to 1000° F.," (482° to 538° C.); "the steam as it goes into the retort is 630° F." (332° C.); "the shale inside the retort 1½ ft. from the top, three hours after charging 630° F." (332° C.); "16 hours after charging 730° F." (387° C.); "and the products of distillation at the exit pipe 500° to 600° F." (250° to 315° C.).

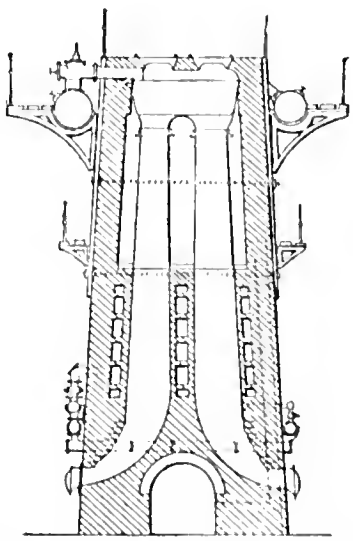
It is to be regretted that Mr. Steuart did not add some further observations to these, because the shale at the point of observation derives very little heat from the oven and is almost entirely heated up by the highly superheated steam which is introduced at the top of the retort; moreover, any air drawn into the retorts passes in by the hopper lids and tends to keep down the temperature at the top of the retort. Even after 16 hours heating the shale there had acquired a temperature of only 730° F. (387° C.) which is not sufficient for its complete distillation, and if dropped into the furnace in that condition it must have carried some if not most of its hydrocarbons to the fate of being used only as fuel. The products of distillation are taken off at the bottom end of the retort and their temperature is comparatively high. It is probable that in the body of the retort, from the underside of the oven arch to the top of the furnace arch, the shale has the full temperature of 1,000° to 1,100° F. (538° to 593° C.).

4. *The Young and Beilby Retort.*—This retort, in its various forms, has also been fully described by both its authors (see especially G. Beilby, Trans. Mining Inst. of Scotland, Vol. V., part 5; this Journal, **3**, 216; Jour. Soc. of Arts, Vol. XXXIII., p. 313—325) and is well known.

Figs. 4 and 5 illustrate the steps in design due to Mr. Young (Fig. 4) and Mr. Beilby (Fig. 5) separately; whilst Figs. 6 and 7 show forms of the combined or Young and Beilby retort.

In its most familiar form (Fig. 6) it consists of an iron

Fig. 6.

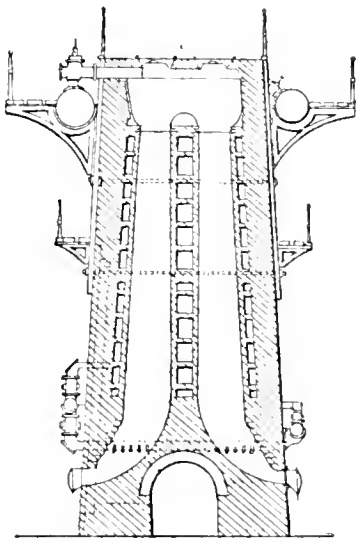


Young and Beilby's Iron and Brick Retort.

retort, circular or oval in section, and about 9 ft. long, placed upon the top of a fire-brick retort of oblong section about 1 ft. 11 in. by 10 in. at its top end, and 2 ft. 5 in. by 12 in. at the bottom of the straight part, which is 8 ft. long, surrounded by flue passages for flame and heating

gases, and ends in a curved shoot or mouthpiece, about 5 ft. 6 in. in vertical height and tapered to a cast-iron discharging door 15 in. diameter.

Fig. 7.



Young and Beilby's Brick Retort.

The cast-iron retorts are grouped above into a series of four by a multiple hopper, which acts as a common reservoir of shale, and is also used to condense the oil vapours so that they may undergo a second volatilisation on being carried back into the retort by means of the green shale. The iron retorts stand in an oven without flues, with openings for inlet and exit of hot gases near the bottom, but on different sides of the oven. The object of this arrangement is stated to be to heat these retorts (or these iron portions of the retort considered as a whole) uniformly to a low red heat, or about 800° F. (427° C.), it being the intention to derive a considerable portion of this heat from highly heated steam and gases passing up inside the retort from the brick portion below. The purpose in having this brick addition to the upper retort is, in the words of its authors, "to treat the residue, or 'spent shale,' to a supplementary operation of steaming after the oil distillation was finished," this supplementary operation being accelerated by the employment of a high temperature (1,832° to 2,000° F. or 1,000° to 1,093° C.) to which the brick retort must be exposed, and which would also enable the red-hot shale coke in it to decompose the steam admitted below and form water-gas. In describing his process, Mr. Beilby said, "The steam entering the lower end of the retort and passing through the red-hot material in the fire-clay portion, is highly superheated and rapidly conveys heat to the raw shale in the upper retort, which is further heated by the flue gases passing outside. The oil vapours and steam passing off by the exit pipe are cooled and condensed, and are collected in tanks. The shale at the lower end of the iron retort receiving the first effect of the highly heated steam, is first exhausted of its hydrocarbons, and the removal of a portion of the materials 'below' moves downwards the whole column within the retort, so that the portion of shale exhausted of its oil products is now brought into the more highly heated clay retort, and being subjected to the current of steam, a large part of its nitrogen is converted into ammonia, which passes away with the steam and oil vapours." *

Ingenious as this process undoubtedly is, and founded upon elaborate and careful analyses and researches carried out by Dr. Grouven and Professor Wm. Foster as well as by Mr. Beilby, yet it is not going too far to assert that its practical realisation on a commercial scale demands physical conditions which it is extremely difficult, perhaps impossible, to obtain. The labours of Messrs. Young and Beilby have unquestionably resulted in considerable improvement in shale distillation. Operations are directed with more intelligence and care than were formerly the rule, and better results are obtained, but in the foregoing remark I refer to the realisation of the theoretical possibilities of the process.

One of the difficulties was perceived by Mr. Beilby himself soon after commencing to work on a practical scale. "Spent shale," he says,† "contains about 85 per cent. of mineral ash, consisting of silicates of varying fusibility. As long as the 15 per cent. of fixed carbon '(ordinarily contained in the spent shale from simple oil distillation)' is intimately mixed with these silicates, the mass is nearly infusible, but whenever any large proportion of the fixed carbon has been burned away by the oxygen of the steam, the ash softens and begins to fuse, and there is the danger that a number of pieces fusing together may plug the retort, and stop the downward passage of the shale. It, unfortunately, happened that the softening point of the ash of the particular shale under consideration was at or near the temperature at which the process could be carried out with economical speed. In the practical working of this shale by the new system, it was evident that the process of burning away the carbon and extracting the nitrogen must be stopped short while there was still sufficient carbon mixed with the ash to keep it from fusing."

Further experience has, however, shown that the difficulty is therein not *fully* stated, but that the fact is that as soon as the process of distillation is completed the remanent solid materials quickly acquire the temperature necessary to allow them to soften, or that they at once allow the heat inside the brick retort to accumulate, so that the brickwork itself softens, and the mineral matter adhering to it and further aiding to "slag" it, a "gobbed" or plugged retort is the inevitable result. In most oil works the workmen know that to miss a "draw" by a very few hours involves very serious labour on them in order to get the spent shale down.

The results of examinations of internal temperatures obtained at Hermand, and the fact, already stated, that it was necessary to expose the "old vertical" retort to a temperature approaching 1,200° to 1,500° F. in order to extract the major part of the oil from the shale in it, also go to prove that on Messrs. Young and Beilby's system the oil distillation *could not* be finished in the iron retort, so that shale-coke should exist when wanted for the subsequent process in the lower brick retort. The heat of steam and gases passing up from red-hot materials below must also be to some extent delusive, because, if the process were working according to the theory, the *cooling effect* of the decomposition of the steam and the formation of water-gas would be such that all the heat which could be imparted to the brick retort from outside would be required to maintain the inside temperature at the point at which the chemical action was possible. Consequently the resultant water-gas and excess of steam could not be highly superheated, if superheated at all. The actual results obtained in the manufacture of water-gas illustrate this.

5. *The Hermand Retort.* — The retort designed by Messrs. J. and H. Armour, and introduced at the Hermand Oil Works, is comparatively new, and, as far as I know, has not as yet been described to this Society.

At their Breich works, Messrs. Armour made some departure from Messrs. Young and Beilby's designs, and erected retorts (Fig. 8) composed partly of iron and partly of fire-brick, with a special construction of flues for heating, and without multiple hoppers, but of a greater length than the ordinary Young and Beilby design.

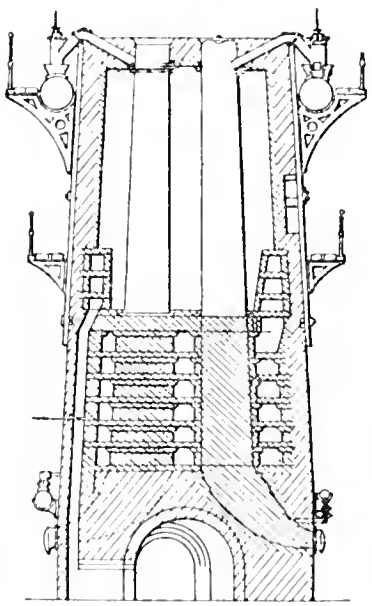
The Hermand retort, however (Fig. 9), is different from any other vertical retort which has been hitherto worked. It is built entirely of fire-brick, in section is rectangular and tapered from 1 ft. 6 in. by 1 ft. 3 in. at the top just under a cast-iron hopper, to 3 ft. 6 in. by 1 ft. 6 in. at

* Jour. Soc. Arts, Vol. XXXIII., p. 516.

† Jour. Soc. Arts, Vol. XXXIII., p. 518.

the bottom of the straight shaft, which is 22 ft. long. The straight shaft terminates in a curved shoot, which tapers down to a circular cast-iron discharging door of ordinary pattern, 5 ft. in vertical height below the bottom of the straight part, this shoot having a capacity of 30 cub. ft., and constituting a cooling chamber, as no heat is applied to it outside. Steam is admitted to the retort in this shoot by a pipe inserted about 12 in. above the discharging door,

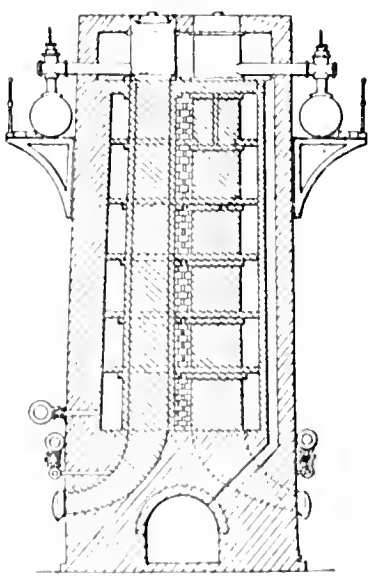
Fig. 8.



Armour's Breich Retort.

and this aids the cooling of the spent shale. It is certain, however, that some air enters continually by the door and brickwork, and this air seems to supply oxygen for the combustion of some of the carbon of the shale, and thus to raise a portion of it to a red heat at about the top of the curved portion at the back where the steam does not penetrate. On the top of the straight shaft is placed a

Fig. 9.



Armour's Hermand Retort.

cast-iron hopper, 4 ft. deep, of oval section 3 ft. 2 in. by 1 ft. 11 in., the exit pipe for the oil-gases being placed at the bottom of the hopper.

The capacity of the Hermand retort, as compared with the Young and Beilby or "Pentland" retort is as follows:—

Hermand Retort.

	Cub. Ft.	Tons	Cwt.
Hopper	15½	0	6¾
Retort body	92	2	1
Curved shoot or cooling chamber	30	0	13½
	137½	3	1¼

Young and Beilby Retort.

	Cub. Ft.	Tons	Cwt.
One quarter of multiple hopper	25	0	10
Upper retort (iron)	20½	0	9¾
Lower retort (brick)	24	0	10¾
Curved shoot or cooling chamber	22½	0	10½
	92	1	10½

These weights are found by taking the shale as equal to 50 lb. weight per cubic foot in the broken state, some actual trials with a box of 4 cub. ft. capacity having given a mean of 49 lb. per cubic foot.

The heating of the Hermand retort is carried out exclusively by the combustion of the scrubbed gas, which is introduced by a pipe near the bottom of the straight shaft. The flame and fire gases are conducted round each group of four retorts by a continuously ascending spiral flue, which forms six steps or stages in the vertical height of the retort. On reaching the end of their travel (of 211 lineal feet) in the top ring of the spiral, the hot gases ascend into a flue which runs along the full length of a bench of retorts on the exit or outside of the hoppers. The two outside flues of a bench unite at one end in a central flue, in which the inner sides of the hoppers are exposed to the hot gases, and thence to the chimney which is placed at the end of each bench of retorts. By this arrangement there is a very complete and economical utilisation and distribution of heat, the temperature gradually diminishing as the fire-gases ascend, the last portions being made use of to heat up the fresh charges of green shale in the hoppers, so that very little is lost in waste gases escaping to the chimney. The total amount of heating surface exposed to the flame and fire-gases is 251 sq. ft. in these retorts, as against 124 sq. ft. in the Young and Beilby form.

These details are important, because they are witness to the presence of several elements which render these retorts specially suitable for the examination of temperatures under the most favourable conditions. The shale is heated up before it enters the retort body, and as it descends the temperature surrounding the retort is gradually increased as the chemical action tends to become less vigorous. No extraneous heat is supplied to the shale by means of superheated steam, as only exhaust or "soft" steam is admitted to the retorts; and, finally, there is no cooling of the escaping oil vapours by reason of contact with cold shale or hopper or other surfaces.

Temperatures in Flues.—A series of measurements of the temperatures in five of the stages of the spiral flue (commencing at the lowest one), taken by means of the Siemens copper ball pyrometer, gave the following results:

1st or lowest stage of flue, 1550° F.

At the next test here the copper ball was melted in consequence of its being placed in the flame.

2nd stage of flue, 1340° F.

Three tests here gave exactly the same result.

3rd stage of flue, (*a*) 1050°, (*b*) 1125°, (*c*), 1125°.

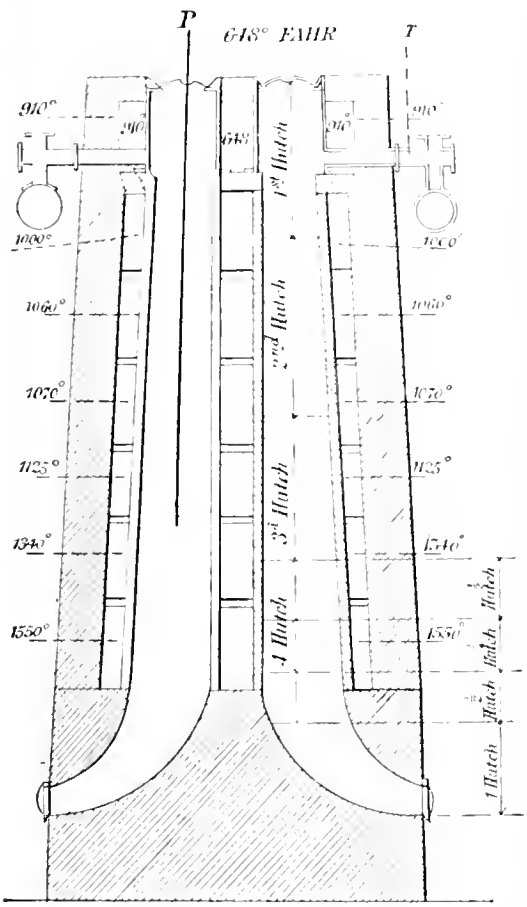
4th stage of flue, (*a*) 990°, (*b*), 1070°.

5th stage of flue, (*a*) 930°, (*b*) 930°.

The same stage at the next adjoining retort was taken subsequently for a test, because the opening of spy-holes in the lower flues of the one hitherto examined had cooled the upper portion of it considerably. This 5th stage of flue gave (*a*) 1060° and (*b*) 1000°.

These temperatures are shown in black figures on the sections, Figs. 10 and 11.

Fig. 10.

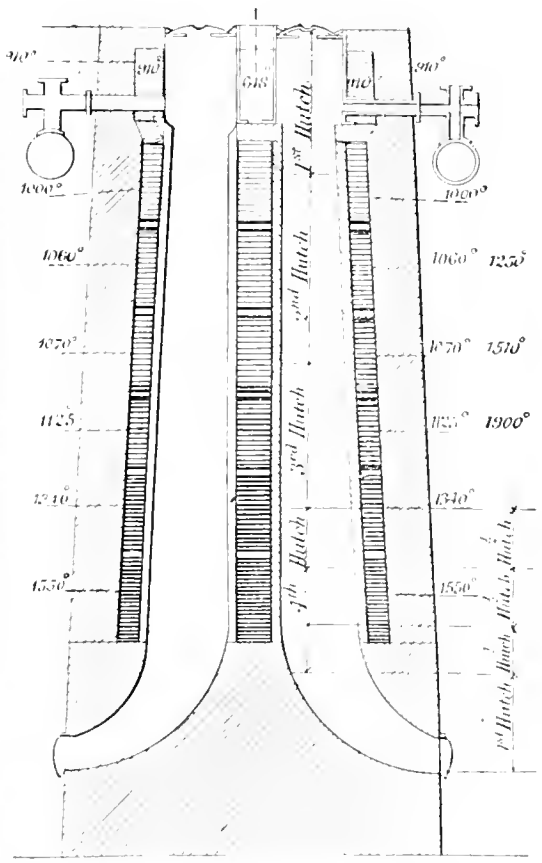


These readings are, of course, only approximations to the actual temperatures, this being all that instrument can afford, and it is to be remarked, moreover, that they were taken at the time when the retorts were being drawn below and freshly charged above, so that there would be found consequently the greatest amount of difference between the top and bottom temperatures which these retorts could exhibit in working.

On another occasion, when observations of the internal temperature were being taken by Mr. Harry Armour, simultaneous tests of the temperature in these external flues were made by me with one of Murrie's pyrometers having a scale of 1000° to 2000° F., but not reliable beyond 1950°. This instrument showed in the third stage of flue from bottom 1900° F., and the pyrometer index was moving up rapidly beyond that figure when the instrument was withdrawn to avoid damaging it; in the fourth stage of flue, 1510° F.; and in the fifth stage of flue, 1.250° F. These temperatures are shown in the outside row of the figures on the right of section, Fig. 11.

By means of another instrument of the same kind, but having a lower range, the temperature in the side flues on the top of the retort benches was found on different occasions to be 770° F., 895° F., and 910° F., the first reading having been taken while the bench was being charged with cold shale. The central flue leading to the chimney and at 41 ft. and 10 ft. distance from the chimney showed 640° F., 650° F., and 648° F.

Fig. 11.



Temperature of Shale in Hoppers.—In order to ascertain the temperature of the shale in the hoppers at different periods a Murrie's pyrometer having a range of from 300 F. to 900 F. was used. The stem of this instrument 5 was ft. 6 in. long, but the bulb or mercury chamber was 9 in. from the bottom end. On one occasion it was inserted into the shale in a hopper just after a draw and before fresh shale was charged. The pyrometer stem extended 4 ft. 3 in. down from the hopper lid, and was left for half an hour, when the reading was 480° F. On another occasion the same instrument was placed in the midst of a charge of green shale at 11.30 a.m. and allowed to remain in the shale till 8.45 p.m., dropping down to its full extent when the charge dropped.

At first only 3 ft. of the stem were inside the hopper, and there was no indication on the dial till 1.15 p.m., when the index showed 320°, although the hopper itself was very hot during the whole time. The pyrometer dropped down to its full length with the charge at 2.35 p.m., when the draw took place and the temperature became 350 F. (177 C.). A fresh charge being put into the hopper the temperature fell to 329° F. (160° C.).

At—	F.	C.
3.25 p.m. the pyrometer marked	390	(199)
3.30 p.m. ,, ,,	400	(204)
3.35 p.m. ,, ,,	430	(221)
3.38 p.m. ,, ,,	450	(232)
3.41 p.m. ,, ,,	500	(260)
3.45 p.m. ,, ,,	520	(271)
3.52 p.m. ,, ,,	530	(278)

At—			F.	C.
4.0 p.m.	the pyrometer	marked	545	(285)
5.0 p.m.	,,	,,	450	(232)
5.40 p.m.	,,	,,	500	(260)
6.0 p.m.	,,	,,	520	(271)
6.25 p.m.	,,	,,	550	(288)
6.45 p.m.	,,	,,	570	(299)
7.0 p.m.	,,	,,	590	(310)
7.10 p.m.	,,	,,	600	(315)
7.35 p.m.	,,	,,	650	(343)
7.50 p.m.	,,	,,	700	(371)
8.0 p.m.	,,	,,	720	(382)
8.40 p.m.	,,	,,	750	(399)

8.45 p.m. the charge was drawn and the pyrometer tilted against the side of the retort. This caused the index to rise quickly, and as it touched the limit of the scale the instrument was withdrawn. The shale at this point, just entering the body of the retort, was found to be hotter than the escaping oil vapours, but not hot enough for distillation. In fact, subsequent tests showed that the shale does not reach a temperature of 1000° F. until it is about 6 ft. from the top of the retort.

Temperature of Shale in the Retort.—A pyrometer (Murrie's) having a range of 1000 to 1800° F., the length of stem being 18 ft. 2½ in. was inserted to a depth of about 10 ft. at 10.50 a.m. when charging retorts. Its position is shown at P on Fig. 10.

At 4.35 p.m. the first movement of the index gave 1020° F.

At			F.	
4.50 p.m.	the temperature	was	1050	
5.30 p.m.	,,	,,	1100	(593° C.)
6.0 p.m.	,,	,,	1120	Average, 1111°.
6.30 p.m.	,,	,,	1120	
7.0 p.m.	,,	,,	1120	
8.0 p.m.	,,	,,	1130	
9.0 p.m.	,,	,,	1140	Draw took place and pyrometer dropped down 2 ft.
9.20 p.m.	,,	,,	1129	Average, 1154°.
10.0 p.m.	,,	,,	1130	
11.0 p.m.	,,	,,	1110	
12 midnight	,,	,,	1150	
1.0 a.m.	,,	,,	1150	
2.0 a.m.	,,	,,	1180	
3.0 a.m.	,,	,,	1200	Draw, pyrometer dropped down to full length.
1.0 a.m.	,,	,,	1090	Draw took place. Average, 1109°.
1.30 a.m.	,,	,,	1080	
5.0 a.m.	,,	,,	1080	
6.0 a.m.	,,	,,	1080	
9.0 a.m.	,,	,,	1100	
9.30 a.m.	,,	,,	1090	
11.0 a.m.	,,	,,	1090	
12.0 noon	,,	,,	1110	
12.10 p.m.	,,	,,	1120	
12.40 p.m.	,,	,,	1140	
1.10 p.m.	,,	,,	1150	Pyrometer drawn out.
1.40 p.m.	,,	,,	1180	

On a subsequent occasion Mr. Harry Armour made an independent series of observations in another retort with the same pyrometer. He inserted it to a depth of about 6 ft. at 8.0 p.m., but it showed no indication of temperature till the following 3.0 a.m., when a draw took place and it dropped to a depth of 8 ft. 6 in. It then showed 1000° F.

At			F.	
6.0 a.m.	the temperature	was	1100	Average 1100°.
7.0 a.m.	,,	,,	1100	
8.0 a.m.	,,	,,	1100	
8.30 a.m.	,,	,,	1100	Draw. Pyrometer lowered to 12 ft.
9.0 a.m.	the temperature	was	1050	Temperature of external flues at this place = 1250° F.
10.0 a.m.	,,	,,	1050	Average 1068°.
11.0 a.m.	,,	,,	1070	
12 noon	,,	,,	1080	
1.30 p.m.	,,	,,	1090	Draw. Pyrometer lowered to 15 ft. 6 in
1.50 p.m.	,,	,,	1100	Temperature of external flues at this place = 1510° F.
2.0 p.m.	,,	,,	1100	Average 1130°.
2.45 p.m.	,,	,,	1110	
3.15 p.m.	,,	,,	1110	
3.30 p.m.	,,	,,	1115	
3.50 p.m.	,,	,,	1120	
4.20 p.m.	,,	,,	1125	
4.55 p.m.	,,	,,	1150	
5.30 p.m.	,,	,,	1150	
6.0 p.m.	,,	,,	1170	
6.30 p.m.	,,	,,	1190	
6.50 p.m.	,,	,,	1200	A draw took place and the pyrometer was lowered to its full length.
6.55 p.m.	,,	,,	1160	Temperature of external flues at this place over 1900°.
7.0 p.m.	,,	,,	1150	Average 1124°.
7.30 p.m.	,,	,,	1140	
7.40 p.m.	,,	,,	1130	
8.0 p.m.	,,	,,	1100	
9.0 p.m.	,,	,,	1100	
10.0 p.m.	,,	,,	1100	
11.0 p.m.	,,	,,	1100	
12 midnight	,,	,,	1150	Pyrometer withdrawn.

During these tests an experiment, which had been previously carried out on different occasions by me and by Professor Foster and Mr. A. H. Allen, was repeated by Mr. Harry Armour in my presence. The object of it was to ascertain the condition of the shale at the bottom of the retort, beyond the point to which the pyrometer stem reached.

In addition to the usual "draw" of half a hutch-load from a retort, another half or three-fourths of a hutch was drawn, and a portion of this last draw was transferred while hot, smoking and blazing, to a small experimental retort placed alongside and ready heated. A lid was put on and a steam jet turned into this small retort, and very soon a stream of oil and ammonia water was collected from the end of the iron pipe which did duty as a condenser. I have specimens of these products here and they, with the cloud of black dust, consisting of particles of unconsumed carbon, which accompanies every draw that I have witnessed at Hermand, Breich, Pumpherston, Holmes, or other works, are irrefutable witnesses to the fact that the temperature inside to the bottom of these retorts, except in rare instances, does not exceed 1100 to 1150° F.

Temperature of the Escaping Oil Vapours.—By means of a glass mercury thermometer inserted at T. (Fig. 10) in the exit pipe where it issues from the brickwork of the bench, a continuous series of readings of the temperature of the escaping oil vapours during 12 hours was obtained. Various other observations were made from time to time which are not quoted here, as they are merely confirmatory of this series:—

At			F.
6.30 a.m.	the thermometer	was	inserted.
7.30 a.m.	the temperature	was	450
8.30 a.m.	,,	,,	469
9.0 a.m.	a draw took place and the retorts were freshly charged.		
9.20 a.m.	the temperature	was	220
9.30 a.m.	,,	,,	320
10.30 a.m.	,,	,,	369
11.0 a.m.	,,	,,	376
11.30 a.m.	,,	,,	400

At		° F.
12 noon	the temperature was	416
12.30 p.m.	„ „	417
1.0 p.m.	„ „	450
1.30 p.m.	„ „	455
(Draw and fresh charge took place).		
1.40 p.m.	the temperature was	284
2.0 p.m.	„ „	295
2.30 p.m.	„ „	304
3.0 p.m.	„ „	321
3.30 p.m.	„ „	333
4.0 p.m.	„ „	353
4.30 p.m.	„ „	362
5.0 p.m.	„ „	378
5.30 p.m.	„ „	392
6.0 p.m.	„ „	400
6.30 p.m.	„ „	410

The regular fall of temperature in both shale and escaping oil vapours at the period of a draw and a fresh charge is not due to any contact with cold shale, but, as it appears to me, to the dropping of shale more highly charged with hydrocarbons into a hotter region, which causes the instantaneous production of a larger volume of gases with the accompanying cooling effect.

Although the comparatively high temperature of 1,200° F. (650° C.) was twice recorded during the examinations of the internal temperature of the retorts, I do not think that it necessarily follows that all the shale had then reached that temperature. This opinion is supported by the fact that on a draw taking place in both the instances referred to the pyrometer descended along with the shale into a hotter region in the retort, and yet the temperature simultaneously suffered a considerable fall which was maintained.

It appears to me that this occasional and temporary rise of temperature is due to the thermometer being for the time surrounded by pieces of shale which had become more quickly exhausted of their hydrocarbon constituents, and had in consequence been able to retain more heat in a sensible form. No one who has watched the operation of drawing retorts can have failed to notice that there are always some pieces of shale which are hotter than others, and this result is undoubtedly due, in great part, if not wholly, to the difference in chemical constitution to which I refer. Some pieces of shale are undeniably much richer in hydrocarbons than others, and they therefore require a longer application of heat for their complete resolution. It is easy to understand, therefore, that if some of the poorer pieces were left surrounding the pyrometer for some hours, they would, on becoming exhausted of oil-yielding constituents, be at once able to retain heat, and would become much hotter than surrounding pieces in which the process of decomposition was still going on. The pyrometer would record this state of matters until the dropping of the charge brought it clear of such exceptional circumstances and into contact with shale which showed more accurately the average temperature of the mass.

I have omitted to state above that during the course of the observations of temperature which are recorded in this paper, the specific gravity of the crude oil produced from day to day was found to remain about 0·873 to 0 878, the temperature being 102° to 120° F.

Analysis of Permenent Gas.—Another indication of the moderate temperature existing in the retorts is found in the chemical constitution of the permanent gas. The following analyses were made (I.) by Mr. R. R. Tatlock, of Glasgow, and (II.) by Professor W. Foster, of London, from samples taken by them at different times from the gas main at Hermand.

Analysis I.

	Per Cent.
Carbonic acid	23·0
Carbonic oxide	4·0
Hydrogen	13·4
Olefines	1·6
Marsh-gas	19·7
Oxygen	1·3
Nitrogen	37·0
	100·0

Analysis II.

	Per Cent.
Carbonic acid	20·7
Carbonic oxide	1·16
Free hydrogen	21·68
Heavy hydrocarbons, ethylene, &c.	1·6
Marsh-gas	8·66
Free oxygen	3·6
Free nitrogen	42·6
	100·0

The proportions of carbonic acid to carbonic oxide in these analyses show that the temperature in the retorts must have been a long way below 1,472° F. (800° C.), which is the lowest temperature at which the reactions resulting in the formation of water-gas take place. By "water-gas" I mean the mixture of gases produced by the decomposition of steam by carbon at the temperature which causes that mixture to contain the largest proportion of carbonic oxide and the smallest proportion of carbonic acid possible.

These analyses also confirm a statement which was made to me by Mr. N. M. Henderson of Broxburn Oil Works, before the analyses were made, viz., that more than half the volume of permanent gas obtained from retorts constructed of brickwork, or partly of brick and partly of iron, and worked at a pressure slightly lower than that of the atmosphere (in consequence of the use of exhausters for drawing off the oil gases from the retorts and mains) consists of atmospheric air which has been drawn in partly through the retorts and partly into the pipes without passing through the hot portions of the retort.

A survey of these results conducts to the conclusion that they offer a very plain confirmation of the chemical or physical law, that change of physical condition, from solid to liquid or from either to gas, is invariably accompanied by absorption of heat, or the production of what is called "latent heat;" and they also illustrate the fact that as long as such a process is in operation it is practically impossible that there can be any considerable increase of sensible heat.

I have heard these things denied or ignorantly described as "physical impossibilities;" but the every-day example of the action of boiling water for the production of steam is a witness at once of their truth and of the ignorance of the objection. It is well known that not only does an immense amount of sensible heat disappear and become latent in the effort to effect the change in the physical state of water from the liquid to the gaseous, but also that as long as water in the liquid form remains in the vessel to which heat is being applied, it does not matter what external temperature is applied, or what is the conductivity of the material of the vessel, the temperature of the water steadily and persistently refuses to advance beyond 212° F. The moment however that the last drop of water disappears the possibility of accumulating sensible heat in the steam appears and is limited only by the period at which dissociation causes the destruction of that gaseous body by its resolution into its elements. The case of shale distillation is strictly analogous, and it will certainly not be to the disadvantage of the process if such physical laws are recognised in the methods by which it is carried out.

Meeting held in the Philosophical Institution, Edinburgh, on Tuesday, May 5th, 1891.

MR. E. C. C. STANFORD IN THE CHAIR.

ON THE DIRECT ESTIMATION OF ARSENIC IN MINERALS, METALS, &c.

BY JOHN CLARK, PH.D., F.I.C.

In a provisional specification "For decomposing sulphides of copper, &c.," taken out by myself in conjunction with Mr. Alexander Esilman in 1867, it was pointed out for the first time that the persalts of iron decomposed the sulphides of a large number of metals, separating sulphur and forming a salt of the metal which was accompanied by the reduction of the ferric salt employed to the corresponding ferrous salt. It occurred to me that this action of the persalts of iron on sulphides might be utilised for the estimation of arsenic when in the form of sulphide. For this purpose known quantities of pure sulphide of arsenic were distilled with a concentrated solution of ferric chloride in strong hydrochloric acid in an ordinary flask connected with a worm condenser, to the end of which a wide tube was attached, which dipped into pure water. The arsenic was then precipitated with sulphuretted hydrogen in the cold and collected on a weighed filter with the following results :—

	Per Cent.
(1) 5 grs. As_2S_3 gave.....	5·02 = 100·40
(2) 5 grs. As_2S_3 gave.....	4·95 = 99·00

It is absolutely necessary, in estimating the arsenic in this way, that the HCl should be concentrated, and it is always advisable to evaporate down the solution three times with a considerable quantity of strong HCl. The perchloride of iron decomposes the H_2S, which would be produced by dissolving the As_2S_3 in HCl, facilitates the solution, and enables the arsenic to be estimated direct.

When the As_2S_3 is dissolved in strong HCl without Fe_2Cl_6, As_2S_3 condenses in the tubes of the apparatus, owing to the evolution of H_2S along with the chloride of arsenic.

Ferric sulphate also decomposes sulphide of arsenic in presence of moderately concentrated sulphuric acid, but the decomposition is much more difficult and seldom perfect.

I have made a number of experiments with ferric chloride on mixed sulphides of arsenic, antimony, and tin with the most satisfactory results, and I have found this to be the simplest and most reliable process for the estimation of arsenic in antimony ore. It is also applicable for the direct estimation of arsenic in iron and copper pyrites, but the ore requires to be very finely ground, a large excess of ferric chloride used, and the evaporation carried down pretty far. When, however, the distillation is carried too far, the distillate is apt to contain a little free sulphur and smell of sulphurous acid, due to the formation of a little chloride of sulphur and its subsequent decomposition by the water in the receiver into HCl, S, and hyposulphurous acid, which, in its turn, is resolved into sulphurous acid and free sulphur. It is, therefore, advisable when the distillate shows any appearance of sulphur to dilute it with water sufficiently to prevent the volatilisation of chloride of arsenic, boil to expel the sulphurous acid, filter if necessary, and then precipitate the arsenic with H_2S in the usual way. A sample of pyrites in which 1·19 per cent. of arsenic was found in the usual way gave, when distilled with ferric chloride, 1·26 and 1·31 per cent.

The perchloride of iron can also be used for the estimation of arsenic in natural arsenides, such as Kupfer nickel, smaltine, &c.; thus—

Ten grs. arsenide of Ni with Fe_2Cl_6 and HCl gave 40·6 As. The same mineral gave, after oxidation by the usual method, 40·43 per cent. of arsenic.

In the case of the native arsenide of cobalt or smaltine the decomposition is rather more difficult, but when the mineral is finely ground and a large excess of Fe_2Cl_6 employed the mineral is completely decomposed, and the results obtained are very satisfactory.

Ten grs. of a smaltine, which by the ordinary oxidation process was found to contain 52·50 As per cent., gave by distillation with Fe_2Cl_6 and HCl—

1st experiment... 8·57 of As_2S_3 = 52·25 per cent. of As.
2nd experiment.. 8·64 of As_2S_3 = 52·68 per cent. of As.

On a former occasion I showed to the Society that perchloride of iron could be used in the estimation of the smallest quantities of arsenic in copper. It is, of course, equally suitable for the estimation of arsenic in brass and bronze, and in my opinion it might, with advantage, be tacked on to Reinsch's process in the estimation of arsenic in cases of poisoning and in organic mixtures containing only a small quantity of arsenic. Reinsch's process is one of the simplest and most reliable methods for the detection of arsenic, and the whole of the arsenic is deposited on the copper when sufficient time is allowed. H. Carmichael (American Jour. 1886, 129) estimates arsenic quantitatively by ascertaining the number of pieces of copper of a certain size which are coated steel-grey with the arsenic, but in my opinion it is more satisfactory to obtain the arsenic in a form in which it can be weighed. This can easily be done by distilling the coated copper with ferric chloride and HCl. In carrying out the process the stomach or material under examination is boiled gently with dilute HCl and pieces of pure copper foil. As soon as one piece has become decidedly coated it is taken out, washed with a little alcohol to remove any adhering fat, and dropped into the distillation flask. The washing with alcohol is very important, as otherwise fat, which is generally present in such cases, adheres to the copper and makes its appearance again along with the arsenic in the distillate. When the material no longer affects the copper after boiling for 20 minutes, the whole of the pieces are distilled with HCl and Fe_2Cl_6 in the usual way. It is, of course, absolutely necessary in a case of poisoning to make a blank experiment with the same quantity of the copper foil

The experiments made to test the accuracy of this process gave very good results. Thus—

0·2 gr. As_2O_3 put into an organic mixture containing a good deal of fat gave 0·245 As_2S_3 = 0·197 grain. of As_2O_3
0·1 grain of As_2O_3 gave 0·105 As_2S_3 = 0·084 grain of As_2O_3
0·05 grain of As_2O_3 gave 0·05 As_2S_3 = 0·040 gram of As_2O_3

When zinc containing arsenic is dissolved in ferric chloride or ferric sulphate a portion of the arsenic is given off in the form of AsH_3; in fact, in the case of some arsenides of zinc made by myself, containing from 5 to 10 per cent. of arsenic, the loss in this way amounted to from 10 to 20 per cent. of the whole, and even when the arsenide was dissolved in pure iron alum a little AsH_3 was evolved. This could be prevented by dissolving the zinc in a mixture of ferric sulphate and sulphate of silver, and distilling off the arsenic with HCl, but the easiest way is to dissolve in dilute H_2SO_4, and pass the gas through a solution of sulphate of silver, which decomposes the AsH_3, then filter off the precipitated silver and mix the filtrate containing the arsenic with the undissolved residue from the zinc, and distil with Fe_2Cl_6 and HCl.

Small quantities of arsenic are occasionally found in iron, as practically all the arsenic in iron ores goes into the pig iron, and when this is dissolved in dilute H_2SO_4 or HCl, according to Pattinson and Stead, all the arsenic is left behind as black, insoluble arsenide of iron. In this case the arsenic can easily be determined by distilling the residue with ferric chloride and strong HCl. In the experiments which I made I found that in pig iron at any rate a portion of the arsenic is evolved as AsH_3 when it is dissolved in dilute H_2SO_4 and it is therefore always advisable to pass the H which is evolved through a solution of sulphate of silver to get the whole of the arsenic. Thus, a sample of pig iron containing arsenic, when dissolved in dilute H_2SO_4 gave the following results :—

	Per Cent.
Arsenic evolved as AsH_3.....	0·073
Arsenic insoluble in dilute H_2SO_4 .	0·092
Total.....	0·165

In determining phosphorus in iron in presence of arsenic by the molybdic process, the precipitate is apt to contain

arsenic, and this can be most conveniently estimated, in my opinion, in the magnesia precipitate by distilling with HCl and ferrous chloride. It has been pointed out by Reis that when arsenic is estimated by the molybdic process the arsenic precipitate separates very slowly at a temperature of from 40° to 50° C., at least 24 hours being necessary for the purpose. I have found that the phosphorus is precipitated before the arsenic, and when the temperature is not allowed to rise beyond 40° C. and the precipitate is filtered off within two hours of precipitation, it is quite free from arsenic, even when a considerable quantity of arsenic acid is present. Even at a temperature of 85° C. only a small percentage (about 5 per cent.) of the arsenic is precipitated in the course of three or four hours, so that I am of opinion that the presence of arsenic in pig iron does not interfere with the estimation of the phosphorus by the molybdic process to the extent which is generally believed.

AN ACCOUNT OF THE MANUFACTURE OF PHOSPHORUS.

BY J. B. READMAN, D.SC., F.R.S.E., F.C.S., EDINBURGH.

PART III.

In my last paper on the manufacture of phosphorus, read before this Society about a year ago, I referred to experiments that I had made with the view of cheapening the process for producing phosphorus, by dispensing altogether both with the use of sulphuric acid to decompose the phosphate of lime and also with the employment of fireclay retorts for distilling the desiccated mixture of phosphoric acid and carbon.

The preliminary experiments, some of which were given in detail in that paper, proved conclusively that silica in the form of sand, ganister, flints, &c., intimately mixed with phosphate of lime and carbon in suitable proportions, was capable, at a high temperature, of expelling practically all the phosphorus contained in the mixture, and that with adequate condensing appliances a very large proportion of the phosphorus may be collected.

Since then a large number of additional experiments have been made to ascertain if it is essential to employ as the raw material, or source of phosphorus, one or other of the native phosphates of lime that are imported in vast quantities into this country from the United States and Canada, France, Spain, Belgium, Norway, &c., &c., for the manufacture of superphosphates, or, if native phosphate of alumina, such as that known as "Redonda" phosphate, would be available.

Experiment proved that with suitable fluxes the latter class of phosphates may be advantageously employed for producing phosphorus, satisfactory results having been obtained from them as well as from phosphate of lime.

So much for the successful solution of the first part of the investigation, viz., the substitution of silica for sulphuric acid in the decomposition of the native phosphate, but the second part, viz., to obtain a suitable apparatus wherein to conduct the distillation, presented many difficulties. Retorts were found unsuitable both on the score of economy and durability, and as the blast furnace seemed likely to be successful, I resolved to give it a fair trial.

I need not take up time by going much into detail in describing the experiments, which were conducted on a large scale for several months. Suffice it to say that this style of furnace was found to be unavailable for the purpose. The large volume of air required, and the difficulty, or perhaps impossibility, of driving off the phosphorus by the time the phosphorus-bearing mixture passed the tuyères of the furnace, were serious obstacles to success. All the air that was passed into the furnace produced gases which had to be cooled and dealt with when they left, for they contained all the phosphorus that was expelled from the material. Then again the slag passing the hottest part of furnace and yet retaining much material only partially decomposed, rendered the former highly infusible and difficult to tap, and sooner or later caused "scaffolding" and choking of the furnace.

Various sizes and shapes of blast furnace were tried, and the blast was used both cold and highly heated, with little pressure and at a pressure of several pounds to square inch; water-jacketed and brick-lined furnaces were tried in turn, but the difficulties indicated, and other experiments in course of working, were found to be insurmountable, and this form of furnace had to be abandoned.

The success of the application of electricity to the production of certain metals and alloys led me to try this source of energy on the manufacture of phosphorus. The results of the first series of experiments were so encouraging, that provisional protection was taken out on 18th October 1888, for the preparation of phosphorus by its means.

The trials were carried on at this time on a very small scale, the power at my disposal being very limited in amount, yet the elements of success appeared to me so great, and the decomposition of the phosphorus bearing material was so complete, that I resolved to prosecute the process on a large scale. After a good deal of negotiation with several firms who were in a position to supply the electric energy required, I finally made arrangements with the Directors of the Cowles Co., Limited, of Milton, near Stoke-on-Trent, the well known manufacturers of alloys of aluminium, for a lease of a portion of their works and for the use of the entire electrical energy they produced for certain portions of the day.

The plant at these works has been frequently described, both at the meetings of the British Association and at other societies of a like nature, and are in all probability familar to some of the members present. The following is an abridged description of the works and plant as given before Section G* of the British Association:—

The works were built near the Milton Station, on the North Staffordshire Railway, the boilers for generating the steam required are of the Babcock-Wilcox type and are provided with mechanical stokers; the steam engine is of 600 h.p., and is a compound, condensing, horizontal tandem, made by Messrs. Pollit and Wigzel, of Sowerby Bridge. The fly wheel of this engine is 20 ft. in diameter and weighs 30 tons, and is geared to the pulley of the dynamo, so that the latter makes five revolutions for each revolution of the engine by rope driving gear, consisting of 18 ropes. The engine is an extremely fine specimen of a modern steam engine, it works so silently that a visitor standing in the engine room with his back to the engine railings at the time the engine is being started cannot tell whether it is in motion or not. In regard to the dynamo, the spindle is of steel, 18 ft. long with three bearings, one being placed on either side of the driving pulley. The diameter is 7 in. in the bearings and 10 in. in the part within the core. This part in the original forgings was 14 in. diameter and was planed longitudinally so as to leave four projecting ribs or radial bars on to which the core discs are driven, each disc having four key ways corresponding to these ribs. There are about 900 of the discs, the external diameter being 20 in., and the total length of the core 36 in.

The armature winding consists of 128 copper bars, each $\frac{7}{8}$ in deep, measured radially, by $\frac{3}{8}$ in. wide. These 128 bars are coupled up so as to form 32 conductors only; this arrangement has been adopted to avoid the heating from the Foucault currents, which with $1\frac{1}{2}$ in. conductors would have been very considerable. The bars are coupled at the ends of the core across a certain chord and are insulated.

The commutator is 20 in. long and has 64 parts. The current is collected by eight brushes mounted on a separate ring, placed concentric to the commutator and the current is led away from these brushes by a large number of thin bands of sheet copper strapped together into convenient groups. The field magnets are of the horizontal double type.

As this machine is virtually a series wound machine, the magnet coils each consist of a few turns only of forged copper bars, $1\frac{1}{2}$ in. wide × 1 in. thick, forged to fit the magnet cores.

* Bath Meeting, 1888.

There is no insulation other than mica wedges to keep the bars from touching the core.

Another account states that the dynamo furnishes a current of about 5,000 ampères, with an E.M.F. of 50 to 60 volts, and is said to be (1888) the largest machine (at least in regard to quantity of current) in England, and probably in the world.

The current from the dynamo is led by copper bars to an enormous "cut-out" calculated to fuse at 8,000 ampères. This is probably the largest ever designed, and consists of a framework carrying 12 lead plates, each $3\frac{1}{2}$ in. $\times \frac{1}{10}$ in. thick. A current indicator is inserted in the circuit consisting of a solenoid of nine turns. The range of this indicator is such that the centre circle of 360° = 8,000 ampères.

The electrodes consist of a bundle of nine carbons, each $2\frac{1}{2}$ in. diameter, attached by casting into a head of cast iron. Each carbon weighs 20 lb., and when new are about 48 in. long. I have here specimens of these carbons.

The "head" of the electrode is screwed to the copper rods or "leads," which can be readily connected with the flexible cables supplying the current.

The electric furnaces are rectangular troughs built of fire-brick, their internal dimensions being 60 in. × 20 in. × 36 in. deep. Into each end is built a cast-iron tube, through which the carbon electrodes enter the furnace.

The large sketch exhibited on the wall will show the general arrangements of the furnace and carbons.

The electrodes are so arranged that it is possible by means of a screw arrangement to advance or withdraw them from the furnace.

It is here necessary to remark that the whole current generated by this vast dynamo is passed through one furnace, such as has been described.

In these experiments, in Staffordshire and elsewhere, we worked entirely with raw materials, for it was evident it was only by the *direct* production of phosphorus from the native minerals that contain it, such as phosphates of lime, magnesia, or alumina, that there was any hope of superseding, in point of economy, the existing process of manufacture.

In the furnaces as used at Milton we experienced much difficulty in distributing the heat over a sufficiently wide area. So locally intense indeed was the heat within a certain zone that all the oxygen contained in the mixture was expelled, and alloys of iron, aluminium, and calcium, combined with more or less silicon and phosphorus, were produced. Some of these were of an extremely interesting nature, and may form the subject of a further communication to the Society.

The experiments on the large scale had not advanced very far when I became aware that another application for letters patent for producing phosphorus had been made by Mr. Thomas Parker, the well-known practical electrician of Wolverhampton, and his chemist, Mr. A. E. Robinson. The joint patent is dated 5th December 1888, and was thus applied for only seven weeks after my application was lodged.

It appeared that Mr. Parker had conducted a large number of experiments simultaneously, but quite independently, of those carried on by myself and those who assisted me, and that he was quite unaware—as I was unaware—of any other worker in this field. It was no small surprise, therefore, to find, during our interview, which took place some time after the dates referred to, that the two patents were on practically the same lines—viz., the production of phosphorus by electricity.

Our interests lay so much together that, after some delay, we arranged to jointly work out the process, and the result has been the formation of a preliminary company and the erection of a large-scale experimental plant in the neighbourhood of Wolverhampton, to prove the commercial success of the new system of manufacture.

The following is a short account of the works and plant at that place:—

The ground is situated on the banks of a canal, and extends to about 10 acres, which are wholly without buildings, except what have just been erected for the purposes of the experiment. These consist of boiler and engine-houses and large furnace sheds.

There are three Babcock and Wilcox steam-boilers of 160 h.p. each, and each capable of evaporating 5,000 lb. of water per hour. The water tubes are 18 ft. long × 4 in. diameter, and the steam and water drums 42 in. diameter and $23\frac{1}{2}$ ft. long, of steel $\frac{7}{16}$ in. thick, provided with a double dead-weight safety-valve, stop-valves, blow-off cock, water-gauges, and steam-gauge.

The total heating surface on each boiler is 1,619 sq. ft., and the total grate surface 30 sq. ft.

The boilers are worked at 160 lb. pressure.

The engine is a triple compound one of the type supplied for torpedo boats, and built by the Yarrow Shipbuilding Company. It is fitted with a Pickering governor for constant speed. The engine is capable of delivering (with condenser) 1,200 I.H.P., and without condenser, 250 I.H.P. less. With steam at 170 lb. pressure the engine worked at 350 revolutions per minute, but it has been re-arranged so as to deliver 700 I.H.P. with 160 lb. steam pressure, without condenser, and at 300 revolutions per minute—

The high-pressure cylinder is	$14\frac{1}{2}$	in.	diameter.
The intermediate	25	in.	„
The low-pressure	32	in.	„

The stroke is 16 in.

The dynamo for producing the requisite amount of electrical current supplied to the furnaces is one of the well-known Elwell-Parker type of alternating current dynamos designed to give 400 units of electrical energy, equivalent to 536 I.H.P.

The armature in the machine is stationary, with double insulation between the armature coils and the core, and also between the core and the frame, and is so arranged that its two halves may be readily connected in series or in parallel in accordance with the requirements of the furnaces, *e.g.*, at an electro-motive force of 80 volts it will give 5,000 ampères, and at 160 volts, 2,500 ampères when running at 300 revolutions per minute.

The exciting current of the alternator is produced by an Elwell-Parker shunt-wound machine driven direct from a pulley on the alternator shaft and so arranged as to give 90 ampères at 250 volts when running at a speed of 800 revolutions per minute. From 60 to 70 ampères are utilised in the alternator, the remainder being available for lighting (which is done from accumulators) and general experimental purposes.

This short sketch will, I trust, give some idea of the magnitude of the plant which is now in full working order and which has all been erected, at a very considerable cost, for the express purpose of proving the Readman-Parker system of commercially producing phosphorus by the new application of electricity to this manufacture.

The process is carried out in the following way:—

The raw materials all carefully and intimately mixed together are introduced into the furnace in the condition shown by the specimens on the table, the current is then turned on and shortly after indications of phosphorus make their appearance.

The gases from the furnace pass away to large copper condensers—the first of which contains hot and the others cold water—and finally they pass on to the air.

As the phosphorus is distilled off from the mixture the residue in the furnace forms a liquid slag, which from time to time is tapped out at the bottom of the furnace, fresh phosphorus-yielding material being introduced at the top. In this way the operation is a continuous one, and we have every reason to believe it can be continued for days without intermission.

Slag Furnaces.—I have here specimens of the slag which has been tapped from the electric furnace in the manner just described. The charge as introduced into the furnace can be made to contain as much as 15 per cent. of elementary phosphorus, and as the weight of the slag from this is rather less than half the weight of the former, and that, moreover, it contains on an average only about one per cent. of phosphorus, it will be apparent that the decomposition is remarkably perfect.

The charges for the furnaces are made up with raw materials, *e.g.*, native phosphates, without any previous

chemical treatment, and that the only manufactured material —if it may be called such—is the carbon to effect the reduction.

The crude phosphorus obtained in the condensers is tolerably pure, as may be seen by the specimen before you, and is readily refined in the usual way.

It may be well to mention that we do not now put the entire current from the dynamo through one furnace. We find that the advantage is on the side of a series of furnaces yielding about one hundredweight and a half of phosphorus each per day.

It was intended to have exhibited photographs of the engines and boilers and also of the dynamo and set of furnaces for to-night's meeting, but unfortunately this has not been accomplished in time.

Discussion.

The Chairman thanked Dr. Readman for the series of interesting and valuable papers on this important subject which he had read to the Section. He felt bound to say that in his opinion Dr. Readman had hardly done himself justice in this last paper, so far as regards reference to his own labours. From personal knowledge he could say that Dr. Readman had for some years devoted an enormous expenditure of labour, time, and money to the perfection of the process he had described. He had had many obstacles to overcome, and he hoped that his ingenuity and application would receive the reward so well deserved. There were one or two points on which he should like some further information. In the first place he would ask whether basic slag had been tried as a source of phosphorus. He should also like to know how the carbons used in the furnace were manufactured, and how they stood the very high temperature of the furnace. The phosphide of iron which Dr. Readman had exhibited was in his opinion a very interesting substance, and it would be interesting to have a somewhat fuller description of its properties. He understood that it was absolutely necessary to the success of a continuous process that a fluid slag must be produced, to be easily run off. Great difficulty had been experienced in getting any lining that would stand the great heat and action of the flux. He knew Dr. Readman had employed, amongst other things, a water jacket, and his experience in this direction would be interesting to the Section. There must also be some difficulty experienced in condensing such a volatile body as phosphorus, especially when the temperature at which it was produced was taken into consideration. The "crude" phosphorus obtained was, he thought, very pure in comparison with specimens of crude phosphorus he had seen obtained by other processes.

Mr. G. Beilby had failed to gather from the paper how Dr. Readman had got over the difficulty experienced with Cowles' furnace, namely, the concentration of the heat in a small area and consequent expulsion of oxygen from the raw material and reduction of the bases to the metallic state. He would be glad to have some further details about the construction of the furnaces now used.

Dr. J. R. Paterson asked whether in the blast furnace experiments the injection of steam had been tried, and if so, what was the result?

Dr. G. G. Henderson asked if the charge of raw material was prepared in the way described in the second part of Dr. Readman's paper, and if the quantity of phosphorus lost in the form of phosphide of iron or otherwise in the slag was at all considerable?

Dr. J. B. Readman, in reply, said that basic slag was the first substance tried, but that it had been found of no avail, because under the conditions of the manufacture any iron in the raw material combined with phosphorus, forming a phosphide containing 23—24 per cent. of phosphorus, and there was sufficient iron in many of the basic slags to take up nearly all the phosphorus in this way. With regard to the carbons, those used by the Cowles Company are manufactured in America, and cost 8*s.* to 10*s.* each. In place of these they had substituted a simple arrangement, using gas carbons. The phosphide of iron obtained in the manufacture, as stated above, contains 23—24 per cent. of phosphorus, corresponding pretty closely to the formula Fe_3P_2. It is steel-grey in colour, hard and extremely brittle, and breaks with a crystalline fracture. It is very fusible and extremely insoluble in hydrochloric and nitric acids, though sulphuric acid attacks it slowly. The difficulty attending the concentration of the heat between the carbons was overcome by reducing the size of the furnaces. Their furnaces were, generally speaking, similar in construction to the Cowles' furnace, but they used a series of small furnaces, capable of turning out about 1½ cwt. of phosphorus per day, instead of large ones. It was found that the brickwork did not suffer, the heat being concentrated between the poles. The operation of tapping is very simple, being carried out in the same way as the tapping of a blast furnace. The slag is quite liquid enough to flow out readily under the pressure of the superincumbent charge. The fusion of the charge is a sign that the phosphorus is expelled from it. In the blast furnace experiments the action of moisture was found to result in the formation of phosphoretted hydrogen. The charge was prepared in the manner described in the former paper. With regard to loss of phosphorus in the form of phosphide of iron he would quote the results of a working experiment:—127 parts of the mixture were used, containing 13 per cent. of phosphorus, 14·3 parts of phosphorus were volatilised, and 2·3 parts of phosphorus were lost, chiefly in the form of phosphide of iron. It would thus be seen that about 86 per cent. of the phosphorus passed on to the condensers. All the iron in the raw material was obtained as phosphide after the treatment in the furnace, and was run out with the slag.

METHYLATED SPIRITS.

BY D. B. DOTT, F.C.S., F.I.C.

The disadvantages attending the use of methylated spirit as compared with pure alcohol are known to every chemist, but are more particularly impressed on one who is engaged in pharmaceutical manufactures. Whether the methylated spirit is employed simply as a solvent, as in the crystallisation of an alkaloid, or is converted into new products as in the preparation of ether or chloroform, there are drawbacks attending its use. It is frequently necessary to use methylated spirit or alcohol not only in the separation of alkaloids and active principles, but also in the purification of organic and mineral salts. For instance, a salt may be so extremely soluble in water that it is hopeless to employ that menstruum for its crystallisation, in which case spirit is generally suitable. In all these instances methylated spirit is objectionable, because of the persistent odour which remains after evaporation of the spirit, and sometimes also on account of the colour imparted to the salt. The enduring empyreumatic odour left by methylated spirit is often a fatal objection to its use. What is evidently required, is a methylated spirit or its equivalent which shall leave no residue when evaporated. By an Act recently passed (53 Vict. c. 8), the Commissioners of Inland Revenue have power not only to use some substance other than wood naphtha for methylating, but may also use any mixture or combination of substances for that purpose. It is not expressly stated, but is presumably implied, that the mixture must not be less than one-ninth of the volume of the alcohol to which it is added. In a paper formerly contributed to the proceedings of this Society,* the use of highly purified wood spirit or methyl alcohol was advocated as the methylating material, the methylated spirit so prepared to be used only by manufacturers. From a manufacturer's point of view such a spirit would probably be most satisfactory, but regarded from an excise aspect there are some weighty objections. These are, that so pure a spirit is scarcely distinguishable from alcohol by ordinary physical and physiological properties, but requires the application of delicate chemical tests. Since the paper above referred to was written, I have had considerable additional

* Vol. VI., 805.

experience in the use of methylated spirit for the extraction of active principles, the crystallisation of salts, and other purposes, and have also tried a number of experiments with various mixtures of solvents. The general conclusion at which I have arrived is, that a mixture of rectified spirit with acetone forms the best "methylated spirit." Acetone resembles alcohol in being perfectly miscible with water, and in dissolving nearly every compound which is soluble in alcohol. Salts generally are not so soluble in acetone as in alcohol, but this is of little consequence when the solvent contains only 10 per cent. of acetone. This mixture evaporates without leaving any appreciable odour, which is a great matter. The acetone mixture is well adapted for the preparation of chloroform, and also for the production of ether. The odour of the mixture is well marked and the taste sufficiently disagreeable. No doubt there are some men who would drink it, as they do the coarsest methylated spirit. It may be objected that such a mixture could be more readily purified than the methylated spirit presently used, and there is some truth in the objection. At the same time it must not be supposed that the acetone can be separated by a simple distillation, or by shaking up with acid sulphite and decanting. Anything like a complete separation of the alcohol and acetone could only be effected by repeated rectification. My own view is, that too much has been made of the possibility of purifying methylated spirit. I do not think the revenue is at all likely to suffer seriously from such methods. However it must be recognised that the excise authorities would probably be more readily satisfied with a methylating mixture containing wood naphtha than with acetone alone. I would therefore suggest that a mixture of equal volumes of acetone and *purified* wood naphtha be added in the proportion of one volume to nine volumes of spirits of wine, to form methylated spirits for manufacturing purposes. The ordinary "miscible naphtha" will not do, even in the proportion of 5 per cent., as it leaves a fixed residue and strong odour. I believe that this purer form of methylated spirit would satisfy nearly all the requirements of pharmaceutical and analytical chemistry, and its introduction would therefore be of great advantage. It would probably be desirable still to retain the quality of methylated spirits presently in use for such purposes as the preparation of varnishes, burning in lamps, and for general retail sale.

There are on the table bottles containing (1) pure alcohol; (2), methylated spirits; (3), spirit containing 10 per cent. by volume of acetone; (4), spirit containing 5 per cent. by volume of acetone and 5 per cent. by volume of purified wood naphtha; so that they may be examined and the difference in their properties noted.

In conclusion, I have to express my thanks to Messrs. Duncan, Flockhart, and Co., in whose laboratory the experiments connected with this note were performed.

Yorkshire Section.

Chairman: Sir James Kitson, Bart.
Vice-Chairman: Dr. F. H. Bowman.

Committee

A. H. Allen.	J. Lewkowitsch.
W. Bielbtt.	C. Rawson.
P. Farley.	Jas. Sharp.
A. Hess.	A. Smithells.
R. Holliday.	Geo. Ward.
J. J. Hummel.	Thorp Whitaker.

Hon. Local Secretary and Treasurer:
C. H. Bothamley, Yorkshire College, Leeds.

Notices of Papers and Communications should be addressed to the Hon. Local Secretary.

Journal and Patent* Literature.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

Boiler Feed-Water containing Magnesium Chloride. A. Goldberg. Chem. Zeit. **15**, 31.

Feed-water containing magnesium chloride may not be directly used. Treatment with caustic soda in the boiler itself is very frequent, but the great difficulty lies in ascertaining the amount of caustic soda necessary, and in keeping only slight excess present. Usually samples are drawn off from time to time and tested, litmus being used as indicator, but a simpler method would seem to be the introduction of an indicator into the boiler. Unfortunately most indicators become colourless on heating under pressure; the author proposes, however, sodium para-nitrophenolate, which does not possess this disadvantage. In taking an observation it is only necessary to blow off the water from the water-gauge and to admit a fresh portion from the boiler. The indicator in the pure state is certainly dear, but perfect purity is not essential. Then again continuous use of the indicator is not necessary, for when once the working quantity of caustic has been ascertained the indicator may be dispensed with for a while. With regard to the working of this indicator, so long as the water in the boiler is alkaline there is direct indication, but directly acidity prevails, reduction takes place to amidophenol and direct indication ceases. The indicator is best prepared on the spot by dissolving para-nitrophenol in a dilute solution of caustic soda.—T. L. B.

PATENTS.

Improvements in Boiler and Furnace Fires. O. Imray, London. From R. Mannesmann and M. Mannesmann, Bliedinghausen, Germany. Eng. Pat. 1284, January 24, 1890. *6d.*

This is an apparatus for use in boiler and furnace fires, whereby a portion of the combustion gases are drawn off and caused to pass through the fresh coal so as to distil off the volatile constituents. An injector is used, which sucks off the gases from the upper portion of the fuel and introduces them below the ash-pit or into the incandescent part of the fuel. The value of the coal is increased by the conversion of the hydrocarbons into permanent gas and by the higher heat produced.—D. A. S.

Improvements in Centrifugal Apparatus for Filtering Water and other Liquids. W. P. Thompson, Liverpool. From A. Stehlik, Vienna, Austria. Eng. Pat. 2632, February 18, 1890. *8d.*

The invention relates to devices in connexion with centrifugal machines used for filtering water and other liquids, the object being to continuously remove the retained deposit and to mix air with the filtered water. Within the revolving drum, which is driven from below and is perforated only on the upper two-thirds of its circumference, are two concentric stationary cylinders held in position by being connected to the casing above the drum. The filtering water is admitted through the annular space between these cylinders to the bottom of the drum, where it deposits part of its impurities,

* Any of these specifications may be obtained by post, by remitting the cost price, *plus* postage, to Mr. H. Render Lack, Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C. The amount of postage may be calculated as follows:—

If the price does not exceed 8*d.*				½*d.*
Above 8*d.*, and not exceeding 1*s.* 6*d.*				1*d.*
„ 1*s.* 6*d.*,	„	„	2*s.* 4*d.*	1½*d.*
„ 2*s.* 4*d.*,	„	„	3*s.* 4*d*	2*d.*

the water on rising being driven out through the perforations, which are covered on the inside with filtering substances, such as asbestos, charcoal, &c. Air-pipes carry the air through the bottom plate of the inner cylinder, and are bent out at their lower ends to come into contact with the inside of the revolving drum, being shaped so as to cut away the deposited material, which then passes out through holes in the bottom of the drum. There are seven claims and three sheets of drawings.—B.

Improvements in Apparatus for making Infusions. C. J. Jones, London. Eng. Pat. 3661, March 7, 1890. 8*d*.

The object of the invention is to facilitate the discharge of the infusion through the filter surface.

A cylinder, capable of being reversed, and containing a piston, has both its ends closed by removable covers, which are kept in position by arms fixed on one side of the cylinder, and carrying a screw. These arms are made in one piece, with a hollow axis, which extends from the centre of the side of the cylinder, and is fitted over the end of a pipe from the boiler. Across each cover internally is a perforated filter plate, and it is also provided with a draw-off tap. The substance to be infused being placed upon the filter surface, and the cover being fixed, the cylinder is reversed, thus bringing the filter plate and material to the top. Boiling water under pressure is then admitted to the cylinder between the cover and the piston, and when the draw-off tap on the cover, which is now at the bottom, is opened, the piston is forced downwards, and the infusion is forced out through the opened tap.

The cylinder may be made with a removable cover at one end only, in which case the cylinder is fixed, and the removable cover is at the bottom —E. S.

Improvements in Condensing Apparatus for Steam and other Vapours. J. Schwager, Berlin, Germany. Eng. Pat. 3915, March 12, 1890. 8*d*.

In this apparatus the currents of vapour and the condensing liquid are made to flow in contrary directions, the air and water pumps being made to exhaust both the liquid of condensation, the condensing liquid, and the uncondensed vapour or air.

A closed upright vessel or condenser has within it a number of central helically-arranged plates, perforated or unperforated, forming a winding staircase. The condensing liquid is caused to flow down from step to step to the bottom, where a suitable liquid seal or trap is formed communicating at the outer end with an air and liquid pump, which at the same time is made to communicate by a pipe with the top of the condensing chamber, and the steam or vapour to be condensed is made to enter through a pipe at the bottom. The steam being prevented by the seal from passing down directly into the pump, rises in the helical passage between the plates in the contrary direction to, and through the descending condensing liquid, to the top of the chamber, and becoming condensed the liquid of condensation flows down together with the condensing liquid, while the uncondensed vapour is drawn off by the pump. Several modifications of the apparatus are shown in the drawing attached to the specification —E. S.

Improvements in Continuous Mechanical Filters for Chemical or other Purposes. H. Yeomans, Northwich. Eng. Pat. 4005, March 14, 1890. 6*d*.

A cylinder of filtering medium, as flannel, wire gauze, &c., is placed, preferably, with its axis vertical, and has a central hollow shaft carrying a helix, which fits the interior of the cylinder closely. The shaft is rotated by suitable gearing, and is supplied through a pipe with water or other liquid, which enters the cylinder through perforations in the upper part of the enclosed shaft. The cylinder is eased in a larger one of iron, or other material, and the two are securely joined at the bottom. A pipe entering the bottom of the internal cylinder supplies the material to be filtered, and another pipe from the bottom of the external cylinder carries away the filtered liquid. The shaft being rotated, the liquid and gases rapidly percolate through the inner to the outer cylinder, the solid particles being raised by the screw past the perforations in the shaft, whilst the liquid runs down again. Water entering through the perforations still further washes the original liquid from the salt or other solid material, which is gradually pressed upwards, becoming further dried in its course. It is then discharged through a pipe into a worm, from which it is carried to a drying chamber or other desired position.—E. S.

Improvements in Apparatus for Evaporating Salt Water for Supplying Extra Feed for Marine Boilers. J. Kerr, Liverpool. Eng. Pat. 5891, April 18, 1890. 8*d*.

The patentee uses an upright, closed, cylindrical, jacketed vessel, the jacket of which is in open communication with the surface condenser of a steam engine. The uncondensed steam from the condenser evaporates the water contained in the vessel, from which the resulting vapour is led back to the condenser. A small steam coil in the lowest part of the vessel can be supplied with steam from the boiler to aid the operation if required. The drawings show one arrangement and there are six claims.—B.

Improvements in Fluid-tight Joints or Couplings for Pipes, and the like. J. Newton, London, and D. A. Quiggin, Liverpool. Eng. Pat. 5992, April 21, 1890. 8*d*.

This invention relates to joints connecting two pipes, or a pipe and vessel, so that their interiors are in fluid-tight communication, and is expressly applicable to joints between the tubular heating surfaces and the pipes or diaphragms in evaporators, &c. such as described in Eng. Pat. 538 of 1889 (this Journal, 1890, 43 and 481).

This is done by interposing between the surfaces, which would otherwise abut in making the joint, a ring or washer of tin or some suitable material, which is secured to one surface by being cast in a circular groove of a dove-tail cross section. The abutting surfaces may be smooth, but preferably each has on its face one or more concentric **V**-grooves so disposed as to accurately interlock. This strengthens the joints and prevents the spreading of the softer surface by undue pressure. There are six claims.

—E. S.

Improvements in Evaporating Pans. G. Fletcher, Litchurch. Eng. Pat. 6484, April 28, 1890. 8*d*.

This invention relates to pans for evaporating cane juice or other liquids, whether in open pans or in closed vessels in a vacuum more or less complete, and is intended to promote the circulation of the boiling liquids. The evaporating pan has its heating surface preferably formed by tubes either fixed in tube plates secured to the sides of the pan, or contained in a drum also secured to the sides, both arrangements being also fitted with one or more circulating tubes, whose areas equal the combined areas of the heating tubes. The requisite quantity of liquid being placed in the pan, steam is admitted to the space between the tube plates, and round the circulating tube, or to the interior of the drum, and the circulation of the liquid is promoted. The construction of the tube plates and drum are shown on the four sheets of drawings accompanying the specification.—E. S.

Improvements in Filtering Apparatus. B. Hunt and W. M. Mackey, Leeds. Eng. Pat. 7075, May 7, 1890. 8*d*.

This invention is designed for rapid filtering when dealing with large quantities of liquids containing suspended matter, as sewage, &c., and is intended to bring the solid or semi-solid matter into a condition for being removed. To save expense in the frequent renewal of sand or filtering material, a sand carrier is used in the form of a grating, of diamond or

triangular section, formed of solid or angle-iron bars, of various proportions as to depth and breadth, and supported on longitudinal bearing bars fixed in end walls, and placed each with an angle projecting upwards, the bars being so close together that even at their widest parts too narrow a space is left for the sand, &c. to pass through. The sand is packed in the angular channels, and its upper surface is made level with, or a little higher than the edges of the bars. A tank under the grating receives the filtered liquid, whilst the solid matter is carted away. In the case of a corrosive liquid, or where contact with the grating is undesirable, the bars or other parts may be coated with a suitable material, or may be made of earthenware or firebrick.—E. S.

An Improved Refrigerating Apparatus. R. A. Messervey, Halifax, Nova Scotia. Eng. Pat. 16,688, October 20, 1890. *8d.*

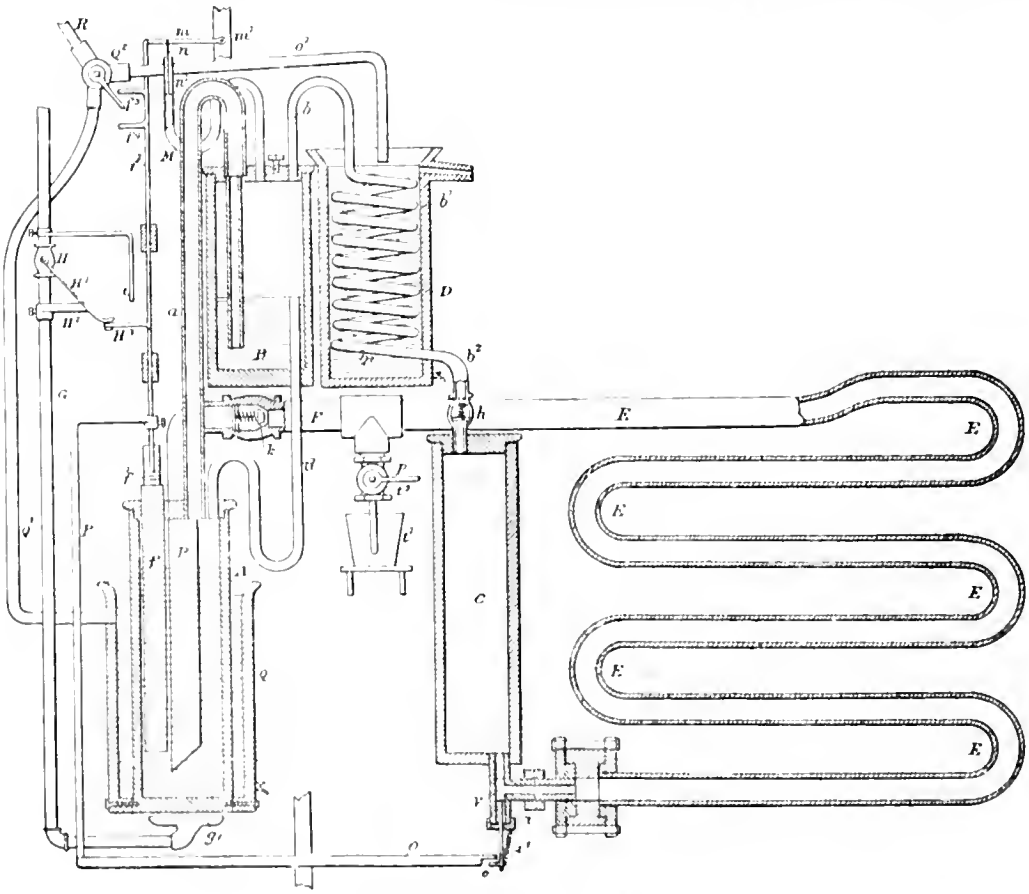
In a refrigerating apparatus in which a saline liquid of low temperature is made to circulate, the patentee causes the pipes containing the liquid, where they pass through the space in which refrigeration is to take place, to be enclosed within a metal casing filled with blocks of rock-salt or conducting material, the object being the purification of the cooled air which leaves its impurities behind with the vapour deposited and condensed on the enlarged refrigerating surface. There are four claims, and several methods of arranging the conducting pipes are indicated in the two sheets of drawings attached to the specification.—B.

Improvements in Precipitators for Impurities in Exhaust Steam. C. A. McDonald, Chicago, U.S.A. Eng. Pat. 18,739, November 19, 1890. *6d.*

A chamber, preferably cylindrical, has a screwed aperture at each end, the upper one being for the admission of steam, and the lower one for a pipe which extends upwards to a point about two-thirds above the bottom of the cylinder, and is supported inside an inverted cup within a short distance of the top, the cup itself being fixed to the sides of the exterior chamber by funnel-shaped perforated plates. The steam on entering strikes against the head of the cup, and thence passes through the perforated plates into the annular space between the cup and the chamber, then through another perforated plate into the cup, and striking against the top of it passes down the enclosed pipe to the place of condensation. The steam in striking against the cup and perforated plates deposits large quantities of its impurities, which are ultimately collected at the bottom of the external case, whence they may be drawn off through an aperture.—E. S.

Improvements in Apparatus for Refrigerating and the Artificial Production of Ice. J. Erny and Z. T. Subers, Philadelphia, U.S.A. Eng. Pat. 19,087, November 25, 1890. *8d.*

This invention relates to apparatus in which the alternate liquefaction and expansion of a suitable gas for purposes of refrigeration is produced automatically, the accompanying illustration giving a general idea of the arrangement.



Refrigerating Machinery.

The letters A and B indicate two strong vessels placed at different levels and containing liquid ammonia. The pipe *a* leads from the top of the lower vessel A to the top of B, and is continued to nearly the bottom of the latter vessel. The trapped overflow pipe *d* leads back from the level of liquid in B to the top of A. From the top of B the pipe *b* leads to the worm b_1 in the cooling vessel D, and is continued to the top of cylinder C

through the check valve h which prevents the return of gas. The freezing coil E communicates with the bottom of C through the pipe i and valve i_1, which latter is moved automatically to open and close the communication as required. The other end of the freezing coil E is jointed through F to the top of, and reaches down into the vessel A, and is also fitted with a back-pressure valve K to prevent gas returning into it. The operations are carried on as follows, viz.: A and B having been charged with liquid ammonia as indicated, the vessel A is heated, which may be done by means of gas as at g_1. The vapours rise into B, any moisture carried over being returned through the trapped pipe d, whilst the gas passes on and is liquefied under pressure in the coil h_1 and cylinder C. When the vessel A has been nearly depleted the flame is automatically removed or extinguished, and the vessel cooled. At the same time the valve i_1 at the bottom of C is gradually opened and the liquefied ammonia allowed to escape into the coil E, where it evaporates and causes great reduction of temperature, whilst itself returning through the pipe F to the cylinder A, and being absorbed by the liquid therein ready for re-evaporation. For the purposes of the automatic regulation the small cylinder f passes through the top of the vessel A, and is closed at the bottom. It contains oil which expands by heat and thereby moves the piston f_1 fitted on top, and which, by means of the levers and rods shown, serves to regulate the supply of gas through the pipes G, and that of the cooling water through pipes Q, at the same time actuating the release valve i_1 at the proper intervals. The parts marked m, n, t, and others are provided for aiding in starting the apparatus.—B.

Improved Apparatus for the Vaporisation of Liquids. H. J. Allison, London. From "The National Salt and Chemical Company," New York, U.S.A. Eng. Pat. 19,835, December 5, 1890. 8*d*.

The apparatus is designed for the evaporation of saline, saccharine and other liquids, and consists principally of a high vessel or tower, in which a current of heated air or gas is forced upwards coming in intimate contact with the liquid which descends in finely subdivided showers, whereby the moisture is absorbed by the gases and the liquid is concentrated. The drawings show three different arrangements and there are four claims.—B.

An Improved Process of and Apparatus for Distilling and Refining Petroleum and other Hydrocarbons, applicable also for Distilling and Refining Animal, Vegetable, and Fruit Oils, Saccharine Juices, Syrups, Essential Oils, and other Substances. H. E. Ryeroft, New York, and A. Mason, Brooklyn, U.S.A. Eng. Pat. 249, January 6, 1891. 8*d*.

See under III., *page* 456.

An Improved Filter for Oil and other Liquids. C. A. Koellner, Neumühlen, Germany. Eng. Pat. 474, January 10, 1891. 6*d*.

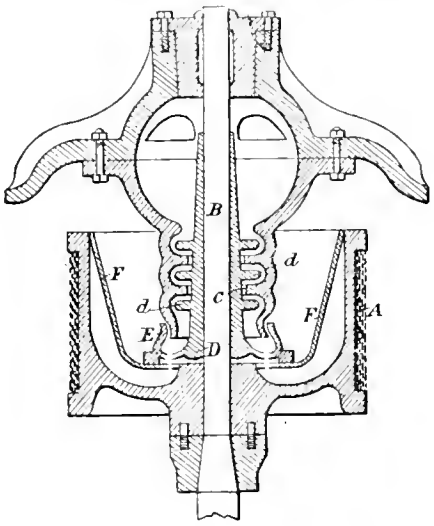
See under XII., *page* 472.

An Improved Process for Centrifugally Treating Particles of Metallic or Mineral-bearing Substances of Different Degrees of Specific Gravity. O. B. Peck, Chicago, U.S.A. Eng. Pat. 652, January 13, 1891. 8*d*.

The patentee proposes to separate mineral particles of different degrees of specific gravity, when in the condition of powder or small granules, by subjecting them to the action of gradually decreasing centrifugal force in a revolving vessel. He finds that the heavier particles are more difficult to discharge and require higher speed than the lighter ones, and he avails himself of that fact for their separation by commencing his operations when the rotating vessel has attained the highest speed and gradually reducing that speed as he proceeds. The drawings show some devices by means of which the desired gradual change in speed is brought about.—B.

Improvements in Machinery for Centrifugally Treating Particles of Metallic or Mineral-bearing Substances of Different Degrees of Specific Gravity. O. B. Peck, Chicago, U.S.A. Eng. Pat. 674, January 13, 1891. 6*d*.

In centrifugal machines for treating the separation of mineral particles of different degrees of specific gravity by means of the action of centrifugal force, the patentee introduces a flexible diaphragm or cup-shaped partition, with a view to retaining the finer particles a sufficient length of time under the influence of the treatment. These particles, more particularly when water is introduced, have a tendency to fly off too soon, hence the necessity for such a device which is indicated in the accompanying illustration.



Details of Centrifugal Apparatus.

A is the revolving vessel strengthened on its circumference with layers of tightly-wound wires, B the shaft held in the bearing and stationary bracket overhead. From the bracket is suspended a casing with internal projecting discs or pins C, and the shaft carries a corresponding bush D, with enlarged flange at its lower end, to which the ring E is secured as well as the inner edge of the canvas diaphragm or cup F, which approaches the revolving vessel at the upper edge and rotates with it. The materials are fed through the holes shown in the overhead bracket, and find their way between the casing and bush to the bottom of the vessel underneath the canvas. As the vessel fills, the canvas is gradually pushed in, and the finer particles creep along on its under surface until they are finally discharged at the top, leaving the heavier parts within.—B.

II.—FUEL, GAS, AND LIGHT.

PATENTS.

Illuminating by Means of the Incandescence of Refractory Substances. W. H. Spence, London. From O. Fahnehjelm, Stockholm, Sweden. Eng. Pat. 5646, December 5, 1883 (Third Edition.) 8*d*.

For the purposes of illumination, suitable refractory substances, such as the oxides of magnesium, calcium, zirconium, silicon, or similar oxides are (either singly or mixed) made into the form of small wires, pins, or lamellæ. These wires are then fixed in holders and arranged so as to be heated to incandescence by means of the combustion of water gas. In manufacturing the wires the finely powdered oxide is mixed with a solution of starch or gum, made into a plastic mass and pressed through a small hole or die so as to obtain a thread of suitable thickness. The thread is cut while soft into the requisite length, dried and then burned at a high temperature. This last is essential, or the pins are liable to twist and bend by the heat of the water-gas flame.

A number of wires made in the above way are fixed in rows or rings in a socket in such a way as to obtain the full effect of the heat; such an arrangement is termed a comb. The socket is of iron or brass, of **U** shaped section, and is filled with a plastic mass of damp clay or magnesia, in which the wires are fixed by inserting one end and afterwards drying.

Ordinary gas burners are available, but the fish-tail form is preferable. (See this Journal, 1886, 424; 1889, 533 and 534.)—D. A. S.

Improvements in the Manufacture of Illuminating Gas and Apparatus for that Purpose. R. Mannesmann, Landore. Eng. Pat. 1237, January 23, 1890. 8*d*.

The object of this invention is the production of illuminating gas from carbonaceous material without the aid of external heat. The process is carried out in a vertical retort or producer, which is provided with a suitable valve at the top for feeding it from time to time, and an ash-pit at the bottom; situated at about the middle of the producer there is a passage leading to a chimney, and near the top of the producer there is an outlet for gas and a passage communicating between the gas outlet and the bottom of the retort, this passage being provided with a fan or blower; all the openings and passages are fitted with suitable valves. The retort having been charged with coal and ignited below, air is admitted periodically and the chimney flue opened so that the lower part of the charge soon becomes incandescent; the air supply is then shut off and the chimney flue closed, the gas outlet and the channel communicating between the upper and lower parts of the producer being opened. A portion of the gas produced is then caused to circulate through the communicating channel, in the direction from the top to the bottom of the producer, by means of a steam injector, so that it is forced through the incandescent coke; in passing upwards it heats the upper and cold parts of the charge and a further quantity of gas is produced. A portion of this gas is led off into the gas main, the rest being employed as before for transmitting heat from the lower to the upper portions of the charge. When the incandescent coke is partially cooled the gas outlet and communicating channel are closed, air is again admitted into the ash-pit, the chimney flue opened, and the whole process repeated as described above. Two retorts are worked in combination with the same gas main and chimney flue, so that when air is being admitted into one the other is passing gas into the main, and *vice versâ*.

—F. S. K.

Improvements in the Production of Water-Gas and Illuminating Gas, and Apparatus for that Purpose. R. Mannesmann, Landore. Eng. Pat. 1238, January 23, 1890. 8*d*.

The water-gas is produced by decomposing steam by causing it to pass repeatedly through incandescent fuel; illuminating-gas is made in a similar manner, the steam being passed through heated coal. The apparatus employed consists of a producer filled with fuel, and two regenerators provided with suitable valves so that they may be made to communicate alternately with the producer. The producer having been ignited, and one of the regenerators raised to a high temperature (the other being heated in the meanwhile by the combustion of a portion of the gas), a circulation of the gas is set up from the top to the bottom of the producer through the heated generator by means of a steam injector; the gaseous mixture, thus strongly heated, passes into the lower part of the producer, where it gives up some of the heat taken up in the regenerator, and, on the other hand, takes up heat from the producer by the decomposition of some of the steam carried with it. In this way some of the water-gas is employed for transferring heat from the regenerator to the fuel, some is drawn off, and some utilised for heating the other regenerator, so that when the one in use has cooled down the other is ready to work, and by reversing their connexion with the producer the process can be continued.—F. S. K.

Improvements in the Production of Coke, and Apparatus for that Purpose. O. Imray, London. From R. Mannesmann and M. Mannesmann, Bliedinghausen, Germany. Eng. Pat. 1283, January 24, 1890. 8*d*.

This invention is intended to produce a better variety of coke, and to utilise the gas and heavy hydrocarbons. A regenerator is used, and the gases from the top of the oven are led down through one of the regenerators and back into the bottom of the oven, a portion of the gas being used to heat the regenerator. A steam or other injector is used. In this way the distillation of the coal is effected by the repeated passage of a part of the gaseous product, external heating is rendered superfluous, the products are increased, and the cost diminished. The excess of gas produced beyond that required for heating the regenerators can be used for other purposes. If a second circulating apparatus is applied, which sucks the hot distillation products through fresh coal, the decomposing tar binds the particles of coke together, and a firmer coke can thus be produced than in the ordinary way.—D. A. S.

Improvement in Gas Producers. O. Imray, London. From R. Mannesmann and M. Mannesmann, Bliedinghausen, Germany. Eng. Pat. 1285, January 24, 1890. 6*d*.

In order to prevent the product of an ordinary gas producer containing a mixture of tar and other heavy hydrocarbons which would be precipitated in the passages, and so interfere with the draught and render the gas more impure, the gases from the top are led or drawn down and introduced again into the bottom of the producer. By this arrangement the tar, &c. is converted into permanent gas, and any carbon dioxide is reduced to carbon monoxide. The gases are led, by means of a pipe, from the top, outside, and down to the bottom of the producer, a steam or air injector or other appliance being used to effect the circulation of the combustion gases down from the top and up through the fresh coal.—D. A. S.

Improvements relating to the Production of Water-Gas and Generator-Gas, and to Apparatus connected therewith. J. von Langer and L. Cooper, Leeds. Eng. Pat. 4223, March 18, 1890. 8*d*.

The object of this invention is to procure an abundant supply and a good distribution of air for combustion, and a rapid discharge of the gaseous products of combustion so as to increase the proportion of carbon dioxide during the first stage of the process, and in this way obtain an increased quantity of water-gas from a given quantity of fuel. Various kinds of furnaces are shown in the drawings accompanying the specification; they are so constructed that air can be admitted by suction through a large number of inlets distributed over the circumference and height of

the furnace (see Eng. Pat. 7252 of 1889; this Journal, 1890, 170), and in some cases also through apertures in an air-chamber built into the top or bottom of the furnace. The products of combustion are discharged through a stack in which a steam, compressed air or gas injector is placed to produce the necessary suction. Steam jets for the production of water-gas are situated in the valved air-openings.
—F. S. K.

Improvements in Inclined Gas Retorts, and in Apparatus for charging the same. C. Hunt, Birmingham. Eng. Pat. 5078, April 1, 1890. 8*d*.

Inclined retorts as at present used have a tendency to slide upon their bearings. This disadvantage is got over by moulding snugs, suitably shaped and placed, on the upper and lower surfaces of the retort; those on the under side of the retort take a vertical bearing upon the walls supporting them, thus converting a side thrust or strain into a vertical one, whilst upon the upper snugs the cross walls may be built and supported.

The apparatus for charging the retorts consists essentially of a small hopper, provided with a suitable shoot, and movable vertically on an iron framework mounted on wheels; the movable hopper is supplied with coal from a trough or continuous hopper furnished at convenient intervals with shoots, and running through the retort-house. With this charging apparatus the curved mouth-piece usually attached to inclined retorts may be dispensed with.
—F. S. K.

Improvements in Apparatus for producing Combustible Gas for Gas-Motor Engines or other purposes. S. Griffin, Bath. Eng. Pat. 6217, April 23, 1890. 8*d*.

Within, and at the bottom end of, an upright cylinder closed at both ends, is placed a vessel rather smaller in diameter and about half the length of the cylinder; the annular space between the two is filled with water, which forms a joint or luting for a bell or receiver, moveable vertically, in which the gas is stored; the smaller vessel is constantly charged with liquid hydrocarbon, the supply being regulated by a valve and float arrangement. Air, heated by a small coil to compensate for the loss of heat by evaporation, is forced through the liquid hydrocarbon in such a manner as to ensure perfect saturation, the supply pipe being so arranged that the liquid cannot flow back when no air is passing. When the receiver becomes filled with gas the air-supply is shut off automatically by means of a suitable valve.—F. S. K.

Improvements in the Manufacture of Gas, and Apparatus therefor. J. H. W. Stringfellow, London. Eng. Pat. 6575, April 29, 1890. 8*d*.

A non-luminous gas of great heating power, and which may be manufactured on a large scale, is produced by causing atmospheric air at the ordinary temperature to pass first through absorbent porous material saturated with liquid hydrocarbon, and then through similar material saturated with water at the ordinary temperature. The porous material is dome-shaped and is enclosed in a chamber, the floor of which is covered with a layer of hydrocarbon or of water, so that the material is kept constantly saturated by means of capillary attraction. The gas obtained in this manner can be employed for incandescence lighting, or it may be converted into a luminous gas by further charging it with hydrocarbon vapour. A portable lamp for use with this kind of gas is also described.
—F. S. K.

Improvements in Incandescent Lighting by means of Calefacient Gases, and in Apparatus therefor. G. Macaulay-Cruikshank, Glasgow. From J. C. Reissig, P. F. Maccallum, La Plata, Argentine Republic, and J. L. Regeriogsgatan, Stockholm, Sweden. Eng. Pat. 7335, May 12, 1890. 8*d*.

This is an improvement of the Fahnehjelm system (see page 452). The combs and burners are inclined to any required angle to obtain a better downward and more equal illumination. Further, to secure effectual contact of the flame with the comb, a flame of any suitable refractory material (metallic or otherwise), preferably with a reflecting surface, is placed immediately behind the combs in such a way as to guide the flame in the direction of the axes of the wires forming the comb, and to prevent the flame leaving the comb through the action of upward currents of air. These guide reflecting surfaces should be placed no farther than one inch from the combs but not so near as to come into contact with the flames. In practice excellent results have been obtained with a space of three-eighths of an inch between the combs and the guide reflecting surfaces; special supports can be dispensed with, and the combs fixed direct to the guide reflecting surface.

To effect economy, and obtain still better light, the principal of regeneration may be applied by using the heat of the products of combustion for heating the air required for combustion.

For details of these various modifications the drawings attached to the specification must be referred to.—D. A. S.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

The Colouring Matter of Red Carbolic Acid. E. Fabini. Pharm. Post. 1891, **24**, 2, 25, 41, and 105; Chem. Zeit. Rep. **15**, 25 and 45.

A series of investigations on the cause of the reddening of carbolic acid have shown it to result from the action of hydrogen peroxide on carbolic acid containing metallic salts in presence of ammonia. Pure carbolic acid is not coloured by hydrogen peroxide, either alone or in presence of ammonia; nor is there any colouration in presence of metallic salts and hydrogen peroxide when the sample is quite free from ammonia. But carbolic acid containing metallic salts is coloured by hydrogen peroxide in presence of traces of ammonia with the formation of the red colouring matter, and the salts of iron or of copper in the proportion of 1:180,000 or even 1:300,000 of phenol produce a distinct colouration. The formation of the colour is, according to the author, due to the ammonia being first absorbed by the phenol with the formation of ammonium phenate, which latter is then transformed into a phenate of the metal present (iron or copper), and this is converted into the red colouring matter by the hydrogen peroxide, the free metal being simultaneously separated. Copper sulphate precipitates green copper phenate from ammonium phenate, and this treated with hydrogen peroxide yields the red colouring matter, hydrogen being evolved at the same time.

The red colouration takes place immediately on warming carbolic acid containing the necessary ingredients for its formation; this accounts for the sudden turning red of many samples of carbolic acid on warming. Carbolic acid, free from metallic salts, can be warmed with ammonia and hydrogen peroxide without any formation of the red colour.

Phenerythrene is the name proposed for this colouring matter, which is always contained in the liquid portion of the carbolic acid, *i.e.* where the ammonium phenate is. Phenol is very soluble in ammonium chloride solution, one drop of this reagent being sufficient to dissolve 1 grm. of phenol, when a considerable lowering of temperature takes place.

Phenerythrene dissolves in alcohol; when precipitated by water it forms light cinnamon-coloured flocks which can be purified by dissolving first in alcohol and then in ether after evaporating off the former solvent. The ethereal solution leaves a black brittle body behind, which is the red colouring matter. It colours carbolic acid red, the colouration being evident with one part of the colouring matter to 300,000 of phenol. The substance has neither taste nor smell; it is amorphous and volatilises on heating, forming a yellow vapour which condenses to a rose-red deposit on cooling. Sulphuric acid gives a blue colouration with the product, which is itself quite free from metal, as shown by ignition with nitre, when the residue is found to be quite free from any metal, although the presence of a metallic salt is necessary for its formation.

The phenerythrene can be readily produced by adding half a drop of ammonia and a drop of hydrogen peroxide to 10 cc. of liquid phenol placed in a test tube. On warming no colouration results if the sample be pure, but if a clean knife point be inserted into the warm mixture the colouration is at once produced.—C. A. K.

The Refining of Petroleum and Lubricating Oils, and the Apparatus used therefor. Schestopal. Chem. Zeit. **15**, 352—354.

Petroleum and lubricating oils obtained by the distillation of mineral oil are generally refined by treatment with sulphuric acid and caustic soda, followed by washing with water. Sulphuric acid at 66° B. is mostly employed, the amount used ranging from 2—4 per cent. for petroleum to 5—10 per cent. for lubricating oils. The acid is well agitated with the oil, either all at once or preferably in several instalments, the acid being allowed to settle thoroughly after each treatment. The acid combines with and dissolves the olefines and aromatic hydrocarbons contained in the oil, and an oxidising action also appears to take place, indicated by the evolution of sulphurous acid. This latter action increases with the specific gravity and temperature of the oil, so that it is well to keep the mixture cool. The time of treatment varies from 1—2 hours, the operation being finished when a sample of the oil shaken with caustic soda solution appears milky and white or only slightly yellow (petroleum), or, when the original green-brown colour has changed to violet-red (lubricating oil). The loss during acidification is 1—3 per cent. for petroleum, and 8—15 per cent. (seldom 20 per cent.) for lubricating oil. The oil is next washed with water and well agitated with a caustic soda solution at 30—33° B. The intermediate washing is best omitted in the case of lubricating oils, since it leads very often to the formation of emulsions which are separated from the oil with great difficulty. The treatment with soda is continued for 5—10 minutes at the ordinary temperature in the case of petroleum; whilst with lubricating oil the action is carried on at 40—50° C. until the violet colour of the oil is changed to a wine-yellow tint. The consumption of soda lye at 33° B. is about 1—1·5 per cent. Too long a treatment with soda must be carefully avoided in order to prevent the extensive oxidation of the oil and the consequent production of the sodium salts of organic acids. The salts are partially saponified during washing, the acid liberated being dissolved by the oil and leading to turbidity in the finished product. The oil after being separated as completely as possible from the lye is washed with cold water (for petroleum), or with water at 60—70° C. (for lubricating oil) until perfectly neutral. Thorough washing is of the greatest importance. Petroleum containing sodium salts in solution burns badly owing to the incrustation that soon forms on the wick; besides which sulphurous acid is given off, if sulphates, &c. be present. The water should be as free from dissolved salts as possible, especially for washing lubricating oils. After washing, petroleum is left in reservoirs for 12—36 hours so that the last traces of water may settle. Or, after standing for an hour it may be filtered through a mixture of wood-shavings and salt. In either case the oil will be ready for the market. Lubricating oil is kept in a vessel heated by steam until the bulk of the water has settled. It is then transferred to a shallow double-bottomed pan and "boiled" by steam until it is quite bright and clear, and no longer froths. In many cases the oil is, after boiling, filtered through animal charcoal, &c.

The apparatus in which the oils are chemically treated may be divided into two groups: 1. Those in which some mechanical stirring apparatus is employed. 2. Those in which agitation is effected by a strong current of air entering the bottom of the apparatus. The author is strongly of opinion that those of the first class are much to be preferred. Agitation by means of air currents is certainly more thorough than by any mechanical device; but when the ready oxidability of petroleum, and more particularly of lubricating oil, and the injurious influence of the acids so produced, are considered, it will be seen that mechanical stirring arrangements are really the more advantageous. In the case of air agitators there is also a much greater tendency towards emulsification, which is very objectionable. The turbidity appearing in finished petroleum, &c. is chiefly due to the presence of organic acids and salts, which gradually separate. The turbidity which badly refined oil sometimes develops in barrels is most likely caused by the action of organic acids on traces of chalk contained in the glue with which the interiors of the barrels are coated. (See also this Journal, 1891, 39.)

—H. T. P.

Petroleum Spirit in Germany. J. Schenkel. Chem. Ind. **13**, 512.

Petroleum spirit has been known in Germany for about 40 years, its first use being for cleaning purposes. At the present time the crude naphtha is refined into four distinct products:—1st, *petroleum ether* (boiling point 70°—120°, sp. gr. 0·640—0·650); 2nd, "*benzine*" (boiling point 70°—120°, sp. gr. 0·700); 3rd, "*ligroin*" (boiling point 120°—135°, sp. gr. 0·730), and 4th, cleaning oil (boiling point 130°—160°, sp. gr. 0·745—0·750). The first of these is used for the production of air-gas; the second, for the extraction of oils and fat from seeds and bones, for miners' safety lamps, for the so-called "chemical washing," as a substitute for turpentine in paints and varnishes, and for washing down machinery and printers' plates. The "ligroin" is burnt in specially constructed lamps, and the last product is also used for cleaning machinery and to replace turpentine.

The price of the spirit has varied from 30 marks per 100 kilos. in 1869 to 42 in 1872; since which year it has fallen to from 18 to 20 in 1890. In the year 1880 a tax of 6 marks per 100 kilos. gross was imposed alike on the crude and in the refined product. At present the spirit used for cleaning bones, in rubber works, in "chemical washing," and in the palm oil trade, is untaxed. A drawback is also allowed on all exported spirit, for every 100 kilos. net, the tax is remitted on 125 kilos. gross of the dutiable crude product. The German railways also stipulate that all petroleum must be packed in casks, on which a special tax is imposed, on first importation the casks being taxed under a special schedule at a still higher rate, and if the petroleum is imported in bulk, the non-existent casks are still charged for.

The consumption of petroleum spirit has probably reached its maximum, and a fall in price may be expected.

—F. H. L.

Paraffin and Bitumen in Brown-coal Tar. E. von Boyen. Zeits. f. angew. Chem. 1891, 101—104.

Zaloziecki (this Journal, 1888, 319) has proposed a method of estimating the crystalline paraffin and the bitumen in a mixture of liquid and solid hydrocarbons by using amyl and ethyl alcohols. The author has adapted this process for the analysis of brown coal tar. Ten grms. of tar were placed in a small flask, dissolved in amyl alcohol (sp. gr. 0·837 at 17·5°), and the paraffin precipitated by the addition of hot almost absolute alcohol. No increase in yield was obtained by increasing the period of settling from one to five days, one day being sufficient. The temperature was 2° to 5°. The precipitate was brought

on to a tared filter and allowed to drain, then pressed strongly by means of a screw press into a small flexible cake. As the precipitate cannot be separated readily from the filter paper, the whole was cut in pieces, dried at a temperature of 120° for about 12 hours in a small porcelain crucible, and weighed till constant, the tare of the filter being afterwards deducted.

The proportion of amyl to ethyl alcohol was found to be of importance. For a tar poor in paraffin 4 parts of amyl alcohol and 8 parts of ethyl alcohol respectively should be taken to one part of tar; while for a richer tar, 4·5 to 12 parts respectively are required. If the percentage of paraffin be unknown, the highest results obtained by any mixture should be taken as the true yield.

The above method gives the total quantity of paraffin and bitumen. Although the precipitate largely consisted of lustrous scales in well-defined crystalline form, there were also present amorphous yellowish brown particles. Brown coal bitumen can be obtained in the purest form by extraction with amyl alcohol, and separating the yellow precipitate by recrystallisation. It occurred as a greyish-white amorphous powder melting at 90° to a shellac-like mass. It was evidently a resin acid and dissolved in potassium hydrate or carbonate-forming salts easily soluble in water, not crystalline, but which dried to a brownish-yellow mass. This resin acid can also be obtained by treating the brown coal with concentrated nitric acid or with potassium nitrate and dilute sulphuric acid as a crumbly wax-like mass. Nitric acid decomposes the woody and humus substance of the coal, while the resin acid resists oxidation. This resin is soluble in any of the brown coal oils, and also melts easily with the paraffin colouring it and setting to a homogeneous mass which is more brittle and not so crystalline as the pure paraffin. The melting point of the paraffin is also raised.

When the tar has cooled the paraffin and bitumen separate in more or less crystalline form and can be pressed free from oil. The paraffin as estimated in the products of distillation of the tar is always less than the results obtained by precipitation, as bitumen is decomposed on distillation. If the difference of the results got by distillation and precipitation be calculated as 80 : 100, the product is the quantity of bitumen in the tar which, subtracted from the results got by precipitation, gives the original quantity of paraffin in the tar, *e.g.*, 10 grms. of a sample of tar treated with 40 grms. of amyl alcohol and 80 grms. of ethyl alcohol gave 25·4 per cent. of total solid hydrocarbons and 17·5 per cent. of crude paraffin by distillation, the difference being 7·9 per cent. This, divided by 0·8, showed 9·9 per cent. of bitumen, which, subtracted from the total solids, gave 15·5 per cent. as paraffin in the tar.

The author intends to follow up the subject in a future paper.—D. A. S.

PATENTS.

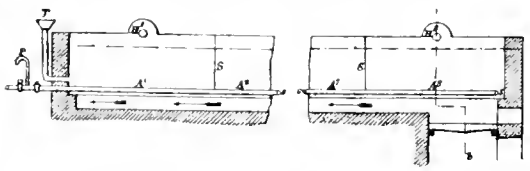
Improvements in the Process of Preparing Benzol and its Homologues, Naphthaline, and Anthracene from Petroleum, Petroleum Scales, Tar, Tar Oils, Paraffin, Vaseline, Ozokerite, and the like, and from Natural Illuminating Gas. F. Hlawaty and E. Friedmann, Vienna, Austria. Eng. Pat. 2242, February 11, 1890. 8*d*.

This specification relates to a pyrogenetic process for the preparation of aromatic hydrocarbons from fatty hydrocarbons. The apparatus consists of a boiler, heated by a furnace, to the top portion of which a retort, provided with a pressure gauge, is attached. The retort is connected with a condenser by means of pipes. Any one or mixture of the above-mentioned liquid or solid hydrocarbons is placed in the boiler and distilled at an internal pressure of 0·25—1 atmosphere. The vapours are led through the pipes in which the less volatile products condense, a portion of the liquid being returned to the retort, whilst another portion is made to pass through branch pipes, heated to redness, by which means it is again vaporised, converted into more volatile products, and condensed together with the vapours passing directly into the condenser. The distillate consists chiefly of benzene, toluene, xylene and cumene. The process may be worked continuously, except that it is necessary to withdraw the coke from time to time from the retort. The non-condensed gases are led through red hot pipes filled with pieces of coke or pumice. Ordinary illuminating gas may be treated in a similar manner. After separating the benzene and other aromatic products in the usual way, the residual liquid is placed in a retort together with 10—20 per cent. of pulverised cellulose, in the form of moss, sawdust, dry rotten wood, &c., and some caustic alkali. The retort is then heated in a furnace, and a current of superheated steam at 750° F., or better of the vapours of acetic acid or methyl or ethyl alcohol, passed through. The escaping vapours are then led through pipes filled with pieces of coke heated to redness, and connected with a condenser. The solid hydrocarbons—naphthalene and anthracene—separate from the condensed liquid on cooling. —A. R. L.

An Improved Process and Apparatus for the Continuous Distillation of Tar. H. Propfe, Mannheim, Germany. Eng. Pat. 2955, February 24, 1890. 8*d*.

The author proposes to convey the tar, as it deposits in the hydraulic main at a temperature of 70° C., continuously to the distilling apparatus; this obviates the loss of time and the danger of fire, consequent on stopping the distillation for recharging, or removing the pitch.

The apparatus consists of a multiple still, in the form of an elongated iron box, divided by partitions S reaching



Apparatus for the Continuous Distillation of Tar.

almost to the bottom, into eight separate compartments A^1 to A^8, which thus communicate below the partitions, and are each provided with a still head H^1 to H^8. The furnace is situated beneath the last compartment A^8, and the gases from it are conveyed through flues in the direction of the arrows. The apparatus which is filled to two-thirds at starting is fed at T, the pipe *s*, terminating in a swan neck P, to maintain the constant level of the tar, being for the exit of the pitch. The distillation commences in the compartment A^8 and proceeds successively in the others. When the contents of A^8 are converted into pitch, which is indicated by the nature of the distillate, the tar is supplied continuously at T, and passes from A^1 below the first partition S until it reaches A^8, gradually increasing in temperature as it does so. The distillates obtained from successive compartments have thus progressively higher boiling points, and the inflow of the tar and the heating are so regulated that first-runnings and water are obtained from A^1 to A^4, light oil from A^5 to A^6, and green oil, whose distillation is assisted by passing in superheated steam, from A^7 to A^8. The pitch passes out through the outlet tube, giving up its heat during its passage, and is of such a temperature that it will not ignite; if however it is too hard to flow, tar oil, deprived of its valuable constituents, is introduced into A^8 by a pipe.

The apparatus may also have the form of a boiler with one or two flues, and it may be arranged for distilling under diminished pressure, and heated by superheated steam, circulating through pipes. For the purpose of insuring uniform heating when direct heat is employed, it is advantageous to use a regenerator, or gases from gas-retort furnaces.—A. R. L.

Improvements in the Distillation of Oils and other Viscous Liquids. J. Dewar, Cambridge, and B. Redwood, Finchley. Eng. Pat. 5971, April 19, 1890. 4*d*.

The object of this invention is to provide against the danger attending the sudden evolution of steam or vapour in the still, and to render the boiling of the liquid tranquil

and uniform. Instead of feeding the liquid directly into the still, it is fed into a compartment of the still head, and allowed to trickle over an extended surface of conducting material, such as copper turnings, being there exposed to the vapours passing from the still. The more volatile portions of the feed are thus carried away in vapour, leaving only the less volatile portions to enter the body of the still. —A. R. L.

Improvements in the Distillation of Hydrocarbon and other Oils. C. M. Pielsticker, London. Eng. Pat. 6466, April 28, 1890. 8*d*.

This patent claims certain improvements on Eng. Pat. 1706, 1882, whereby the difficulties of so regulating the temperature that the oil is immediately vaporised on entering the retort, and of avoiding the superheating of the same, and the consequent production of permanent gas, are removed. The distillation is conducted in a continuous manner, and the distillate is of uniform and lower gravity than that of the raw material. The oil, contained in a tank, is heated by a steam coil, and is forced by a pump or steam injector into an iron coil, contained in a cylinder filled with metal or salt of known melting point, or better, embedded in loosely fitting channels made in a block of iron, heating being accomplished in both cases by a furnace. In the second case the coil is formed of separate lengths of pipe, which can thus be readily cleared of carbon, and are connected and made continuous by covers at each extremity, provided with channels. By passing the oil rapidly through the coil the deposition of carbon is minimised, but this is better attained by gradually tapering the coil towards the end which leads to the retort. The latter is heated in a furnace, and is connected with a condenser. When it is intended to produce very light oils or permanent gas, the distillation is conducted slower and at a higher temperature, or it is retarded by baffle plates fitted in the retort, and by a valve placed on the goose neck connecting the latter with the condenser. —A. R. L.

An Improved Process of and Apparatus for Distilling and Refining Petroleum and other Hydrocarbons, applicable also for Distilling and Refining Animal, Vegetable, and Fruit Oils, Saccharine Juices, Syrups, Essential Oils, and other Substances. H. E. Ryeroft, New York, and A. Mason, Brooklyn, U.S.A. Eng. Pat. 249, January 6, 1891. 8*d*.

This invention is practically an extension of Grant and Mason's distillation process, U.S. Pat. 339,545 of 1886, whereby the fractionation of the materials is also attained. The authors claim that it provides an improved method of fractional distillation, yielding uniform fractions and securing regular treatment of the crude substances, without waste of heat, time and material. The apparatus consists of either a vertical coiled-pipe retort or of one having a direct course, the former being preferable. It contains as many different chambers as the desired number of fractions, the successive sections being divided by partitions each a little below the preceding one, and arranged in separate spaces of the furnace. Each bend of the coil has attached a goose neck provided with a condenser, which discharges into a trough by means of a pump, the latter being also used to diminish the internal pressure, whence the distillate may be run off into any suitable receptacle. The sections are heated either by one furnace placed below, by separate fires in each compartment, or by steam. The heat of the furnace gases may be utilised as they pass up the flues on either side for heating the various sections, the temperature being controlled by means of dampers and air passages. As the heavier products require more heat, the successive sections may be made longer, but provided the temperature of each section is kept higher than that of the one above it, they may all be of one length. The oil is continuously introduced by a feed pipe into the highest section in a stream, and is converted into spray by an impinging jet of steam. The liquid circulates through the different sections, which are divided by traps to keep back the vapour, the latter passing into the condenser. The oil after passing the trap encounters another jet of steam, and so on through all the sections, the temperatures of which are regulated according to the fractions required. No carbonisation takes place in the last section, as it discharges any heavy oil remaining unvaporised into a tar still. Although the feed is generally continuous, it is desirable in some cases that it should be intermittent. The essential feature of the invention lies in the fact that so large a surface of oil is exposed to the temperature of a given section, and thereby local heating avoided, that the uniformity of the fraction is assured. For refining such materials as are to be turned out in one product, steam jets are only used in the upper sections of the retort.—A. R. L.

Improvements in Distilling Crude Petroleum, Mineral Oil, Tar, and the like, and in Apparatus therefor. M. Böhm, Privoz, Moravia. Eng. Pat. 327, January 7, 1891. 6*d*.

The object of this invention is to utilise the heat, contained in the vapours from the still, for the preliminary heating of the material to be distilled. The apparatus consists of a tank provided with a worm, and is filled from the bottom with the oil to be heated, the latter being then conveyed to the still by an outlet pipe near the top. It has also a discharge pipe, fitted with a cock, on the bottom, and a dome or still head on the top. The vapours as they leave the still on being led into the worm, thus communicate their heat to the oil in the tank and partially condensing meanwhile, pass into a condenser placed below; whilst any of the oil which may become vaporised passes through the still head into a second condenser.—A. R. L.

IV.—COLOURING MATTERS AND DYES.

A Study of Certain Triphenylmethane Derivatives. E. Noelting. Bull. Soc. Ind. Mulhouse, 1890, 98—100.

Noelting and Polonowsky have found that tetramethyldiamidobenzhydrol combines with para-substituted amines, such as *p*-toluidine, *m*-xylidine, and pseudocumidine, the condensation taking place in the *m*-position to the amido-group when sulphuric acid is used, and in the *o*-position when hydrochloric acid is the condensing agent. Thus, with *p*-toluidine, according to the method used, there is obtained—

I.

$$HC\begin{cases}[C_6H_4N(CH_3)_2]_2\\ C_6H_3(NH_2)CH_3\ [CH:NH_2:CH_3 \quad 5:1:4]\end{cases}$$

or—

II.

$$HC\begin{cases}[C_6H_4N(CH_3)_2]_2\\ C_6H_3(NH_2)CH_3\ [CH:NH_2:CH_3=6:1:4]\end{cases}$$

The first compound gives on oxidation a blue-green dye; the second does not oxidise regularly unless acetylated, when it gives a very bluish-green dye.

Noelting and Skawinsky in a similar way have condensed *p*-nitrodimethylamidobenzhydrol with *p*-toluidine, and are studying the derivatives of the compounds obtained.

The same chemists, by the action of the three nitrobenzaldehydes on dimethyl-*m*-toluidine, have prepared corresponding nitrotetramethyldiamidotolylphenylmethanes—

$$HC\begin{cases}C_6H_4NO_2\ [1:2,\ 1:3 \text{ or } 1:4]\\ [C_6H_{11}N(CH_3)_2.CH_3]_2\ [CH:N(CH_3)_2:CH_3=1:4:6]\end{cases}$$

All three compounds, on oxidation, yield green colouring matters. Kock previously prepared the leuco-base of one of these compounds, but did not oxidise it. The amido-

derivatives prepared by the reduction of these compounds give on oxidation differently-coloured compounds; thus, the para-compound gives a violet, the meta-compound a green dye. The ortho-compound cannot be directly oxidised: after acetylation, it yields a green-blue dye.

Dimethyl-*m*-toluidine thus behaves exactly like dimethylaniline as regards condensation with the isomeric nitrobenzaldehydes. It does not, however, like the latter, form a colouring-matter when oxidised in presence of *p*-toluidine.

By the condensation of nitrodimethylamidobenzhydrol with *m*-toluidine and dimethyl-*m*-toluidine, there are respectively obtained—

$$HC\begin{cases} C_6H_4NO_2 \\ C_6H_4N(CH_3)_2 \\ C_6H_3(NH_2)CH_3 \ [CH:NH_2.CH_3 = 4:1:3] \end{cases}$$

and

$$HC\begin{cases} C_6H_4NO_2 \\ C_6H_4N(CH_3)_2 \\ C_6H_3.N(CH_3)_2.CH_3 \ [CH:N(CH_3)_2:CH_3 = 4:1:3] \end{cases}$$

Both, on oxidation, yield green dyes.

Noelting and Trautmann have prepared hexamethyltriamidotritolylmethane—

$$CH[C_6H_3.N(CH_3)_2.CH_3]_3$$
$$[CH:N(CH_3)_2:CH_3 = 4:1:3]$$

by condensing dimethyl-*m*-amidotoluidine with ethyl orthoformate, $CH(OC_2H_5)_3$. It oxidises to a blue dye.

Noelting and Freyes condensed together tetramethyldiamidobenzhydrol and *o*-tolylenediamine, obtaining the compound—

$$HC\begin{cases} [C_6H_4N(CH_3)_2]_2 \\ C_6H_2.(NH_2)_2.CH_3 \ [CH:CH_3:NH_2:NH_2 = 4:5:1:2] \end{cases}$$

On oxidation it forms a blue-green dye. By treating this dye with phenanthraquinone, an azine, which is oxidisable into a green dye, is obtained.—E. B.

Examination of New Hydroxyanthraquinone Dyes. L. Gattermann. Meeting of the Chemical Society, Heidelberg, January 23, 1891. Chem. Zeit. **15**, 150.

On treating alizarin with strongly fuming sulphuric acid, tetrahydroxyanthraquinone is produced, the sulphuric anhydride of the fuming acid acting as an oxidising agent and becoming converted into sulphurous anhydride. The dye-product, which has been named *Bordeaux*, is identical with Liebermann's quinalizarin, and its constitution is therefore—

$$C_6H_2(OH)_2:C_2O_2:C_6H_2(OH)_2 \ [OH:OH:OH:OH = 1:2:1':4']$$

It yields a nitro-derivative crystallising in dark black-green needles and by the reduction of this, amido-bordeaux is obtained. When quinizarin is treated with fuming sulphuric acid, a product identical with Bordeaux and quinalizarin is obtained, and this may be taken as a further indication of the para-positions of the hydroxyl groups introduced when alizarin is converted into Bordeaux. Methylbordeaux has likewise been obtained from methylquinizarin. A pentahydroxyanthraquinone is prepared from Bordeaux by oxidising its solution in sulphuric acid by manganese dioxide. It is known in trade under the name Cyanine R, and forms magnificent dark bronze-coloured scales. A hexhydroxyanthraquinone is obtained when Bordeaux is treated at a high temperature with ordinary concentrated sulphuric acid, and the same product is also formed when anthraquinone is treated during some days with pure sulphuric anhydride.

The reaction described above can be extended to nearly all the hydroxyanthraquinones, purpurin, for instance, yielding a tetrahydroxyanthraquinone isomeric with Bordeaux.—A. K. M.

The Induline Group. O. Fischer and E. Hepp. Annalen, 1890, **262**, 237—264.

Rosindulines.—The formation of these dyes has been previously described (Annalen, **256**, 233; this Journal, 1889, 877). The best yields are obtained when the intermediate product—the quinone-anilides—are produced in but small quantity, as it is only in the nascent state that these yield rosindulines. A low temperature and the presence of diluents will increase the yield of quinone-anilide. In the formation of phenylrosinduline from benzene-azo-α-naphthylamine and aniline, *benzene-azo-α-phenylnaphthylamine* is first formed, and can be detected during the first phase of the reaction by the blue solution it yields with concentrated sulphuric acid, phenylrosinduline giving a green solution. A small quantity of a new rosinduline, $C_{38}H_{26}N_4$ (*anilido-isonaphthylrosinduline*) has also been obtained from the melt and remains undissolved when this is boiled with benzene; it forms bluish violet salts and yields a green solution with concentrated sulphuric acid, from which water throws down an indigo-blue precipitate. The base crystallises from xylene in needles having a bronze lustre. When it (1 grm.) is heated with concentrated hydrochloric (20 grms.) and glacial acetic acids (10 grms.) at 180—200° for about 10 hours, it splits up into aniline and a rosindone which is a hydroxy-derivative of isonaphthylrosindone; this reaction is shown in the following equation, which also indicates the probable constitution of the anilido-isonaphthylrosinduline—

$$C_6H_5N:C_{10}H_5\begin{cases}(1)\ N \\ (2)\ N\end{cases}C_{10}H_5.NHC_6H_5 + 2H_2O =$$
$$\dot{C}_6H_5$$

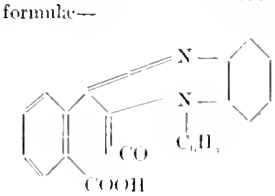
$$O:C_{10}H_5\begin{cases}(1)\ N \\ (2)\ N\end{cases}C_{10}H_5.OH + 2C_6H_5NH_2$$
$$\dot{C}_6H_5$$

On heating amido-azo-α-naphthylamine hydrochloride (one part) with aniline (two parts), and aniline hydrochloride (one part) a mixture of *phenylrosinduline* and *isonaphthylrosinduline* is obtained, and their separation is effected by crystallisation from a mixture of benzene and alcohol. The isonaphthylrosinduline is identical with the product previously obtained from benzene-azo-α-dinaphthylamine, and its constitution is therefore—

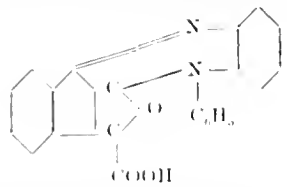
$$C_6H_5N:C_{10}H_3\begin{cases}(1)\ N \\ NC_6H_5\end{cases}C_{10}H_6$$
$$(2)$$

Heated with concentrated sulphuric acid it yields a very sparingly soluble sulphonic acid, the salts of which are also but very slightly soluble in boiling water. When the sulphonic acid is heated with water under pressure at 200° it splits up into the corresponding rosindone and metamidobenzenesulphonic acid. The rosindone is converted by sulphuric anhydride into a readily soluble sulphonic acid, which dyes silk a beautiful yellowish red, and exhibits a red fluorescence. Monobromrosindone and its sulphonic acid also produce magnificent eosin shades with strong fluorescence. The colours are comparatively fast.

Rosindonic acid, $C_{22}H_{14}N_2O_3$, is produced when rosinduline or its sulphonic acid, or rosindone is oxidised by chromic acid in acetic acid solution. It is insoluble in water, sparingly soluble in alcohol, and readily in ether and benzene; it melts at 209°. It is a monobasic acid and of the two possible formulæ—



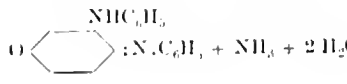
and—



the authors consider the second the more probable as the substance does not react with hydroxylamine.

When orthonitrophenol (1 part) and aniline (2 parts) are boiled with 50 per cent. acetic acid (10 to 20 parts) for some hours, an abundant separation of *dianilidoquinone-anil* is obtained—

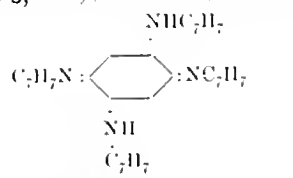
$$C_6H_4(NO_2)OH + 3\,C_6H_5NH_2 =$$



$$+ NH_3 + 2\,H_2O$$

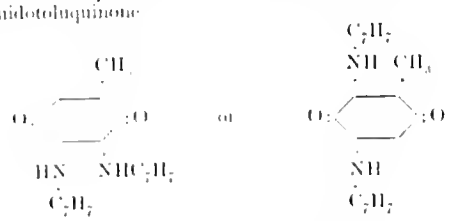
This product is identical with the substance obtained by Zincke and Hagen (Ber. **18**, 785) from the action of quinone on aniline and apparently also with the supposed hydroxyazophenine obtained by Kohler (Ber. **21**, 910) from paranitrosometoxydiphenylamine, and by the authors (this Journal, 1888, 316) from dibromonitrosophenol.

The azophenine of paratoluidine was first prepared by Kimich (Ber. **8**, 1031); its formula, however, is—

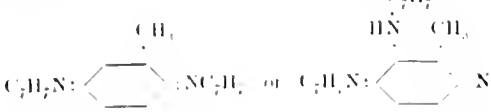


and not $C_{40}H_{32}N_4O$ as assumed by Kimich. The authors name it *paratoluazophenine*. When it is heated with wood spirit and sulphuric acid it splits up into paratoluidine and diparatoluidoquinone.

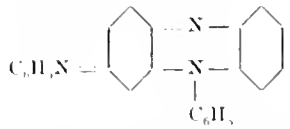
Azotoline.—The authors assign this name to a substance obtained by Nolting and Witt (this Journal, 1884, 248), from orthamidoazotoluene and paratoluidine, and called by them the azophenine of paratoluidine. It is found that when this substance is boiled with wood spirit and sulphuric acid, it suffers a decomposition similar to that of azophenine and a ditoluidotoluquinone



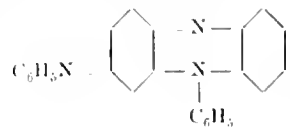
is produced. Azotoline should accordingly have the constitution—



Amidophenylinduline, $C_{24}H_{18}O_4$ (D. R. P. 50,534); when this is heated with concentrated hydrochloric acid under pressure at 150°, it yields ammonia, aniline, and a substance soluble in alkalis (this last product differing in this respect from the product obtained from the indulines $C_{18}H_{14}N_2$). *Phenylindulines*, $C_{24}H_{17}N_3$, is obtained by diazotising amidophenylindulines and boiling the product; it melts at 230°—231°, and is found to be identical with a substance obtained by the action of hydrochloric acid on azophenine and which was previously described as *anilidoquinonedianil* (Annalen, **256**, 261). The formation and properties of phenylindulines point to the constitution—



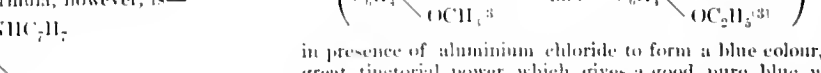
The authors have also examined Cassella's *indazine* obtained by the action of nitrosodimethylaniline on diphenylmetaphenylenediamine. The purified base has a composition agreeing with the formula—



—A. K. M.

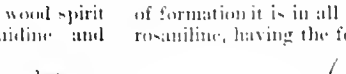
Alkyl Hydroxy-Derivatives of Dimethylaniline. E. Grimaux. Compt. Rend. **112**, 290—292.

Carbonyl chloride reacts with meta-methoxy- or ethoxy-dimethylaniline—



in presence of aluminium chloride to form a blue colour, of great tinctorial power, which gives a good, pure blue with silk and wool and with cotton when mordanted with tannic acid. Heated with sulphuric acid to 100° C. a red fluorescent colouring matter results, resembling the product obtained by the action of dehydrating agents on dimethyl-meta-amidophenol.

The blue colour has not been analysed, but from its mode of formation it is in all probability a tri-ethoxy-hexa-methyl rosaniline, having the formula—



Hence by the introduction of the ethoxy groups into hexamethyl rosaniline, the colour is changed from violet to blue.

Meta-ethoxy-dimethylaniline yields a nitroso-compound which behaves similarly to nitroso-dimethylaniline with most reagents. It forms hydroxy-azines with gallic and tannic acids, pyrogallol, orcinol, and resorcinol; eurhodines with meta-diamines and an indophenol with α-naphthol, but it does not react with β-naphthol to form an analogue of Meldola's blue, nor does it yield a methylene blue derivative by suitable treatment. With phthalic anhydride alone the base does not react, but in the presence of zinc chloride or of sulphuric acid condensation takes place, with the formation of a fluorescent red colouring matter which appears identical with rhodamine. In this reaction and in some others the ethoxy group appears to be changed to the simple hydroxy group, and the reaction takes place as with dimethyl-meta-amidophenol. This is also the case when the base is heated with arsenic acid to 175°, when a rose-coloured condensation product results. With phthalyl chloride a green colour is formed, with dimethyl-meta-amido benzoic acid a blue colour, with chloroform and caustic soda a red colour, whilst the acid chloride of benzene sulphuric acid, benzaldehyde, zinc chloride, and benzo-trichloride also give colour reactions.

Ortho-ethoxy-dimethylaniline (ortho-dimethyl-anisidine) boils at 210—212° C. Its behaviour towards reagents is quite different to that of the meta-compound. It does not react with carbonyl chloride, chloroform and caustic soda, benzaldehyde or benzo-trichloride, nor does it yield a nitroso compound, resembling, therefore, dimethyl-ortho-

toluidine. When the base is heated with arsenic acid to 175° C., or with the acid chloride of benzene sulphonic acid, or by simply heating the hydrochloride of the base alone to 175°—180° C., a beautiful blue colour is produced.

Neither the meta- nor the ortho-base are oxidised by chloride of copper with the formation of a colour, on the lines of the production of methyl violet from dimethylaniline.

The author has also commenced the study of the behaviour of the nitro-derivatives of the above bases with reagents.

—C. A. K.

Note on Minghite, an Indian Dyewood. A. Feer. Bull. Soc. Ind. Mulhouse, 1891, 85—86.

See under VI., *page* 460.

PATENTS.

Improvements in the Manufacture and Production of Sulpho-Acids of a Red Basic Naphthalene Colouring Matter. J. Y. Johnson, London. From the "Badische Anilin und Soda Fabrik," Ludwigshafen-on-the-Rhine, Germany. Eng. Pat. 6875, May 3, 1890. 6*d*.

This is an extension of Eng. Pat. 15,259 of 1888 (this Journal, 1889, 877), and describes the preparation of sulphonated derivatives of the *Rosinduline* series by treating sulphonated derivatives of the compounds mentioned in the previous patent with aniline and its hydrochloride. Substances belonging to the following classes are suitable for the purposes of this invention. (1.) Sulphonated derivatives of α- and β-naphthoquinone. (2.) Nitronaphthol sulphonic acids. (3.) Nitroso-naphthol sulphonic acids. (4.) Azo-compounds from aniline, &c., combined with naphthol and naphthylamine sulphonic acids. In all these cases one sulpho group in the naphthalene must at least be heteromeleal to the amido-, nitro-, nitroso-, azo-, or hydroxy- groups. In order to test the suitability of a compound for the purposes of this invention, it is advisable to heat a certain quantity of it with twice its weight of aniline hydrochloride and three times its weight of aniline, raising the melt from 140° C. to 180° C. in about 8 or 10 hours. Tests are taken out at intervals, and after saturation with hydrochloric acid, are extracted repeatedly with dilute hydrochloric acid until the whole of the aniline is removed. If the residue dissolve to a green solution in concentrated sulphuric acid, the substance can be employed for the production of colouring matters, according to this invention. The sulphonic acids obtained may be further sulphonated, yielding colouring matters which dye animal-fibres red. The following is an example of the application of this invention. About 50 kilos. of amido-naphtho-quinone-imide sulphonic acid (di-imido-naphthol sulphonic acid), 50 kilos. of aniline hydrochloride, and 175 kilos. of aniline are heated in an enamelled vessel to 150° C., the temperature after about three hours being raised to 160° C., and kept at this until the melt becomes no greener on dissolving in strong sulphuric acid. The melt whilst still warm is poured into 200 kilos. of 30 per cent. hydrochloric acid, 1,000 litres of water being afterwards added, when the whole is boiled mixed with 2,000 litres of water, cooled, filtered, washed, and pressed. In order to purify the acid it is converted into its sparingly-soluble sodium salt. The acid cannot be used for dyeing purposes, on account of its insolubility, and requires to be sulphonated, which may be performed by means of fuming sulphuric acid, when, according to the temperature employed, different sulphonic acids may be obtained. These acids dye animal-fibres bluish shades of red.—T. A. L.

Improvements in the Production of a New Hydroxyquinone and the Utilisation of the same in Dyeing. R. Holliday, Huddersfield. Eng. Pat. 7421, May 13, 1890. 6*d*.

By fusing Armstrong's sodium naphthalene disulphonate with caustic soda for a longer time than is necessary to produce dihydroxynaphthalene, it is converted into a hydroxyquinone which after conversion into its nitroso compound can be employed with various mordants for dyeing purposes. Wool can be dyed black by treating it alternately with this nitroso-hydroxyquinone and chromium and iron salts.—T. A. L.

Improvements in the Manufacture and Production of Colouring Matters. J. Hall, Manchester. Eng. Pat. 8215, May 27, 1890. 6*d*.

Dehydro-thio-*p*-toluidine or its sulphonic acid, when diazotised, will combine with azo-compounds of which *m*-phenylene diamine, *m*-tolylene diamine or resorcinol are constituents. A colouring matter which dyes unmordanted cotton a red shade of brown is produced by diazotising naphthionic acid and combining it with *m*-phenylene-diamine and afterwards adding the diazo-compound from dehydro-thio-*p*-toluidine sulphonic acid. The dyestuff thus formed is salted out, filter-pressed and dried. The colouring matter may also be produced by combining the diazo-compound of dehydro-thio-*p*-toluidine sulphonic acid with *m*-phenylene diamine and afterwards adding the diazo-compound of naphthionic acid. A darker shade of brown is produced by using amido-azo-naphthalene disulphonic acid instead of naphthionic acid and a similar effect by using *m*-tolylene diamine instead of *m*-phenylene diamine. Yellower shades are obtained by the use of resorcinol.

—T. A. L.

Production of a Yellow Colouring Matter. O. Imray, London. From the "Farbwerke vormals Meister, Lucius, und Brüning," Hoechst-am-Main, Germany. Eng. Pat. 8506, June 2, 1890. 4*d*.

The colouring matter is obtained by the action of a salt of tetrazodiphenyl on an alkaline solution of *o*-cresotic acid.

—T. A. L.

Improvements in the Production of Colouring Matters. O. Imray, London. From the "Society of Chemical Industry," Basle, Switzerland. Eng. Pat. 10,047, June 28, 1890. 6*d*.

These are colouring matters belonging to the rhodamine series, and are obtained by heating the condensation product of resorcinol and succinic acid (resorcinol-succinein) with secondary amines at a high temperature. The end product of the reaction, if dimethylamine be employed, is tetramethyl-*m*-amido-phenol-succinëine or succinic acid rhodamine, whilst succinic acid rhodaminol is formed as an intermediate product, the latter having both basic and acid properties. 13·2 kilos. of resorcinol-succinëine and 13·8 kilos. of a 40 per cent. solution of dimethylamine are heated with 70 kilos. of alcohol in a closed vessel at 170—200° C. for 14 hours. The melt is then diluted with water and heated on the water-bath with 21·9 kilos. of 33 per cent. soda-lye until the alcohol and excess of dimethylamine are driven off. The alkaline solution is then extracted with ether or toluene, and the succinic acid rhodamine separated from this solution by dilute hydrochloric acid or hydrochloric acid gas in the form of its hydrochloride as a green glistening crystalline mass. It dyes cotton and silk pink, the latter showing a vermilion-red fluorescence. The sodium salt of the succinic acid rhodaminol is precipitated from the alkaline solution by the addition of salt, forming a reddish-brown mass. Both the sodium and potassium salts are easily soluble in water, and dye silk a light pink from a soap-bath.—T. A. L.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

The Action of Copper on the Resistance of Colours to Light. A. Scheurer. Bull. Soc. Ind. Mulhouse, 1891, 82—84.

The author has studied the action of copper oxide on the light-resisting properties of the phenolic colouring matters. For this purpose medium shades of the following colours were printed by block on white calico: Persian berry yellow (fixed with alumina), Alizarin-blue (chrome), Alizarin-blue (nickel), Alizarin-maroon (chrome), Anthracene-brown (chrome), Naphthazarin-grey (chrome), M G Orange (chrome). Each fent was then divided into four parts. One portion was not further treated, being used for comparison (set No. 1). Another portion was boiled for 10 minutes in a solution containing per litre of water 24·9 grms. of copper sulphate and 10 c.c. of strong ammonia liquor (set No. 2). The third set was passed through gum tragacanth mucilage (30 grms. per litre) and dried; and the fourth set was prepared in a mixture of a solution of 20 grms. of copper sulphate in 480 grms. of gum tragacanth mucilage and 500 grms. of the same mucilage to which 20 cc. of ammonia liquor had been added. All four sets of fents were exposed to the sun for a month (August) with the following results:—The colours of set 4, with the exception of MG Orange, were not affected; set 2 suffered to some extent; sets 1 and 3 were much bleached, MG Orange, in both cases, being quite decolourised; a little protection was exercised at the commencement of the exposure by the gum tragacanth paste on set 3, but at the close of the experiment this set was as much decolourised as set 1. It was also ascertained that copper oxide, whether precipitated directly in the fibre or applied superficially by suspension in a thickening agent, greatly increased the fastness to light of basic dyes fixable with tannic acid, and also of indigo.

The author concludes that:

1. The protective action exercised by copper on the fastness to light of colours is a general one for all colours.

2. This action is not necessarily due to a combination of the copper oxide with the colouring matters or lakes.

3. Intimate contact of the copper oxide with the colour-lakes is unnecessary.

4. All that is necessary for the preservation of colours from the action of light, is to have a thin layer of copper oxide over them, the actinic rays being incapable of penetrating through such a layer.—E. B.

Note on Minghite, an Indian Dyewood. A. Feer. Bull. Soc. Ind. Mulhouse, 1891, 85—86.

The dyewood is found to closely resemble munjeet in appearance and properties, and is presumably identical with the same. It consists of brown, friable sticks, 3 to 5 mm. thick, which are very vascular and traversed by a central cavity. An extract of the colouring matter was made and its properties determined. Alcohol alone being found incapable of extracting the colouring matter, alcohol containing 10 per cent. of strong hydrochloric acid was used. The alcoholic solution was concentrated, the colouring matter precipitated by addition of water, collected on a filter, washed, and dried at a low temperature. 100 parts of powdered minghite yielded in this manner 7·5 parts of a yellow powdery extract. The colouring matter is insoluble in water, dissolves in organic solvents with a brown colour and in alkalis with a violet-red. Its smell recalls that of madder. At a high temperature it sublimes in orange needles. To test its dyeing properties, it was dissolved in a little alcohol before adding to the dye bath. On the alumina mordant it gave a red, on iron violet, and on chrome a purple-rose. There is considerable difference in the shades dyed with the extract and with the wood itself, the former being more yellow and less fast to soap than the latter, which closely resemble those of alizarin. From this it would seem that acidulated alcohol extracts a yellow colouring matter which stays in the wood in the ordinary operation of dyeing. These differences in the dyeing properties of minghite and its extract are similar to those of madder and garancine.

As regards the colouring power of the extract of minghite, 0·75 grm. of the same was found equivalent to 1 grm. of 20 per cent. alizarin paste.—E. B.

Dyeing with Aniline Black and Smoothing of the Cotton Warp. Oesterr. Wollen u. Leinen Industrie, 1891, **11**, 4.

The dyeing and oxidising is performed on machines constructed like those used in hot-air drying, but provided with four rollers in four separate troughs. The material is passed consecutively through troughs containing Turkey red oil kept at a temperature of 40°, a cold concentrated solution of copper sulphate and twice through a solution of aniline salts and sodium chlorate ("strength 5°"), the excess of liquor being each time removed before the material enters the next trough. It is now passed over the hot-air dryers, and then on to the usual smoothing machines with rollers for drying. Finally it enters a solution of sodium bichromate heated to 40° and after squeezing the excess of liquor off, and washing the sizing is applied. The troughs must be frequently refilled with solutions of the same strength. The Turkey red oil and sodium bichromate are used up fastest. The copper sulphate bath is kept up to strength by leaving crystals of the salt at the bottom of the vat.—A. R.

Researches on Turkey Red Oil. Scheurer-Kestner. Compt. Rend. **112**, 158—160 and 395—397.

See under XII., *page* 171.

VII.—ACIDS, ALKALIS, AND SALTS.

Arsenic in Commercial Acids. G. Buchner. Chem. Zeit. **15**, 13.

According to the author a determination of arsenious acid in 100 kilos. of English oil of vitriol showed 131 grms. of As_4O_6, so that a carboy containing 120 kilos. would contain as much as 157 grms. Commercial hydrochloric acid showed in 100 kilos. of acid 592 grms. of As_4O_6.—T. L. B.

Observations on Apparatus for the Concentration of Sulphuric Acid. W. C. Heræus. Chem. Zeit. Rep. **15**, 36.

In a pamphlet on this subject the author observes that there exists a generally adopted belief in the superiority of the purest platinum as the material for constructing vessels for concentrating sulphuric acid. To put this view to the test the author alloyed pure platinum (containing only 0·01 per cent. iridium), with 5 per cent. and 10 per cent. of iridium, and rolled the alloy into sheets which were then placed, together with a sheet of the pure platinum, for 40 days in a concentration apparatus in which a 98 per cent. acid was manufactured. Taking the loss in weight of the pure platinum in this experiment as 100, the 5 per cent. iridium alloy lost 73 and the 10 per cent. alloy only 58, thus showing an important advantage in favour of platinum-iridium alloys as a material for constructing concentration apparatus. In further experiments on the resisting power of gold in a similar capacity, still more favourable results were obtained. Taking the loss in weight of pure platinum again as 100, commercial platinum (containing 0·5 per cent. iridium) lost 90, the 10 per cent. iridium alloy lost 58, and pure gold only 13, that is one-seventh the loss sustained by the material usually employed for concentration purposes. A gold solder

must therefore be greatly superior to a platinum solder in the construction of apparatus, and in view of these facts the author has patented a process for covering the surface of platinum vessels with a compact adhesive layer of gold on those parts in contact with acid during concentration. As only 144 grms. of gold at 2,800 marks per kilo. go into solution against 1,000 grms. of commercially pure platinum at 1,800 marks per kilo. under the same conditions, the coating of concentration apparatus internally with gold offers considerable pecuniary advantages.—G. H. B.

Remarks on Luedecke's Heintzite. W. Feit. Chem. Zeit. **15**, 115.

The author considers that the mineral found by Luedecke in a piece of pinnoite from Leopoldshall and named by him heintzite is in reality identical with kaliborite, which was discovered by Feit in Schmidtmannshall, near Aschersleben (this Journal, 1889, 882). The differences in the analytical numbers of the two experimenters may be explained by their having adopted different methods of analysis :—

	Luedecke.	Feit.
K_2O	7·39	6·48
MgO.....	12·23	12·06
B_2O	60·53	57·46 (by difference)
H_2O.....	19·85 (by difference)	24·00
	100·00	100·00

The author maintains that his method of determining the water and calculating the B_2O_3 by difference is preferable to the determination of the latter as conducted by Luedecke. He finds that the loss on ignition is the same whether the mineral be heated alone or with magnesia, and from this he concludes that the loss is due solely to water and not in part to the volatilisation of boric acid.—A. K. M.

On the Sodium Bichromate of Commerce. R. Kissling. Chem. Zeit. **15**, 373.

This substance is met with in trade in three forms: 1. In small crystals containing two molecules of water of crystallisation; 2. In lumps or powder of the fused substance containing less water; 3. In larger crystals. The first form is very convenient to use, but its manufacture has become somewhat restricted, owing to the impression that it more readily deliquesces on exposure. The author combats this assumption and gives figures to show that the rate of absorption of moisture on exposure of all three forms is not sensibly different, but admits that the initial larger quantity of water in the crystals hastens the period of incipient deliquescence. After 23 days' exposure over 60 per cent. of water had been absorbed in each case. Determinations of the actual amount of bichromate in samples from several sources were made by titration with iron solution, using ferricyanide as indicator.

Description.	Price.	Water.	$Na_2Cr_2O_7$.
	Per 100 kilos.	Per Cent.	Per Cent.
English I.	58·15 M	10	86·05
English II.	58·15 M	10	88·42
English III.	58·15 M	13	83·79
German I.	60·81 M	11	88·39
German II.	60·81 M	12	87·90
German	56·12 M	6·6	92·84
German	7·12 M	7·1	88·61

—G. H. B.

On the De Wilde-Reychler Chlorine Process. K. W. Jurisch. Chem. Ind. **14**, 151—155.

Reference to this process has already appeared (this Journal, 1890, 510) in an abstract of the patent specifications concerned. The present article describes the results of laboratory work and of experiments on a semi-industrial scale. The object of the process is to render practicable the decomposition of magnesium chloride by air with the evolution of chlorine, and the modifications consist in the use of magnesium sulphate to give coherence and porosity to the mass, and of manganese to favour the evolution of chlorine. The initial mixture corresponds to the formula $MgSO_4 + MgCl_2 + MnCl_2$, which on gradual heating loses water of crystallisation, and subsequently at a low red heat evolves chlorine and leaves a coherent porous black substance which plays the part of intermediary in the reaction $2\ HCl + O = H_2O + Cl_2$. The experimental apparatus comprised: 1, a vessel for the production of hydrochloric acid gas from the crude acid and hot sulphuric acid; 2, a superheater for the acid gas; 3, a superheater for air; 4, a decomposer to hold the active substance, and consisting of an upright clay cylinder with an internal diameter of three-quarters of a metre; 5, a scrubber for absorbing undecomposed hydrochloric acid gas; 6, four absorbers for the production of bleaching liquor; 7, a suction pump to draw the gases through the apparatus. For the first series of experiments a decomposer holding 900 kilos. of material was used, but this was afterwards substituted by one holding 2,800 kilos. of material arranged in layers on three perforated plates to allow of easy penetration of the gases. Starting with the black material in the oxidised state, hydrochloric acid gas at a temperature of 425° to 525° C. is sent into the decomposer, where it is absorbed by the material to saturation, about one-fourth of the gas being decomposed in this part of the process and evolved as free chlorine. The fully chlorinated material has then become white in colour, and the stream of acid gas is changed for a current of heated atmospheric air, the oxygen of which causes the evolution of chlorine, which continues until the material has resumed a black oxidised condition. During the chlorination period of the process the evolved gases contained 20 to 30 volumes per cent. of chlorine, the rest consisting of atmospheric air and oxygen. During the oxidation period the gases contained 18 to 20 per cent. of chlorine and 1 to 2 per cent. of hydrochloric acid, but this proportion decreased rather rapidly after the fourth hour of work down to 4 per cent. of chlorine at the eighth hour and end of the oxidation. The hydrochloric acid accompanying the evolved chlorine was removed by washing with water in the scrubber, and the chlorine was used for the production of bleaching liquor. The improvised character of the experimental plant left much to be desired as to a due proportion in the capacities of the various parts, and in this direction a great improvement in the amount of duty remains to be effected. As an actual result the 2,800 kilos. of material gave a production equal to 800 kilos. of bleaching powder in 24 hours, a quantity which would be doubled in the same time in more suitably proportioned plant. By utilising authoritative statements of cost of production, notably those of Hasenclever, for similar operations on the large scale, the author arrives at the figure of 229·3 frs. for one ton of chlorine when the hydrochloric acid is purchased, and 137·9 frs. per ton when the acid is produced on the spot. The statement occurs that a French manufacturer places the cost of producing one ton of chlorine by the Hurter and Deacon process at 150 frs. The essential advantages of the process under consideration are, that the apparatus is small and cheap, both to erect and maintain, and that the chlorine gas is so concentrated as to offer no difficulty in the manufacture of strong bleaching powder, whilst an ordinary workman is enabled, by the simplicity of the operations, to adequately fulfil the conditions of successful application.—G. H. B.

On the Amide of Sodium and the Chloride of Disodammonium. Joannis. Compt. Rend. **112**, 392—394.

Sodammonium becomes decomposed spontaneously at the ordinary temperature into hydrogen and the amide of sodium, NH_2Na. The decomposition is always very slow (about 0·35 cc. per 24 hours for 1 grm. of substance), and tends to approach a limit as the pressure of the disengaged hydrogen increases. The evolution of hydrogen is accompanied by the gradual formation of transparent colourless crystals about 1 mm. in breadth. These crystals are the amide of sodium and differ in appearance from those obtained by Gay-Lussac's method, which gives a blue or green amorphous mass. The crystals dissolve in water with a hissing noise, but no gas is given off and the solution contains only soda and ammonia.

Sodium chloride reacts on sodammonium, but does not produce the sub-chloride described by Rose. When sodium chloride and sodammonium are brought together in saturated solution, the disengagement of hydrogen rapidly increases to such a degree that it is difficult to get a measurement of the evolved gas owing to premature destruction of the apparatus employed. At the end of the reaction the solution has a red, brown, or blue colour owing to excess of sodammonium when so much has been used: but if sodium chloride is in excess the resulting solution is colourless, and if the white product be washed with liquid ammonia the excess of sodium chloride becomes removed and what remains is amide of sodium, which is, in fact, most readily prepared in this way. The reaction described above is due to the formation of disodammonium chloride, NH_2Na_2Cl, an unstable substance from which liquid ammonia dissolves out the sodium chloride, whilst water decomposes it quietly into soda-ammonia and sodium chloride. Its composition as expressed in the above formula was satisfactorily arrived at by indirect methods of analysis.

—G. H. B.

Works for the Automatic Supply of Brine at Syracuse, U.S. C. B. Brush. Trans. Amer. Soc. Civil. Eng. **23**, 1890, 95; Proc. Inst. Civil. Eng. Abs. **103**, 63.

The old salt works at Syracuse, which at one time were the largest in the country, had experienced a great falling off in their production, owing partly to the exhaustion of their natural supply; and to resuscitate the industry, the Tully Pipe-line Company have established works for the constant supply of water saturated with salt.

The brine is delivered at Syracuse into an open reservoir of 5 million gallons, the fresh water being obtained by a gravitation supply from the Tully Lakes, at a distance of 23 miles from the city, and converted into brine during its passage to Syracuse by passing it through wells sunk into the beds of rock-salt.

From the source of supply, which is about 800 feet above the level of the reservoir, the fresh water is conveyed in a 12-inch main; and the wells are located on its course, at a distance of three miles from the source, where the ground is about 400 feet lower. At this point 12 wells have been sunk into the beds of rock-salt, which are found at a depth of 1,200 feet below the surface. The first bed has a thickness of 43 feet, and the second of 54 feet, the two beds being separated by a layer of slate rock, 25 feet thick.

The wells are arranged in three groups, about 1,000 feet apart, each group containing four wells placed at the corners of a rectangle, 400 feet by 150 feet. Each well consists of a 6-inch bore pipe, with an interior pipe 3 inches in diameter. The fresh water is led down to the rock-salt through the annular space, and returns through the central pipe as saturated brine. As the salt is dissolved, the cavity at the base of each well is enlarged, and the saturation becomes more rapid.

The brine rising from each well is stored in a regulating tank, having a capacity of 1 million gallons, and provided with a self-acting valve on the principle of an ordinary ball-cock, by which the admission of water from the main is controlled by the level of the brine. From these tanks the brine is conveyed by the 12-inch main to the Syracuse reservoir, which is also commanded by a self-acting valve of the same kind.

At every point the flow is automatically controlled, and is limited by the draw-off at the Syracuse reservoir. At the present time the supply is about 300,000 gallons per day with a saturation of 90 per cent., and it is expected that 95 per cent. of saturation will eventually be obtained.

PATENTS.

Improvements Connected with the Manufacture of Soda by the Ammonia Process. F. Ricard, Paris, France. Eng. Pat. 4394, March 20, 1890. 6*d*.

In the manufacture of soda by the above process a solution of chloride of ammonium is obtained. This is evaporated to dryness and heated with sea salt, and the volatilised chloride then mixed with manganese carbonate and again roasted, forming carbonate of ammonium and manganese chloride. By mixing the carbonate with brine the ordinary reaction is set up. The chloride of magnesium or calcium chloride, or other chloride, may also be employed. The chloride, when treated with magnesia and carbonic acid simultaneously, is reconverted into the carbonate, whilst the chloride of magnesium when dried and heated with steam is converted into the oxide with the evolution of hydrochloric acid gas. The carbonate can either be utilised afresh as above described, or by roasting converted into the peroxide, which can be employed in the manufacture of chlorine. Other applications of these methods are given.—S. G. R.

Improvements in or Connected with Apparatus used in the Distillation of Ammonia. J. J. and T. F. Meldrum, Manchester. Eng. Pat. 4434, March 21, 1890. 8*d*.

The lime employed may be either slaked previously or else placed upon a sieve lying below the level of the water in a tank, the sides of which are sloping. The lime is kept thoroughly agitated by means of a pipe furnished with suitable apertures, through which is forced a current of steam or air, preferably the former. This tube is also fitted with a special steam pipe to clear both it and the perforations if they should have become blocked by the deposition of lime. The milk of lime is mixed with the gas liquor and fed into the still by means of an injector "with a central nozzle for introducing the milk of lime and a combining cylinder in which the two liquids flow together, the lime forming a central core and the ammonia liquor surrounding it." A still more thorough incorporation is obtained by causing the mixture to impinge upon a dash plate at right angles to the current, or by other similar devices. Where the plant is very small a pipe is provided by which a portion of the lime feed is returned to the supply tank. The pipe is then much less liable to become choked than with a small flow, whilst the lime is not fed in to excess. Drawings are attached to the specification.—S. G. R.

An Improved Process for the Production of Hydrate of Magnesia. H. Precht, Stassfurt, Germany. Eng. Pat. 4759, March 26, 1890. 8*d*.

Magnesia obtained by calcining magnesite is under ordinary conditions extremely difficult to hydrate. The patentee effects this more readily and rapidly by heating with water at 105° C. This is carried out either by using superheated steam, or water under steam pressure. In the latter case the mixture must be kept well stirred or the whole will set into a stone-like mass.—S. G. R.

Improvements in Treating Phosphatic Minerals. L. Mond, London. Eng. Pat. 5072, April 1, 1890. 4*d*.

According to this invention the minerals which are to be treated are more particularly those containing phosphates and carbonates of lime, though the more inclusive range of "phosphatic minerals containing carbonates" is claimed. Such minerals are in the first place calcined so that the carbonates are eliminated or reduced. The resulting product

is mixed with water and treated with sulphuretted hydrogen, access of air being as much as possible excluded. The lime, of the carbonate of lime present, is thus converted into the soluble calcium hydrosulphide, $Ca(SH)_2$, which is separated, and the insoluble residue, containing all the phosphates, is washed on suitable filters. To recover the sulphuretted hydrogen from the soluble calcium hydrosulphide obtained, the solution of the latter is treated with carbonic acid, itself derived by calcining the original mineral. Thus carbonate of lime is precipitated and sulphuretted hydrogen evolved, which is used "in treating a second batch of calcined mineral." To compensate any loss of sulphuretted hydrogen, some Le Blanc alkali waste may be added to the calcium hydrosulphide solution. It is also proposed to recover the sulphuretted hydrogen by heating or boiling the solution of calcium hydrosulphide for some time, sulphuretted hydrogen being evolved and hydrate of lime separated out. The residual solution, after removal of the hydrate of lime, and still containing a little sulphuretted hydrogen, is used in place of water for mixing up a fresh batch of the calcined mineral.

Thus some calcium hydrosulphide always remains in the liquor, and the second operation, in which a quantity of sulphuretted hydrogen equivalent to this hydrosulphide must be added, will yield the full quantity of sulphuretted hydrogen needed in the third operation, and so on, excepting small incidental working losses.

Improvements in the Preparation of Chlorine. G. E. and A. R. Davis, Manchester. Eng. Pat. 6416, April 28, 1890. 8*d*.

The patentees point out that their inventon is embodied in a process for manufacturing chlorine by means of nitric acid in which a minimum quantity of sulphuric acid is employed, sufficient merely to decompose the common salt necessary for the production of the hydrochloric acid, and to provide a means for the perpetual regeneration of the nitric acid used in the process. They incidentally point out that in Dunlop's process, Eng. Pat. 11,624 of 1847, in which common salt and nitrate of soda are treated with sulphuric acid, the probable cause of ultimate abandonment would be sufficiently explained by the fact that the manufacture of 35 tons per week of chlorine would require at least 2,000 tons of sulphuric acid in which to absorb the nitrous compounds formed.

The patentees separate their operation into three parts—

First.—What may be termed the salt-cake process, in which common salt or other suitable chloride, is treated with the sulphuric acid that has been used for absorbent purposes in other parts of the process.

Second.—The treatment of the hydrochloric acid gas with nitric acid in such a manner that the chloronitrous gases and oxides of nitrogen formed along with chlorine, interact in the presence of air, water, and nitric acid, with the ultimate production of chlorine, and reproduction of nitric acid; and,

Thirdly.—The absorption of any remaining oxides of nitrogen in strong sulphuric acid, leaving only chlorine mixed with air and nitrogen to pass on for utilisation.

With regard to the plant, any ordinary arrangements for making salt-cake and hydrochloric acid gas may be used. Preferably the mechanical salt-cake furnace described in Eng. Pat. 6433 of 1890, in which the fuel gases are kept out of contact with the hydrochloric acid gas, is used; besides and in connexion with this, there is used a series of "two or more towers packed with suitable material, down which nitric acid is made to flow, an absorbing tower for arresting traces of nitrous compounds, that have escaped the oxidising and other arresting influences in the previous towers, and a wash tower down which water is caused to flow."

The claiming clauses of this patent are as follows:—

1. The method of preparing chlorine from hydrochloric acid by the aid of nitric acid in the presence of air, in towers packed with suitable material, the nitric acid being employed to act as a carrier of oxygen from the air to the hydrogen of the hydrochloric acid without the necessity for refrigeration.

2. The utilisation of the water charged with impurities from the final wash tower (for washing the chlorine obtained in the process with water). This water is employed to preserve the nitric acid in No. 1 nitric acid tower at its normal strength.

3. The process of making chlorine, working only with one nitric acid tower, in which nitric acid is made to act as a carrier of oxygen from the air to the hydrogen of the hydrochloric acid.

4. The use of apparatus for preparing chlorine from hydrochloric acid, constructed substantially as described, in the manner and for the purposes set forth.

Improvements relating to the Preparation of Chlorine. G. E. and A. R. Davis, Manchester. Eng. Pat. 6831, May 3, 1890. 8*d*.

In the previous specification, Eng. Pat. 6416 of 1890, it was shown how the last traces of nitrogen compounds, mixed with the chlorine, were absorbed in sulphuric acid. It was further stated that that sulphuric acid was then used to decompose a fresh batch of salt. The water formed during the reactions runs away from the first nitric acid tower holding in solution some hydrochloric acid gas. It has been found since filing the Patent 6416 of 1890, that such solutions of hydrochloric acid gas thus running away may contain as much as 30 up to 50 per cent. of the hydrochloric acid entering the tower, and the present invention is for the purpose of treating that aqueous solution in such wise that the hydrochloric acid gas may be retained in the system until it is converted into chlorine. This is accomplished by adding to the apparatus already described in Eng. Pat. 6416, 1890, a tank or partially closed vessel at a suitable level, so that the aqueous solution of acid running from the first nitric acid tower, and the sulphuric acid running from the absorbing tower can be led into it. These two liquids on mixing evolve much gas, and this is conducted from the tank into the nitric acid tower at a suitable height by means of pipes. The mixture must be continuous and regular, and the proper dilution with air secured. It is preferred to fit the tank or other receptacle with a diaphragm, dividing its lower section into two chambers, the smaller to serve as a mixing chamber, from which the commingled liquids overflow into a second or larger chamber where they are subjected to the action of the current of gases coming from the salt-cake apparatus. As an alternative process an extra tower, to be used as a drying tower, is interposed between the salt-cake apparatus and the first nitric acid tower. Down through this tower, packed with suitable material, one portion of the total nitrous-sulphuric acid, considered as being split into two streams, is allowed to run. Up the tower and meeting this acid the hydrochloric acid gas and air coming from the salt-cake apparatus, pass, and are dried, the sulphuric acid flowing to the salt-cake pot to work another charge of salt. The second stream of nitrous-sulphuric acid is meanwhile run into the divided tank first described together with aqueous hydrochloric acid coming from the first nitric acid tower.

Improvements in Apparatus for Recovering Soda and other Chemicals from Spent Liquors. L. D. Armstrong, Lock Haven, Penn., U.S.A. Eng. Pat. 18,187, November 11, 1890. 8*d*.

The apparatus consists of a rotary evaporator constructed of a series of shells or cylinders arranged one within the other, and communicating with a suitable source of heat so that the products of combustion may come in direct contact with the liquor during its circuitous passage over the inner and outer surfaces of the cylinders.—S. G. R.

Improvements in the Production of Bicarbonate of Soda and Sulphuretted Hydrogen, and in Apparatus therefor. J. Leith, St. Helens. Eng. Pat. 21,078, December 7, 1890. 8*d*.

When brine is heated under pressure with ammonium sulphide and carbon dioxide, sulphuretted hydrogen is evolved, and bicarbonate of soda and ammonium chloride

produced. The sulphuretted hydrogen is passed into a mixture of calcium sulphide and water, forming calcium sulphydrate. This solution is mixed with the chloride of ammonium solution, from which the bicarbonate has been separated by filtration, and the two are heated, ammonium sulphide and sulphuretted hydrogen being given off and calcium chloride remaining behind in solution. The sulphide of ammonium is utilised as already indicated, whilst the sulphuretted hydrogen is burned to form sulphurous acid, or otherwise disposed of.—S. G. R.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

Researches upon the Devitrification of Glass, and upon the Solvent Action of Water upon Glass. Monit. Scient. December 1890, 1229—1233.

Devitrification.—A microscopic examination of the crystals forming the core of the particles extracted from certain samples of devitrified soda-glass, shows that they consist of wollastonite or calcium bisilicate. *A priori*, it might be expected that such would be the composition of these crystals, because the alkaline silicates have as yet only been obtained in the wet way, and containing water of crystallisation, whilst double silicates of calcium and sodium or of calcium and potassium are not known to occur in nature. If, then, crystals be found in a glass made from lime and soda, they can only consist of calcium silicate (when, at any rate, the glass contains no aluminium, or only a trace of it).

If aluminium, magnesium, or oxide of iron be added to such a glass, it is possible, in certain cases, to obtain crystals of double or multiple silicates, containing two or more of these bases, and sometimes also sodium. Thus, crystals of albite (silicate of aluminium and sodium) have been found in a soda-glass. The aluminium existing in this glass was only found in small quantity, and had been introduced accidentally from the use of impure materials, and from the action of the materials upon the clay of the melting pots.

The formation of crystals of calcium silicate in glass leads one to conclude that ordinary glass ought not to be considered as a double silicate, but as a mixture of sodium silicate and of calcium silicate + acid, the calcium silicate being merely dissolved in the sodium silicate.

It is known that in the wet way, alkaline silicates are readily decomposed by salts of calcium, forming calcium silicate, the composition of which is dependent upon the composition of the alkaline silicate. If lime be added to a glass of soda and lime, not capable of devitrification, it takes up a certain amount of silica to form calcium silicate, thus increasing the proportion of the matter to be held in solution by the sodium silicate. By successive additions of lime, enough calcium silicate may be formed to saturate the sodium silicate. After this point is reached, crystallisation or devitrification may occur.

The addition of silica instead of lime produces the same result, although less rapidly. The silica acts by diminishing the proportion of alkali and by saturating a part of the alkali, consequently diminishing its solvent capacity upon calcium silicate.

A study of the various glasses made from lime and soda leads to the conclusion that a glass formed according to the following equation is least susceptible of devitrification:—

$$SiO_2Na_2O + 3{\cdot}2\ SiO_2 + 1{\cdot}55\ CaO = SiO_2Na_2O + 1{\cdot}55\ (CaO,2\ SiO_2).$$

Expressed centesimally its composition is about:—

	Per Cent.
Silica	71·5
Lime (CaO)	16·2
Soda (Na_2O)	11·5
Alumina and oxide of iron	0·8
	100·0

An easily devitrifiable glass, on the other hand, has the following composition:—

	Per Cent.
Silica	75·7
Lime	14·5
Soda	9·0
Alumina and iron	0·8
	100·0

This corresponds to the formula—

$$SiO_2Na_2O + 1{\cdot}78\ SiO_2 . 1{\cdot}78\ CaO.$$

It will be seen that the percentage of lime in the non-devitrifiable glass is greater than in the devitrifiable. This is explained by the fact that it is not the mere difference in quantity of lime that produces the difference between the two kinds of glass as regards their susceptibility to devitrification, but the property of devitrification is a function of the ratio of the sodium silicate to the calcium silicate + acid held in solution by the sodium silicate. This ratio is equal to 0·40 in stable glass, and in unstable glass it is—

$$\frac{Q + 13{\cdot}66}{62{\cdot}64 + 11{\cdot}5} = 0{\cdot}28.$$

The more the ratio decreases in value from 0·4, the more readily devitrifiable does the glass become; and this ratio can decrease in value only by increasing the quantity of lime or silica, or by diminishing the quantity of soda.

The above only applies to lime and soda glasses. The same principle holds good in the case of lime and potash glasses, but the ratio fixing the maximum of stability of the glass is probably different, due to the different solubility of calcium silicate in potassium silicate.

It is known that a saturated solution of one salt is still further capable of dissolving another salt. A similar property may exist in a glass containing several bases, and this would explain why glasses are the less easily devitrifiable the greater the number of bases they contain. It would also explain the stability of aluminous glasses, which can be worked to any extent without devitrification, although in them the earthy bases exceed in amount the weight of lime which in a simple lime glass would lead to rapid devitrification. Since the presence of several bases in a glass results in diminishing the tendency to devitrification, it would seem that glass-makers, when a colourless glass is not required, ought to try to produce glasses realising these conditions, more especially as they would thereby effect an economy of material, lime, magnesia, and oxide of iron, being much cheaper than potash or soda. It would be easy to procure a calcareous clay at a low price, of such a composition that it would only be necessary to add to it sand and a little alkali to make these stable multiple basic glasses. This is, in fact, what glass bottle makers do, and the stability of bottle glass which contains a comparatively small quantity of soda may be ascribed to the number of bases existing in the glass.

But for making colourless glasses, the glass-maker is thrown back upon the sole use of lime and soda as bases, and, by making the glass approximate to the composition above indicated, he will be able to make it but little susceptible to devitrification.

Solvent Action of Water upon Glass.—Mylius and Forestier having stated (Monit. Scient. 1890, 34) that water does not dissolve glass, but decomposes it into alkali and silicic acid, the authors have re-investigated the subject.

Three kinds of glass were used—blown glass, used for incandescent electric lamps, watch glass, and crown glass. The glasses were finely powdered and digested for eight hours at about 100° with a litre of distilled water in a platinum dish, the water being added in portions of 100 cc. at a time, so as to keep the level of the liquid about constant. After filtering the water to remove the suspended glass the water was evaporated to dryness. The weight of

the residue did not, however, represent exactly the weight of glass dissolved, as it was found to contain carbonic acid derived from the air, which had decomposed the dissolved silicate, forming a precipitate of gelatinous silica.

A determination of the dissolved alkalis was, however, made, and it was found that the incandescent lamp glass had yielded, per 100 parts of glass, 3·974 per cent. of soda; the watch glass, 2·076 per cent.; and the crown glass, 6·986 per cent. (+ 0·20 per cent. of sodium sulphate).

An attempt to estimate the dissolved silica in the case of the lamp glass gave—

	Per Cent.
Silica	6·134
Soda	3·974

or about one equivalent of silica to three of soda, so that the silicate dissolved by the water may be taken to be a tribasic silicate, $SiO_2\ 3Na_2O$.—H. S. P.

Glaze for Earthenware Tubes. Thonind. Zeit. **14**, 754.

The best plan is to employ a clay containing iron, which is either poured on to the tubes when they are about of the hardness of leather, or else allowed to run on whilst the tubes are rotated. The burning is conducted at a fairly high temperature. If blast-furnace slack is made use of the variation in its composition and the large percentage of calcium contained must be considered. The presence of calcium sulphide in the slag is to be avoided, as during the burning this is transformed into the sulphate and gives rise to bubbles in the glaze. It is necessary to mix the slag with sand and earthenware cement so as to make the glaze adherent.—C. A. K.

The Slate-Clay found in the Coal Measures of Bohemia. C. Bischof. Sprechsaal, **23**, 1010.

The author compares the properties of the valuable slate-clay of Bohemia with kaolin. They are both white, but the latter is looser, more voluminous and dry. Slate-clay is very dense, and on macerating with water, the water is not rendered so turbid as with kaolin. For technical purposes the slate-clay should contain only small quantities of sand and considerable quantities of alumina.—A. R.

PATENTS.

An Improvement in the Manufacture of Glass. J. G. Sowerby, Gateshead. Eng. Pat. 3286, March 1, 1890. 8*d*.

Ordinarily such an article as a jug is made in several operations, "the handle, top, and lip are separately made, and the former attached to the body." By this invention the whole is made in one operation. The molten glass is poured into the body of the mould, a *solid* plunger lowered, and some of the molten material thus forced up so as to fill the handle, &c., in the case of such an article as a jug. Compressed air is then forced in through the ring round the plunger, blowing the glass out to the required shape and size, the escape of air being prevented by metallic springs which act as a packing to the plunger.—V. C.

Improvements in Kilns or Ovens for Firing Glass, Enamelware and for other Purposes, and in Annealing Devices. H. T. Parfitt, Lewisham. Eng. Pat. 4592, March 24, 1890. 8*d*.

The kilns are heated by burners in which "atmospheric-gas, water-gas, or the like" is used. The flame follows the curved roof of the kiln so that the products of combustion do not come into contact with the articles treated. Deflecting blocks are placed so that the flame does not pass directly to the flues. The products of combustion are employed to heat up a second chamber, usually placed above the first. The articles to be treated are placed on low trucks which run on rails and can be drawn out without interrupting the process. These trucks are provided with moveable fire-clay partitions by means of which the size of the chambers can be reduced at will. When the truck is drawn out of the kiln a cover of iron wire quilted with asbestos is placed over it, forming an annealing chamber.—V. C.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

Preservation of Timber. J. W. James. Proc. Inst. Civil Eng. **103**. 1890—1891.

The author's observations of the piles of a jetty and of railway sleepers at Port Darwin, South Australia, showed that the wood called "jarrah" resisted the attacks of the teredo better than "karri," but that "billian" (North Borneo ironwood) was preferable to either; it was also but little damaged by white ants. The belief that the teredo is killed by the removal of the timber in which it is from the water, and exposure to the sun for 48 hours is erroneous, specimens of the insect alive, though feeble, being obtained from timber that had been exposed to a tropical sun for two months. Sleepers of "jarrah" and sugar-gum treated with a liquid called "Carbolineum Avenarius" resisted the attack of white ants for two months, while untreated sleepers were badly eaten, but the preservative effect diminished after the elapse of a few more months. The same result was obtained with another compound termed "Anti-Termite." In general the attack of both white ants and teredo is more severe in tropical than in sub-tropical or temperate regions.

The only native timber brought under the author's notice that is really suitable for buildings and public works in the northern territory of Australia is the cypress-pine which resists the attacks of the teredo and white ant, though the latter will strip the sapwood from it. It will not, however, stand heavy shocks or severe transverse strains.

(For the preservative effect of wood creosote against the ravages of the teredo see this Journal, 1890, 1005).

—B. B.

On the Action of Magnesium Sulphate Solutions on Cement. Michaelis. Thonind. Zeit. **15**, 18.

In a discussion on comprehensive methods of testing materials for building purposes, the author stated that the magnesia had no specific action in the experiments with magnesium sulphate, and that the sulphuric acid only is a factor in the decomposing action exerted on hydraulic limes or cements by solutions of sulphates. The magnesia simply separates out as hydrate, and is visible as a slimy substance. The author agrees with an opinion of F. Schott concerning his investigation of Scott's cement, that disintegration was due to the formation of a calcium sulphate containing more than two, and probably as many as seven, equivalents of water.—G. H. B.

Wearing Properties of Cement for Paving Purposes. Gary. Thonind. Zeit. **15**, 233—235.

The process for ascertaining the wear-resisting qualities of cement to be used in the preparation of paving stones and similar articles subject to attrition, adopted by the Imperial testing works for building materials, consists in pressing the substance to be tested on a cast-iron disc revolving at the rate of 22 revolutions per minute, and fed with emery, the loss of weight of the test-piece after a standard number of revolutions being ascertained. In the case of cement, cubes, the sides of which had an area of 50 sq. cm., were made by the Böhme hammer apparatus, hardened in air or water for 7 or 28 days, and subjected to the test outlined above.

The following table shows the character of some cements tested:—

	Specific Gravity after Ignition.	Time of Setting.	Fineness: Per Cent. Residue on a Sieve of		Tensile Strength: Kilos. per Square Centimetre.		
			5,000 Meshes per Sq. Cm.	900 Meshes per Sq. Cm.		7 Days.	28 Days.
		Hours.					
1	3·125	1½	26	2·5	Neat	32·25	37·23
					1 : 3	13·50	20·30
2	3·125	5	22	3·0	Neat	14·88	52·90
					1 : 3	18·38	23·80
3	3·107	3	4	0	Neat	18·93	55·15
					1 : 3	19·80	25·03
4	..	11	6	0·1	Neat	25·00	27·72
					1 : 3	19·78	28·05
5	2·778	7	6	0·5	Neat	27·83	38·83
					1 : 3	17·18	30·03
6	3·115	3	11	2·7	Neat	18·30	50·73
					1 : 3	26·68	32·58

Samples 4 and 5 are puzzodana cements.

The behaviour of these cements alone and mixed with various quantities of sand, hardened in air and water, is shown in the following table:—

No.	Age.	Kept in Moist Air.					Kept under Water.				
		Neat.	1 : 1.	1 : 2	1 : 3	1 : 4	Neat.	1 : 1	1 : 2	1 : 3	1 : 4
1	7 days	5·5	1·2	3·5	6·1	8·9	5·0	3·7	3·8	7·9	10·4
	28 days	7·9	1·5	1·9	9·7	13·8	2·9	1·8	2·7	4·1	6·8
2	7 days	1·6	2·5	3·1	8·3	9·5	1·6	1·7	3·0	6·5	8·8
	28 days	3·9	2·0	3·5	6·0	7·3	3·6	1·8	2·3	5·0	5·6
3	7 days	5·1	2·9	6·1	18·3	62·8	2·1	2·1	2·1	4·7	15·9
	28 days	2·1	1·6	1·9	2·3	22·9	2·2	1·3	1·1	1·8	2·2
4	7 days	10·1	3·9	3·9	7·3	17·3	1·0	2·6	2·5	3·6	4·6
	28 days	3·0	1·2	3·1	5·2	14·9	3·6	2·8	2·	2·1	1·8
5	7 days	10·6	7·6	10·2	19·2	28·7	7·0	5·9	7·1	15·7	17·1
	28 days	5·3	1·6	1·6	9·0	11·6	5·8	0·9	1·1	2·3	13·1
6	7 days	6·2	2·3	4·2	6·5	17·1	3·5	1·3	2·2	5·0	10·9
	28 days	5·3	2·2	3·3	4·1	8·9	3·9	1·3	2·2	2·7	3·9

The results are given in cubic centimetres ground away, the loss of weight being translated into the corresponding volume.

The test-pieces whose behaviour is recorded in the columns headed "Kept under water" were kept in air for 24 hours after gauging, remained the rest of the time in water, and were removed therefrom one hour before being tested.

A study of this table reveals that the superiority in point of endurance of the older test-pieces was not great, and in some cases the order of merit was reversed. This is probably due to the cement having become somewhat brittle in the long as compared with the short time test. The same influence is at work in the case of the test-pieces kept in air, the loss by attrition being generally greater than when they were placed under water.

The important fact that neat cement wears away faster than fairly rich mixtures of cement and sand is also clearly shown. The reason for this is tolerably plain: When neat cement is subjected to attrition, the face is ground away evenly, and fresh particles are continually exposed and removed. In the case of mixtures of cement and sand, the cement lying between the grains of sand is removed, and the harder sand takes most of the wear as long as the cement in which it is partly embedded resists the shearing stress produced by the grinding process. That this is what really goes on is shown by the sudden increase in quantity worn away when the proportion of sand exceeds a certain limit; the cement no longer suffices to hold the sand together, and the removal of large amounts is easy.

The large differences in the adhesive powers of various cements is shown by the corresponding fluctuations in the table. The best results are given by mixtures of one part of cement to two or three of normal sand, the increase in loss by wear rising rapidly when this proportion is exceeded. Other things being equal, the quantity of sand that may be added without causing a serious rise in rate of wear increases with the fineness of the cement.

—B. B.

PATENTS.

Improvements in and Means for the Manufacture of Cement. W. R. Taylor, Rochester. Eng. Pat. 5719, April 15, 1890. *8d.*

In the usual processes the cement materials are made into cakes by mixing with water, and are then placed in the kiln with solid fuel. According to this invention the blocks of cement material are made up by mixing with a liquid fuel, as petroleum residue or the like. These blocks are made perforated or corrugated, so as to expose a large surface for heating. The coke in the kiln is sprinkled with liquid fuel. The kiln is fed from above with blocks made as above and with fuel, and the clinker withdrawn from the bottom, so that the process is continuous. One form of furnace described is an inclined rotating furnace, in which the materials travel gradually to the lower end, from which they are removed.—V. C.

Improvements relating to the Treatment of Gypsum for Building, Statuary, and other Purposes. G. F. Redfern, London. From W. Heller, Berlin, Germany. Eng. Pat. 16,553, October 17, 1890. *6d.*

The object of this invention is to obtain from gypsum, materials similar in appearance to natural marbles, but which resist better the action of the weather. The process

of burning with alum is ineffective, and borax has likewise been found to be unsuitable. The borate of *potassium*, however, effects the desired result, forming an insoluble crystalline compound with gypsum burnt so as not to contain more than 10 per cent. to 2 per cent. of its original water of crystallisation. The gypsum used must not contain carbonate of lime, nor must it be of the fibrous kind. After dipping in the solution of borate of potassium, the blocks are heated to 80° C. or 100° C. and then dipped in the solution of such metallic salt as will impart the desired colour. To increase the resistance to the action of the weather the material is heated to 80° C. and dipped while still hot in ozokerite or some similar liquid.—V. C.

X.—METALLURGY.

A Study in Thermo-Chemistry; the Reduction of Metals from their Ores. W. N. Hartley. Scient. Proc. Roy. Dublin Soc. 1891, **7**, 35—42.

After explaining the terms used in the paper (in which "a gramme atom is an atomic weight in grammes," and "a heat-unit is the quantity of heat required to raise 1 kilogramme of water 1° C."), and defining an *exothermic* reaction, in which heat is evolved, and an *endothermic* reaction, in which heat is absorbed, giving an example of each reaction, the author treats of the—

Conditions of Chemical Change in Smelting Operations.—All chemical reactions take place only within certain limits of temperature; at low temperatures chemical combination generally cannot take place, while at very high temperatures chemical combinations cannot exist.

The ores of the useful metals are for the most part oxides, carbonates or sulphides; the two latter are generally converted into oxides by roasting.

In the smelting operations, either in the blast or reverberatory furnace, the following functions are performed:—(*a.*) Initiation of the reducing process by raising the ore to a suitable temperature. (*b.*) Reduction of the ore by carbon monoxide. (*c.*) In certain cases, in which the reducing process consists of feebly exothermic reactions, maintaining the reducing process by supply of extraneous heat.

Reduction is considered under the following heads:—(1.) Reduction by means of furnace gases. (2.) Reduction by carbon. (3.) Reduction by another metal. (4.) "Reduction by air." In the furnace the fuel is first burnt to carbon dioxide; this, as is well known, in contact with more red-hot fuel becoming converted into carbon monoxide. The furnace gases consist chiefly of carbon monoxide and some hydrogen. The difference in the heat evolved by the combustion of various substances is considerable, as shown in the following equations:—

(1.) $H_2 + O = H_2O$ gaseous + 58·2 heat-units.
(2.) $C + O = CO$ gaseous + 28 heat-units.
(3.) $CO + O = CO_2$ gaseous + 69 heat-units.
(4.) $C + O_2 = CO_2$ gaseous + 97 heat-units.

The reducing action of carbon monoxide will be seen from equations (1) and (3) to be stronger than that of hydrogen by 10·8 heat-units, as the former evolves 69 heat-units for every atom of oxygen removed from an oxide, while the latter evolves 58·2 heat-units. "Consequently it is necessary to consider the action of carbon monoxide and of carbon in smelting processes, but not that of hydrogen."

All those metallic oxides the heat of formation of which is less than 69 heat-units are capable of reduction in a reverberatory furnace.

Thermo-Chemical Equations.

(1.) Reduction accomplished by Means of Furnace Gases.

Smelting of Lead Ores; Reduction of Lead Oxide:—

$PbO + CO = Pb + CO_2 + (69-51)$ heat-units.
Heat evolved = 18 units.

Reduction of Copper Oxide:—

$CuO + CO = Cu + CO_2 + (69-38{\cdot}4)$ heat-units.
Heat evolved = 30·6 units.

Reduction of Ferroso-ferric Oxide:—

$Fe_3O_4 + 4\,CO = 3\,Fe + 4\,CO_2 + (69 + 4 - 269)$ heat-units.
Heat evolved = 7 units.

The process of reducing ferroso-ferric oxide in the smelting of iron probably takes place in the two stages—

(1) $Fe_3O_4 + CO = 3\,FeO + CO_2$

and

(2) $FeO + CO = Fe + CO_2$,

but exact thermal data concerning these reactions are wanting.

Smelting of Tin Ores; Reduction of Stannic Oxide:—

$SnO_2 + 2\,CO = Sn + 2\,CO_2 + (69 \times 2 - 135{\cdot}8)$ heat-units.
Heat evolved = 2·2 units.

These being all exothermic reactions, for the most part are easily brought about, but the last evolves little heat "and so requires the highest temperature to be applied in order to begin the reaction."

(2.) Reduction by Carbon.

Zinc Smelting.—In the smelting of zinc, the ore, usually calamine, is mixed with powdered anthracite and strongly heated in fireclay retorts: the carbonate is first converted into oxide and this is reduced. The reaction may be stated as follows:—

$ZnO + C = Zn + CO + (28-86{\cdot}2)$ heat-units.
Heat absorbed = 58·2 units.

"Here it will be seen that the reaction is strongly endothermic, and it probably does not take place in the zinc smelting furnace. It necessitates a very high temperature in order that 58·2 heat-units may be supplied to each molecule of zinc oxide and charcoal. It is, however, much more probable that the CO_2 driven off the calamine became CO by the action of excess of carbon, and the reaction is then as follows:—

$ZnO + CO = Zn + CO_2 + (69-86{\cdot}2)$ heat-units.
Heat absorbed = 17·2 units.

But

$CO_2 + C = 2\,CO + (56-97)$ heat-units.
Heat absorbed = 41 units.

The result as to heat disturbance is therefore the same, viz., absorption of 58·2 units."

(3.) Reduction by another Metal.

Certain ores are capable of reduction by being heated in contact with another metal more easily obtainable or less costly than that to be extracted. The following are examples:—

Lead Smelting:—

$PbS + Fe = Pb + FeS + (23{\cdot}8-17{\cdot}1)$ heat-units.
Heat evolved = 6 units.

Reduction of Mercury Ores:—

$HgS + Fe = Hg + FeS + (23{\cdot}8-19{\cdot}8)$ heat-units.
Heat evolved = 4 units.

Special Action of Sodium.—"Magnesium and aluminium are incapable of reduction from their oxides, and are therefore converted into chlorides from which compounds they may be separated by the action of metallic sodium when the material is heated sufficiently to initiate the reaction." (See this Journal, 1890, 737—738.)

Reduction of Magnesium from its Chloride :—

$MgCl_2 + 2\,Na = Mg + 2\,NaCl + (191{\cdot}6 - 151)$ heat-units.
Heat evolved = 43·6 units.

Reduction of Aluminium from its Chloride :—

"$AlCl_3 + 3\,Na = Al + 3\,NaCl + (291{\cdot}9 - 160{\cdot}9)$ heat-units.
Heat evolved = 131 units."

(4.) Air-Reduction Process.

In combining with sulphur, metals evolve less heat than in uniting with oxygen, therefore it will be seen that oxygen can decompose sulphides yielding an oxide. If the oxide be only feebly exothermic the metal will be produced by the action of heated air upon the sulphide thus :—

Reduction of Mercury from Cinnabar by Air :—

$HgS + O_2 = Hg + SO_2 + (69{\cdot}2 - 19{\cdot}8)$ heat-units.
Heat evolved = 49·4 units.

This reaction takes place easily because it is strongly exothermic.

The Smelting of Galena.—A series of four equations is necessary to explain the process :—

(1.) *First Process.—The Roasting of Galena to Lead Oxide* :—

$PbS + 3\,O = PbO + SO_2 + (51 + 69{\cdot}2 - 17{\cdot}8)$ heat-units.
Heat evolved = 102·4 units.

(2.) *Second Process.—The Reduction of Galena by means of Lead Oxide* :—

$2\,PbO + PbS = 3\,Pb + SO_2 + (69{\cdot}2 - 51 \times 2 - 17{\cdot}8)$.
Heat absorbed = 50·6 units.

This reaction being endothermic an amount of extraneous heat must be applied equal to 50·6 units. Hence the necessity for increasing the temperature of the furnace at this stage of the process.

But a third and a fourth change are effective in lead smelting :—

(3.) *The Roasting of Galena to Lead Sulphate* :—

$PbS + 2\,O_2 = PbSO_4 + (214 - 17{\cdot}8)$ heat-units.
Heat evolved = 196·2 units.

(4.) *The Reduction of Galena by Means of Lead Sulphate* :—

$PbS + PbSO_4 = 2\,Pb + 2\,SO_2 + (138{\cdot}4 - 214 - 17{\cdot}8)$ heat-units.
Heat absorbed = 127 units.

This change being very strongly endothermic requires a great increase of temperature.

In conclusion the author draws attention to the value of these figures in clearly defining the various furnace operations and showing the difficulties surrounding the solution of various problems which have led to a waste of time and money on unattainable objects.—G. H.

On Crystallised Ferro-manganese. B. Rathke. Ann. **260**, 326—332.

In examining a number of samples of ferro-manganese containing varying amounts of manganese, the author has observed that those containing the smallest amount show the leafy surface of spiegel iron; in the samples containing about 24 per cent. the crystals are smaller and more like flat prisms; with 41 per cent. they are long flat needles. Compact crystals first appear in the samples containing 72 per cent., and they contain more manganese than the remainder of the sample, *i.e.*, about 76 per cent. Similarly the crystals of the samples containing 82 per cent. contain 82·5 per cent. of manganese. As these crystals appear to be definite chemical combinations, it appeared to the author that the relation of the carbon to the metal in them would throw some light on the condition of the carbon in white iron, which may either consist of a compound of the whole of the iron and carbon or a mixture of a carbide of iron and pure iron.

The crystals were analysed by combustion of the carbon and subsequent determination of the silicon, iron, manganese, and phosphorus in the usual way. The crystals were found to contain more carbon than the bulk of the sample, and those crystals containing most manganese also contained most carbon. The following are the results of analyses of the crystals :—

C	7·5	7·4	6·47
Si	0·18	0·15	0·52
Fe	9·48	17·0	47·33
Mn	82·45	75·73	44·99
P	0·10	0·12	0·60

Two analyses of bulk samples were :—

C	6·50	6·62
Si	0·09	0·60
Fe	12·00	8·25
Mn	81·24	85·50
P	0·30	0·15

The author hopes to further investigate this subject.
—A. L. S.

The Method of Hunt, Douglas, and Hauch for Extracting Copper. W. Stahl. Berg. u. hüttenm. Zeit. 1891, **50**, 13.

Ores containing 4·68—5·88 per cent. of copper, on treatment by the Hunt, Douglas, or Hauch process were only deprived of 2·02—3·86 per cent. The reasons for this bad result are the spongy state of the ore, difficult filtration in consequence of ferric oxide separating out, presence of much manganese (4—6 per cent.), the chloride of which only seems to react with oxides of copper in presence of plenty of oxygen.—A. R.

On the Presence of Native Nickel in the Gravels of a Torrent. A. Sella. Compt. Rend. **112**, 171—173.

On examining auriferous gravels from the Elvo torrent near Piella (Piémont) the author found some metallic grains, soft and strongly magnetic, and resembling grains of native platinum. Hardly more than a decigramme of the substance was collected, and analyses give the following results :—

	Per Cent.
Nickel (containing cobalt)	75·2
Iron	26·6
	101·8

This corresponds nearly to the formula Ni_3Fe. The specific gravity was about 7·8. The particles may have had a meteoric origin.—G. H. B.

PATENTS.

Improvements in Processes for Smelting and Treating Tin Ores, Slags, Slimes, and Furnace Débris containing Tin and other Products, and in Apparatus therefor. A. J. Campion, Margate. Eng. Pat. 2057, February 7, 1890. *8d.*

A furnace is used termed the "Facile" and is similar to an ordinary cupola furnace used for melting cast iron, but is without blower or artificial air-blast. The shaft or body of the furnace may vary in size according to the material to be melted. Above the hearth or well of the furnace, which is provided with a tap hole, six or nine conical holes are made in the sides of the furnace, on a level with the fuel zone, which communicate with the interior. The top of the furnace is closed by a conical cap connected with a hollow flue leading into the chamber of a chimney shaft of considerable interior dimensions, constructed to retain

metallic particles which may be carried over through the flue. The interior of the hollow cap and flue leading to the chamber of the shaft is provided with one or more pipes, through which jets of steam at high pressure are passed. This causes a vacuum and suction draught through the holes above mentioned near the bottom of the furnace sufficient for all the purposes of combustion and smelting.

The charging hole is below the conical cap and hollow flue, and is fitted with an air-tight door, which is only opened when fresh charges of fuel and material have to be added. When slag, slimes, or other furnace débris containing a percentage of from 5 to 22 per cent. of tin combined with silicates and oxides of iron and other metals have to be smelted, these are heated in the furnace with alkali waste, the quantity being twice that of tank waste to the total iron and silica in the slag or débris. The action of this flux is to separate the oxide of iron by its combination with the sulphur in the waste, the lime being free to combine with the silica and alumina, which, together with a small portion of soda in the waste, form a fusible slag. The oxide of tin is liberated, is reduced by the fuel, and finally collects in the well of the furnace. Should the proportion of silica in the slags or débris be very large (exceeding 40 per cent.), the patentee prefers to use a flux of lime slaked with a saturated solution of sodium sulphate or carbonate in the proportion of one of "soda-lime" prepared in this way to one of silica. When the débris is in a fine state of division it is mixed with the flux and pressed into briquettes, dried and smelted. If the metal running from the furnace is hard by reason of the presence of foreign substances, it is fused in a small "Facile" furnace with iron oxide, iron ore, or scale. This removes sulphur. For the removal of tungsten, nickel, cobalt, or other oxidisable metals, it is fused in the same furnace with nitrate of soda or oxide of manganese or both.

If gold, silver, or the platinum group of metals be present, the dross should be smelted in a small "Facile" furnace with litharge or metallic lead in proportion of from one-half to an equal weight of the dross or skimmings containing the precious metals. When it is desirable to separate tin from slags containing tin to form a solder, the slag is melted in any furnace and lead is added, the proportion of the latter being from one-third to one-half by weight of the tin left in the slag.—J. B. C.

Improvements in the Manufacture of Steel or Iron. J. H. Darby, Brymbo. Eng. Pat. 4030, March 14, 1890. 4*d*.

In Eng. Pat. 418 of 1888 and Eng. Pat. 20,586 of 1889 (this Journal, 1890, 1134) a process is described by the present patentee whereby molten steel or iron is filtered through a layer of carbonaceous material, the carbon being dissolved or taken up by the metal, the carburised metal being run into a second ladle or cast direct into the moulds. Where the plant does not admit of this process the charcoal, gas carbon, or other carbonaceous matter to be used, is thoroughly dried and a measured quantity introduced by means of a shovel spout or other suitable apparatus into the casting ladle, if possible below the point where the stream of metal flows from the spout of the open-hearth furnace or the Bessemer converter, or the carbon may be enclosed in a case of thin sheet iron or other material and be thrown into the metal, where it will dissolve. The proportions of the carbonaceous matter required will vary with the different grades of metal. The patentee finds that "100 lb. of carbon added to a ladle holding about 10 tons of metal gives excellent results for 5 % carbon steel."

—J. B. C.

The Application of Anthracite Gas to Metallurgical and other Furnaces, and Arrangements connected therewith. T. D. Roek, London. Eng. Pat. 6256, April 24, 1890. 8*d*.

The object of the invention is to render it possible to apply producer-gas made entirely from anthracite coal to regenerative steel-furnaces and to improve the conditions of application of such gas to metallurgical furnaces in general. An important feature of the invention consists in providing for the supply of the anthracite gas to a furnace at a fixed, predetermined and carefully ascertained pressure. Gas-holders, pressure gauges, and indicators are used, whereby any required pressure may be maintained. It is necessary also that the supply of air should be carefully regulated, and the author introduces a convenient method for testing the gas with this object.

An arrangement of plant is outlined consisting of producer-gas holder and regenerative furnace. The regenerative furnace may be of ordinary construction, except that suitable means (valve with chain and weighted lever) are provided for the introduction of materials, solid or liquid, for testing the flame. The author tests the flame at the entrance and exit to the furnace. If the testing material, when applied to the entrance of the furnace, is not consumed without smoke, as observed through sight-holes, then more and more air must be admitted with the gas until such testing material is just consumed without producing smoke. If an excessive supply of air is being admitted, then the escaping gases will contain a greater or less amount of unconsumed air, which can readily be detected by the introduction of testing materials at the exit.—J. B. C.

XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

An Oxide of Gold. W. Hampe. Chem Zeit. **14**, 1778.

See under XXIII., *page* 485.

Silver Peroxide. W. Hampe. Chem. Zeit. **14**, 1779—1780.

See under XXIII., *page* 485.

Höpfner's Electrolytic Process for obtaining Copper and Silver direct from their Ores. Dingl. Polyt. J. **279**, 162—163.

In Höpfner's process a bath is used divided by diaphragms into two or more compartments. One division contains the electrolytically insoluble anodes, the second the cathodes of copper plate.

A double salt of cuprous chloride and halogen salt circulates round the anodes and a similar solution passes the cathodes. On the latter metallic copper is deposited at the rate of 2·36 grms. per ampère-hour, that is double the quantity of metal when compared with the use of cupric salt. In case no cuprous chloride were present free chlorine would form at the anode and an electro-motive force of 1·8 volt would be required. The chlorine combines, however, with cuprous chloride to form cupric chloride equivalent to 1 volt. The electrolysis can therefore take place with an E.M.F. of 0·8 volt.

By determining the heat of formation of cuprous and cupric chloride, the author shows that theoretically the electrolysis begins with the consumption of 0·13 volt. The liquid as it flows past the cathodes gradually gives up its copper and is used again. The anode liquors retain their supply of copper. The copper is, however, present as cupric and not cuprous chloride. The latter leaves the bath in a continuous stream. This solution is employed for extracting copper from powdered copper and silver ores in special leaching vessels. Sulphide ores give the following reaction—

$$CuCl_2 + CuS = S + Cu_2Cl_2$$

The solution of cuprous salt is regenerated, but it is twice as concentrated as previously. To bring it to its normal condition of concentration, it is diluted with the

waste liquors from the cathodes. This regenerated solution may be utilised as before, and the process is therefore a continuous one.

This process is only disturbed by the presence of small quantities of iron, arsenic, antimony, bismuth, &c., which pass into solution in place of copper.

These impurities must not be allowed to deposit with the copper, and the presence of iron materially affects the solvent action of the copper salt on the ore. These impurities can, however, be easily eliminated by precipitation with copper oxide. The silver, if present, is deposited first. The resulting copper is chemically pure. The advantages of the process are that: 1. By electrolysing a solution of cuprous chloride the amount of copper deposited is twice that which would be deposited from a solution of copper sulphate with the same current. 2. The alkaline and earthy alkaline chlorides have such a solvent action on cuprous chloride that solutions free from iron can be employed, which cannot be attained with sulphate. 3. Pure copper may be derived from the most impure ores and from silver ores, silver may be deposited at the same time. With one horse-power 11 kilos. of copper may be deposited in 24 hours. If the work of the necessary pumps and the mechanical agitation of the liquor be included and reckoned at one quarter, and the electro-dynamic power at three-quarters of the total necessary work, with 30 kilos. of coal, 33 kilos. of copper may be obtained, a result never yet reached, and one which permits of the utilisation of the poorest ores.

The process is particularly applicable to the working of copper ores such as are found in Spain and Chili, where fuel is dear.—J. B. C.

Electro-Metallurgy of Aluminium. A. Minet. Compt. Rend. **112**, 231—233.

The author has introduced certain alterations into the method previously used by him (this Journal, 1890, 520), for obtaining aluminium by electrolysis. The effect of these improvements has been to diminish the difference of potential required and to increase the yield, so that 32 grms. of metal are now obtained by an expenditure of energy equivalent to one horse-power-hour. (The "horse-power" referred to by the author is the French *cheval-vapeur*, which is less by about 1·3 per cent. than the English horse-power.) The bath used is made up in the same way as before. The vat is a casting of the same form as that previously employed, but its dimensions are smaller and the arrangement of the electrodes is altered. The inside of the vat is lined with a layer of agglomerated carbon, which serves as the *negative* electrode. The aluminium is deposited on this lining, and collects at the bottom of the vessel. The apparatus can be used continuously for a period varying from 20 to 30 days. The following are the details of a day's work with a single vat (one of three arranged in series):—

Density of current (per square centimetre): At the positive pole = 0·75 ampere, at the negative pole 0·5 ampere.
Temperature = 920°.
Duration of the experiment, t = 22 hours.
Strength of current, C = 1,500 amperes.
Quantity of electricity, Ct = 33,000 ampere-hours.
Theoretical weight, W = $Ct \times 0{\cdot}34$ = 11,220 grms.
Weight obtained, w = 6,500 grms.
Efficiency of system: in terms of t = $\frac{w}{W}$ = 58 per cent.
quantity of electricity used = $\frac{w}{W}$
Minimum electro-motive force, e = 2 volts.
Resistance of the electrolyte, r = 0·0017 ohm.
Difference of potential at the electrodes, E = $e + Cr$ = 4·55 volts.
Power employed, P = $\frac{CE}{736}$ = 9·27 horse-power.
Total expenditure of energy = Pt = 204 horse-power-hours.
Weight of metal obtained per horse-power-hour = 31·9 grms.
Expenditure of energy per kilogramme of aluminium obtained = 31·3 horse-power-hours.

These results are an improvement on those previously obtained, and the manipulations are also simpler.

When commercial alumina is used and transformed directly into aluminium oxyfluoride (without previous purification) for feeding the bath, the metal obtained contains from 2 to 3 per cent. of impurities, mainly silicon; the proportion of iron is only 0·6 to 0·8 per cent. As usual, the aluminium can be hammered and worked cold. With products free from silicon, the richness of the metal rises to 99 per cent. The author believes that the necessary difference of potential may be further reduced to 4 volts (independently of the current strength). With this difference of potential, the sodium chloride (which forms 65 per cent. of the bath) would no longer be decomposed, for the electro-motive force required for its decomposition is 4·35 volts; consequently the yield (or efficiency) would rise to 70 per cent. The outstanding loss of 30 per cent. appears to be mainly due to the action of the nascent aluminium, which probably attacks the fluoride and forms a sub-fluoride. In fact, the yield increases when the proportion of fluoride in the bath is diminished by dilution. The losses are greatly diminished, and the yield nearly reaches the theoretical amount when the apparatus is used for obtaining alloys of aluminium. In this case the inside lining of the vat is dispensed with. The vat itself is made of one of the metals forming the alloy, and the aluminium in the nascent state unites with it.—D. E. J.

The Atlas Accumulator. Elect. Rev. **28**, 207—208, and Electrician, **26**, 484.

The Atlas accumulator is the joint work of C. Hering, Abakanowicz, D'Arsonval, and Picou. In appearance it is somewhat similar to Volta's original pile, the perforated plates being laid horizontally and built up in the form of a tower. The pile of plates is enclosed in a vessel containing the dilute sulphuric acid, so that the mechanical principle of construction may be said to be a compromise between that of the pile and that of the ordinary battery. The plates are of porous lead and of peroxide of lead respectively, the positive being separated from the negative plates by sheets of perforated celluloid or india-rubber. Between and in contact with each pair of positive plates is a sheet of lead which is provided with a kind of *lug* clamped between two screws working on the thread of a rod of antimony-lead alloy which forms the positive pole of the accumulator, and is provided at its upper end with a screw clamp for attaching the wire. The screws on the rod of antimony and lead alloy are free to expand in every direction. Similarly, between each pair of negative plates is a sheet of lead similarly connected with a second rod which forms the negative pole. The chief advantage claimed is specific lightness, so important for traction work. Other advantages are that the plates cannot buckle and that they can readily be examined, and when necessary removed. The following data relating to this accumulator are given:—

Capacity per lb. of plate	9 ampere hours.
Discharging current	7 to 9 amperes per lb. of plate.
Dimensions of a 150-ampere-hour cell	6½ × 7½ × 13 inches.

M. Picou holds that accumulators should be charged at a constant potential of 2·3 volts per cell instead of with constant current. By adopting the former plan the charging is done more quickly: thus 3 hours instead of 6½ were taken to charge a Gadot accumulator to within 17 per cent. of maximum. The constant current method also requires towards the end of the operation a higher potential. For charging at constant potential a shunt dynamo is used.

—V. C.

XII.—FATS, OILS, AND SOAP MANUFACTURE.

Researches on Turkey-Red Oil. Scheurer-Kestner. Compt. Rend. **112**, 158—160 and 395—397.

In view of the uncertainty which still attaches to the theories regarding the composition and essential properties of Turkey-red oil, the author gives in these two papers a summary of the conclusions which his work on this subject has led him to adopt. These refer exclusively to the product derived from castor oil by the action of monohydrated sulphuric acid. The complex mixture of fatty acids forming Turkey-red oil contains a very large proportion of sulphoricinoleic acid, in which the sulpho group is joined to an atom of oxygen and not to a carbon atom. This is in agreement with the views of Benedikt and Ulzer as opposed to Muller-Jacobs (see this Journal, 1885, 115; 1886, 452; and 1887, 543). The other fatty acids present are regarded by the author, as well as by Juillard, as a mixture of polymerides of ricinoleic acid, but the author differs from Juillard as to the extent of the condensation and objects to that chemist's employment of sodium chloride for salting out the fatty acids on account of the greater polymerising effect of the hydrochloric acid set free. In this respect the use of sodium sulphate is more to be recommended and at the same time the application of heat is to be avoided. Guided by these considerations, the author's researches have lead to the following results: Turkey-red oil consists of sulphoricinoleic acid, which is stable at the ordinary temperature, together with mono- and diricinoleic acids, as shown by determinations of the molecular weight by Raoult's method of solution of the substance in acetic acid; the sulphonated fatty acid is hydrated, and in that state is stable; it loses its water completely at 120°, and becomes insoluble by splitting up into sulphuric acid and fatty acid. From a tinctorial point of view, the author notices that it is the sulphonated fatty acid which tends to produce yellow shades of alizarine, whilst the polymerised fatty acids are favourable to the blue shades.

A separation of the acids of Turkey-red oil may be effected by shaking with a mixture of water and ether, when the fatty acids are taken up by the ether and the sulphonated fatty acid is retained by the water, from which it may be separated by salting out with a solution of sodium sulphate. The proportions of the two kinds of acids vary even when produced under apparently identical conditions. The solubility of Turkey-red oil in water is due to the presence of the sulphonated acid, which is therefore the important factor to its solubility. The fluorescence always exhibited by Turkey-red oil is due to the non-sulphonated acids. Polymerisation occurs to a larger extent in the non-sulphonated acids, which gave a molecular weight of 472 as against 402 given by the sulphonated fatty acids obtained in the same experiment. (The molecular weight of the normal acid is 298.) Sulphoricinoleic acid as precipitated from aqueous solution by sodium sulphate forms a syrupy hydrate, and constitutes about 40 to 50 per cent. of the most soluble kind of Turkey-red oil. Its composition approaches that of diricinosulphonic acid, $(C_{17}H_{32})_2 - CO_2H - CO_2 - O - SO_2.OH$. The two main constituents of Turkey-red oil may be determined volumetrically by the use of litmus and phenolphthaleïn as indicators successively. Ammonia should be the titrating solution and the volumes of water present should be about the same in all cases in order to obtain comparable results. Litmus becomes blue when the sulphonated acids are neutralised, whilst phenolphthaleïn is reddened only when all the fatty acids present have been neutralised. Considering the influence of the proportions of the two kinds of fatty acids on the solubility of Turkey-red oil and on the shade obtained with alizarine in the subsequent dyeing, this method of titration may have considerable practical value. A similar product results from the action of sulphuric acid on castor oil or on normal ricinoleic acid.

—G. H. B.

PATENTS.

New or Improved Soft Soap and Method of Manufacturing the same. M. Williams, Liverpool. Eng. Pat. 3503, March 5, 1890. 4*d*.

To 6 parts of soda soap the patentee adds 8 parts of potash soap, 25—35 parts of water, and 6 parts of ordinary strong solution of silicate of soda or potash, the mixture being thoroughly mixed and boiled. The amount of water to be added depends on the required consistency of the soap.

—K. E. M.

An Apparatus for Straining or Filtering Oil used for the Purposes of Lubrication. T. Walton and C. C. Walton, Rochdale. Eng. Pat. 4491, March 22, 1890. 6*d*.

The specification relates to the treatment of oil in a hollow vessel of suitable form provided with a number of sieves, the whole being placed in a second vessel provided with outlets for separated oil and water.—K. E. M.

A New and Improved Lanolin Compound and Process for Preparing and Utilising the same, especially applicable to the Preparation of Lubricants. W. P. Thompson, Liverpool. From R. Krause, Wittenberge, Prussia. Eng. Pat. 5229, April 3, 1890. 4*d*.

The soap formed by treating wool-grease with alkaline lye is dissolved in water and filtered. To this a solution of alum or other alumina salt is added, whereby a brown precipitate is formed, which is called "aluminium-lanolate." With this substance, when dried, lubricating oils of any viscosity may be produced by dissolving it in any fluid mineral oil. If dissolved in a small quantity of mineral oil a gelatinous substance is obtained which may with advantage be mixed with india-rubber or gutta-percha. Solvents for india-rubber are said to be also solvents for "aluminium-lanolate." In textile industries this substance may also be used as a scouring agent.—K. E. M.

An Improved Manufacture of Soap. C. A. Serre, Leytonstone. Eng. Pat. 7019, May 6, 1890. 4*d*.

With dried soap, preferably olive-oil soap, powdered talc or pumice stone or silica is incorporated. This mixture is re-ground with olive oil containing perfume so that the particles of soap becoming covered with a film of oil lose their tendency to clog under the influence of atmospheric moisture.—K. E. M.

Process and Apparatus for Smelting Margarine, Tallow, or other Crude Fatty Substances by Means of Hot Air. P. Wild, Berlin, Germany. Eng. Pat. 19,960, December 6, 1890. 11*d*.

This invention relates to the rendering of fats by means of hot air and cannot be adequately understood without reference to the numerous drawings accompanying the specification.—K. E. M.

Improvements in the Naphtha Process of Extracting Oils. J. W. Evans, Cleveland, U.S.A. Eng. Pat. 21,196, December 10, 1890. 8*d*.

The "naphtha process" of extracting oil from crushed seed is carried out in a percolator. After drawing off the solution of oil in naphtha which separates from the meal by gravity, steam is introduced. This volatilises the naphtha which is drawn off at the top of the percolator. In order to facilitate the volatilisation of the naphtha, and at the same time to remove the residual oil, the presence of which is objectionable in the meal when used for cattle food, the inventor introduces steam in several places into the

percolator and draws off the naphtha vapours from the top and bottom; the vapours escaping at the bottom carrying with them the residuum of oil.—K. E. M.

An Improved Filter for Oil and other Liquids. C. A. Koellner, Neumühlen, Germany. Eng. Pat. 474, January 10, 1891. *6d.*

The patentee claims the use of filtering apparatus in which the liquid to be filtered passes through filter-beds sideways or upwards and then downwards; also an arrangement by which the filtering process may be observed from outside, and the porosity of the filtering material regulated.—K. E. M.

XIII.—PAINTS, PIGMENTS, VARNISHES, AND RESINS.

PATENTS.

Improvements in the Process of and Apparatus for Producing Ferro-ferric and Ferric Oxides. A. Crossley, Pontypool, and J. W. Jones, Manchester. Eng. Pat. 8914, June 9, 1890. *8d.*

The salts of iron, &c., are heated in retorts of special construction, fully described and illustrated in the specification, and hot or cold air, or steam, is drawn over the surface of the powder by exhausting apparatus of any suitable kind.—E. G. C.

Improvements in the Manufacture of Paints. W. A. Hall, Bellows Falls, U.S.A. Eng. Pat. 16,786, October 21, 1890. *4d.*

This invention relates to the manufacture of what are termed "water-paints," the material, which contains no oil, and does not scale off or crack, being composed of "hydrous silicate of magnesia," dextrin, gypsum, carbonate of calcium, powdered alum, and salt.—E. G. C.

Improvement in the Preparation of Gold Paint for Use in Gilding and the Like for Internal Decorations. John, James, and R. W. Tennant, Aberdeen. Eng. Pat. 17,988, November 8, 1890. *4d.*

"Pure gutta-percha steeped in benzol for 24 hours, then pressed and strained, after 24 hours again strained, then allowed to stand for 14 days. On the expiry of the 14 days the top half to be taken off and the remaining half allowed to settle for 10 hours, and both upper halves mixed together. After this benzoline added and strained a third time, then add gold bronze and mix all together."—E. G. C.

XIV.—TANNING, LEATHER, GLUE, AND SIZE.

On the Oxidation of Tanning Materials. R. Jahoda. Zeits. f. angew. Chem. 1891, 104—105.

Many tanning materials absorb oxygen when exposed to the air in a moist condition. The author has tested the above fact on some of the more common tanning materials, and has compared the results obtained by Lowenthal's and the gravimetric methods before and after exposure to the air. The former method, which depends on oxidation, is most affected by this change. Pine bark by this method showed a falling off of from 6·65 to 2·29 per cent. of the available tannin, whilst the same bark showed by the gravimetric method a decrease of from 9·27 to 6·4 per cent. This decrease seems limited in extent, as while it continued for 14 days it did not further decrease when exposed for 30 days. In the above example the final point seems to be 2·29, and by the gravimetric method 6·59. This decrease in the percentage is proportional to the length of time of exposure to oxidation.

Oak bark and quebracho wood showed no change. Oak wood showed a slight decrease. The tanning material was moistened with water in a flask and oxygen passed in from time to time, the flask being corked up and allowed to stand. The change is without doubt due to oxidation of the tannin, water assisting the action by parting with dissolved oxygen, and at the same time dissolving the tannin and rendering it more oxidisable.

The author appends a table of some dozen results as the result of oxidation from 5 to 30 days.—D. A. S.

PATENTS.

The Preparation of Skins, Kips, and Hides, by an Improvement in the Process known as "Unhairing" or "Pulling." F. R. Maggs, Yeovil. Eng. Pat. 7509, May 14, 1890. *4d.*

This invention consists in the application of crude sulphide of barium, containing soluble sulphides, mixed with slaked lime to the unhairing of hides, kips and skins. The hides or skins are brushed with the mixture made into a paste with water. The "strength" of the mixture is entirely dependent on the nature and condition of the skins, kips, or hides under treatment. For ordinary skins it would require about 10 lb. of the barium sulphide to 40 lb. of the slaked lime.—B. H.

Improvements in Tanning. J. E. Pujos, Paris, France. Eng. Pat. 11,397, July 21, 1890. *6d.*

This invention is for a quick method of tanning. The hides are first soaked and limed in the usual way and are then unhaired, fleshed and "scudded." They are next immersed in a dilute solution of oxalic acid containing 10—15 grms. of oxalic acid to each hide. The hides are then removed from the bath and worked on both sides, after which they are thoroughly washed till almost quite free from acidity. They are now sent into tan-liquor consisting of what the inventor calls "converted tannin." This tanning liquor is prepared as follows: To 100 kilos. of extract (oak or chestnut, &c.) of 25° are added 100 litres of clear water. 15 kilos. of commercial ammonia are then added and the mixture thoroughly agitated; 8 kilos. of ordinary commercial sulphuric acid are next added and stirring continued till complete mixing has taken place. The hides or skins prepared as above are treated first with liquors of "converted tannin" of the lowest strength and gradually brought into stronger liquors, till they are finally operated on with the strongest liquors of 4—5° B. "It may also be stated that this process of converting tannin by means of ammonia and sulphuric acid is suitable for all tanning substances, such, for examples, as oak, chestnut, sumach, scarlet oak, vallonia cæsalpina coriaria, the mangrove or mangle, &c." – B. H.

Improvements in Machinery or Apparatus for Fleshing, Shaving, Grounding, and otherwise Treating or Finishing Hides or Skins. W. R. Pullman and H. Smith, Godalming. Eng. Pat. 131, January 3, 1891. *1s. 1d.*

This invention relates to improvements in machinery for performing upon green or manufactured or partly manufactured hides or skins, operations for the finishing of the same, such as grounding, paring, fleshing, shaving, frizzing, reducing, staking and levelling. The specification is unsuitable for abstraction, and would be unintelligible without the accompanying drawings.—B. H.

XVI.—SUGAR, STARCH, GUM, Etc.

On Wood-sugar (Xylose) and Wood Gum (Xylan). E. W. Allen and B. Tollens. Annalen, **260**, 289—306.

Many vegetable substances when warmed with a hydrochloric acid solution of phloroglucinol yield a cherry-red colouration, and when distilled with dilute acids yield an estimable quantity of furfural. These two reactions are characteristic of the pentaglucoses and those bodies which yield these sugars on hydrolysis.

Wood and other similar bodies when moistened with phloroglucinol in the cold yield the red *lignin reaction*. The object of this research was to obtain more detailed knowledge concerning the bodies which yield the above pentaglucose reaction.

Xylan and Xylose from Straw.—Straw is treated with 2 per cent. ammonia and well washed; it is then soaked in 4—5 per cent. soda for two days, and the alkaline liquor separated; from this strong alcohol precipitates a gum. The gum is washed with alcohol acidified with hydrochloric acid until all the soda is removed, the alcohol removed by ether and the gum dried over sulphuric acid. Further similar treatments of the straw residue yield more gum. The total yield is 16·2 per cent. of the straw. The gum gives the pentaglucose reaction on warming with phloroglucinol and hydrochloric acid, but does not give the lignin reaction. No indication was obtained of bodies yielding other sugars on hydrolysis. The gum contained 28·3 per cent. of ash, which consisted chiefly of silica.

By distillation with hydrochloric acid the gum yielded 11·0—19·2 per cent. furfural. A solution of the gum in soda was levo-rotatory $[\alpha]_D = -84·1$. When hydrolysed with 5 per cent. sulphuric acid, the gum yielded 7·4 per cent. crystallised xylose.

Xylose from Cherrywood.— Although cherry-tree gum yields arabinose on hydrolysis yet the wood of the same tree when treated as above yielded a gum which when hydrolysed produced xylose. Shavings of the wood give the pentaglucose reactions; when distilled with hydrochloric acid the yield of furfuramide is 4·8 per cent. The wood yielded 12·4 per cent. of gum and 87·5 grms. of gum yield 19·4 grms. of xylose.

Gum and Pentaglucose from Loofah.—Loofah consists of the isolated vascular bundles of the fruit of *Luffa cylindrica*. It gives both the lignin and pentaglucose reactions. On treating loofah as above 5·7 per cent. of a gum was obtained. The gum gives the pentaglucose reaction, but no reaction with iodine indicating starch or cellulose. When distilled with hydrochloric acid it yields 25·8 per cent. furfuramide. Dissolved in soda it is levo-rotatory $[\alpha]_D = -69·2$.

Arabinose from Beetroots.—A gum stated to be identical with arabic acid has been extracted from beetroots by milk of lime. Washed beetroot slices give a slight red colouration on moistening with a hydrochloric acid solution of phloroglucinol. When treated with soda as above 10·5 per cent. of a gum was obtained containing 14·6 per cent. of ash. This yielded arabinose on hydrolysis.

On Wood Gum (Xylan) and the Lignin Reaction.—The lignin reaction has been used to indicate the presence of xylose- or arabinose-yielding bodies, and has been trustworthy. The authors have observed that the reaction is diminished after extracting straw, &c. with soda as above, and after repeated extractions disappears. The extracted wood gum does not, however, yield this reaction, it may be that the body giving this reaction and extracted by soda is soluble in alcohol, and is not precipitated with the wood gum. The red colouration produced by heating phloroglucinol and hydrochloric acid when examined in the spectroscope shows a band in the green between D and E, whilst the red colouration produced in the cold (lignin reaction) shows no such band. It thus appears that the two reactions have no connexion.—A. L. S.

On Xylonic Acid. E. W. Allen and B. Tollens. Annalen, **260**, 306—313.

Six grms. of xylose dissolved in 30 grms. of water were oxidised by 12 grms. of bromine at the ordinary temperature for 36 hours. The excess of bromine was removed by heating the solution and the hydrobromic acid by silver and lead carbonate, the excess of these metals being removed by sulphuretted hydrogen. The filtrate was neutralised with calcium carbonate, and as it did not crystallise the lime salt was precipitated by alcohol. It contained 10·2 per cent. of calcium, calcium xylonate, $(C_5H_9O_6)_2Ca$, contains 10·8 per cent. of calcium. The authors have not been able to crystallise this salt, nor have they had more success with the zinc or silver salt. They have, however, crystallised strontium xylonate. The air-dried salt has a composition $(C_5H_9O_6)_2Sr.8\frac{1}{2}H_2O$; on long exposure to the air it loses $2\frac{1}{2}$ molecules of water and then contains 6 H_2O.

Xylonic acid and its salts possess very different properties to arabinonic acid and its salts, as the calcium salt of the latter crystallises easily, and strontium arabinonate crystallises with 5 H_2O. Strontium xylonate is dextro-rotatory $[\alpha]_D = +12·14°$.

Xylonic acid has not been crystallised; the acid as obtained by adding the calculated quantity of hydrochloric acid to strontium xylonate is first levo-rotatory, but this soon changes to dextro-rotation, the constant value being $[\alpha]_D = +17·48°$. Strontium arabinonate is dextro-rotatory $[\alpha]_D = +1·96°$; arabinonic acid prepared from the strontium salt by adding the calculated quantity of hydrochlorie acid is levo-rotatory, the levo-rotation gradually increasing to the constant value $[\alpha]_D = -45·86$. It is thus evident that xylonic acid and arabinonic acid are not identical but isomeric.—A. L. S.

Levosin, a New Proximate Constituent of Cereals. C. Tanret. Compt. Rend. **112**, 293—295.

Wheat, rye, and barley contain a well defined substance which is levo-rotatory and to which therefore the name of *levosin* has been given. To isolate this new body the ground grain is extracted with 50 per cent. alcohol, and the extract treated with two volumes of 94 per cent. alcohol, whereby a quantity of gum is precipitated. This is filtered off, the alcohol distilled off from the filtrate and the residue treated with baryta water until a precipitate forms, which redissolves at once. The solution is filtered and the filtrate boiled with a large excess of baryta water, when a precipitate is formed which is filtered, washed with baryta water and decomposed by carbon dioxide. The resulting solution, after filtering off the barium carbonate, contains the levosin, which remains behind on evaporation still contaminated however, with 0·5—1 per cent. of barium salt, which can be removed by dissolving the above residue in 60 per cent. alcohol, and separating the barium by addition of the requisite quantity of sulphuric acid. The barium sulphate is then filtered off, the levosin precipitated by the addition of 95 per cent. alcohol, taken up with water and the aqueous solution evaporated. Levosin is a white amorphous solid, soluble in water in all proportions, very soluble in dilute, but almost insoluble in strong alcohol. It melts together at 145° C., but is only completely melted towards 160° C. Its specific gravity is 1·62, and its rotatory power, which is unaffected by temperature, $[\alpha]_D = -36°$. An analysis of the product dried at 110° C. points to the empirical formula $C_{12}H_{10}O_{10}$; a molecular weight determination by Raoult's method to the molecular formula $C_{48}H_{40}O_{40}$. Exposed to the air the dry substance takes up 4 molecules of water to form the hydrate $C_{48}H_{40}O_{40}.4\,H_2O$. Levosin does not reduce Fehling's solution, nor does it undergo fermentation either with yeast or with diastase. The hydrate is very readily hydrolysed by dilute acids, and even by heating with water to 100° in a sealed tube for 24 hours. The resulting solution has a rotatory power $[\alpha]_D = -76°$, and contains about 75 per cent. of levulose, the remainder being a feebly dextro-rotatory glucose.

Levosin is not attacked by solutions of the alkaline hydrates; it forms compounds with bases, some of which have been analysed. The barium compound, $C_{48}H_{30}Ba_4O_{40}$,

is formed by the addition of baryta water to a solution of levosin. It is insoluble in an excess of baryta water, and is dissociated by water into the compound $C_{18}H_{18}Ba_2O_{20}$ which is only slightly soluble. In presence of sugars, however, this barium salt redissolves, until the former are completely saturated, a fact which is made use of in the method given for the isolation of levosin. A calcium salt, $C_{18}H_{18}Ca_2O_{20}$, and two lead salts, $C_{18}H_{16}Pb_2O_{20}$ and $C_{18}H_{14}Pb_3O_{20}$, are described. Lead acetate precipitates the former of these lead salts only after addition of alcohol; the latter is insoluble in water and results when levosin is treated with an ammoniacal solution of lead acetate.

Levosin yields both a tri-acetyl and a tetra-acetyl compound. With nitric acid a slightly explosive ester results in the cold. On further action oxalic acid is formed without the intermediate production of mucic acid.

Levosin has been found in rye, wheat, and barley to an extent varying from 0·3 to 2·0 per cent. on the dry material. Barley contains the most, and the quantity is greatest when the cereal is matured. When dried, wheat and barley only contain 0·1—0·2 per cent. of levosin. None was detected either in oats or in dried maize.—C. A. K.

The Conversion of Starch into Dextrin by the Butyric Ferment. A. Villiers. Compt. Rend. **112**, 435—437.

The conversion of starch into dextrin is easily effected as follows:—50 grms. of potato starch and 1,000 cc. of water (not distilled) are made into a paste. The paste, contained in a flask which it must nearly fill, is inoculated at 100° C. with a few cubic centimetres of a cultivation of *Bacillus amylobacter*. The flask is closed with a plug of sterilised cotton and placed in an oven kept at 40° C. In 24 hours the starch paste will generally have become liquid, but the fermentation is allowed to proceed until a drop of the liquid no longer gives a blue or violet colouration with iodine. This result is attained in 2—4 or more days, according to circumstances. The *bacillus* cells, which at the beginning of the experiment form straight mobile rods, become towards the end of the fermentation thickened at one end and assume a tadpole-like shape. A little gas is liberated during the fermentation, but its quantity is insignificant. The liquid finally obtained smells of butyric acid, of which about 0·3 part is produced per 100 parts of starch taken. The chief product, however, is dextrin, which may be separated by filtration, evaporation, and precipitation with alcohol. The dextrin forms when dry a white, friable, very hygroscopic mass, which possesses a slightly sweet taste and consists of a mixture of different dextrins which vary in specific rotatory and reducing powers. Iodine colours the dextrins having a high rotatory power reddish, whilst the others are not coloured. The reducing powers of these dextrins vary inversely as their rotatory powers, as the following table shows:—

Specific Rotatory Power.	Reducing Power.
	K.
156°	28·9
175·1	11·3
207·5	5·0

It remains to be decided whether these dextrins are identical with those produced by the action of acids or diastase on starch. It is remarkable that the dextrins formed are not accompanied by maltose or glucose. This fact seems to show that the conversion of the starch is brought about without the aid of any diastase secreted by the butyric ferment; for in such case, reasoning by analogy, the further reduction of a portion of the dextrin to maltose might fairly be expected.—H. T. P.

XVII.—BREWING, WINES, SPIRITS, Etc.

On the Improvement of Inferior Brewing Water by Sand Filtration. W. Schultze. Allgem. Zeits. f. Bierbr. u. Malzfabr. 1891, **19**, 1.

See under XVIII. *B., page* 477.

Diastase. J. Szilágyi. Chem. Zeit. **15**, 349—351.

Diastase was prepared from barley and oat malts by digesting the green malt with alcohol of 20 per cent. strength. To the solution obtained alcohol was added until a flocculent precipitate began to form. After settling, the clear liquid was treated with a double bulk of alcohol, the diastase thus precipitated being filtered off, washed with alcohol and ether and dried over sulphuric acid.

Diastase thus prepared obstinately retains a considerable percentage of ash, which may be removed by repeated dialysis. An elementary analysis of the diastase obtained yielded the following results calculated on the ash-free substance:—

	Barley Malt Diastase.	Oat Malt Diastase.
Carbon	46·80	48·12
Hydrogen	7·14	7·04
Nitrogen	9·98	10·04
Sulphur	1·14	1·19
Oxygen	34·64	33·61
	100·00	100·00

In order to test the saccharifying power of barley-malt diastase, varying amounts of a solution containing 0·1 grm. of diastase per 500 cc., were added to lots of 20 cc. of a solution of soluble starch prepared according to Lintner's directions. 100 cc. of starch solution were equivalent to 2 grms. of air-dried starch. The mixtures were allowed to stand for one hour at the ordinary temperature. The maltose formed was then determined, the results obtained being as follows:—

Diastase used.	Diastase used.	Maltose formed.	Corresponding Amount of Starch.	Corresponding Amount of Air-dried Starch (containing 13·4 per Cent. of Water).	Percentage of Starch converted into Maltose.
Cc.	Mgrms.	Grm.	Grm.	Grm.	
5	1	0·1208	0·1229	0·1419	35·48
10	2	0·15079	0·1428	0·1648	41·20
15	3	0·18181	0·1722	0·1988	49·72
20	4	0·20739	0·1964	0·2256	56·40
25	5	0·2220	0·2103	0·2428	60·75
30	6	0·2275	0·2155	0·2488	62·20

Similar experiments were made at more elevated temperatures, the time of action being reduced to 30 minutes. The results are given in the table on next page:—

Diastase used.	Saccharifying Temperature in °C.	Maltose formed.	Percentage of Starch Converted into Maltose.
Mgrms.		Grm.	
1	40	0·15630	42·7
	50	0·18880	51·6
	60	0·15876	43·4
2	40	0·21840	59·7
	50	0·25000	68·3
	60	0·21910	59·9
3	40	0·2458	67·2
	50	0·2878	78·7
4	40	0·2652	72·5
	50	0·2872	78·8

Oat-malt diastase was examined in the same way as above, the results obtained being as follows :—

Diastase used.	Saccharifying Temperature in °C.	Maltose formed.	Percentage of Starch converted into Maltose.
Mgrms.		Grm.	
1	40	0·1770	48·37
	50	0·21238	58·00
	60	0·1770	48·37
2	40	0·2418	66·10
	50	0·26546	72·54
	60	0·24780	67·74
3	40	0·28318	77·37
	50	0·29491	80·60
	60	0·2890	77·55

From these numbers it appears that oat-malt diastase has a slightly stronger fermentative action than that from barley-malt; and this is practically confirmed by the fact that the use of oat-malt for saccharifying purposes in distilleries leads to a better and more complete fermentation of the wash than is the case when barley-malt is employed, other circumstances being equal.—H. T. P.

The State of Combination of Sulphuric Acid in Plastered Wines, and the Detection of Free Sulphuric Acid. L. Magnier de la Source. Compt. Rend. **112**, 341—343.

The author is of opinion that *fully* plastered wines always contain potassium bisulphate. Such a wine contains no potash in excess of that required to form neutral potassium sulphate with the sulphuric acid. A wine contains as much tartaric acid after as before plastering with pure plaster. If at any time it deposits tartar, it does so at the expense of the potassium of the potassium sulphate, and consequently a corresponding amount of potassium bisulphate is formed. Completely plastered wines are rare in commerce, yet it is often found in analysing plastered wines that very little difference exists between the total ash and the potassium sulphate. In such wines free sulphuric acid can generally be detected. A pure unplastered wine containing naturally 0·32 grm. of sulphuric acid (H_2SO_4) per litre was treated with the following quantities of sulphuric acid :—

—	Per Litre.	—
	Grms.	
a	4·00	Undrinkable.
b	1·80	Undrinkable.
c	1·00	Very acid, but good.
d	0·55	Most agreeable flavour.

Each of these mixtures was divided into two equal parts, one part being saturated with potassium carbonate. The eight lots were then evaporated to dryness and incinerated, the sulphuric acid being determined in the residues. The following results were obtained :—

—	Wine + Sulphuric Acid.	Wine + Sulphuric Acid + Potassium Carbonate.
	Grms. per Litre.	Grms. per Litre.
a	1·19	4·01
b	1·21	2·00
c	1·20	1·30
d	0·84	0·86

These numbers show that the addition of a quantity of sulphuric acid exceeding 1 grm. per litre could not be detected by an analysis of the ash of the wine. Sulphuric acid added in small quantities to unplastered wine ceases to exist in the free state, and no method of analysis would return it as such unless it were again set free by some secondary action. But if this were so, the results would be valueless, because they would apply equally well to plastered and unplastered wines.—H. T. P.

On Italian Wines. E. Niederhäuser. Pharm. C.H.N.F. 1891, **12**, 15.

As the consumption of Italian wines has increased considerably the following tables may be of interest :—

For Table see next page.

The commission for wine statistics at Karlsruhe has decided to condemn white wines containing more than ·12 per cent. and red wines containing more than ·16 per cent. acetic acid. According to these figures the majority of the above Italian wines would be considered bad, which is unjust, as none of them have a taste of acetic acid. The chlorine found in these wines varies considerably, rising as high as 23—25 mgrms. in 100 cc.; German wines contain only a few milligrammes.—A. R.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

(*A.*)—CHEMISTRY OF FOOD.

PATENTS.

A New or Improved Method for Preserving Meat, Fish, and the like. F. Grognet, Paris, France. Eng. Pat. 2620, February 18, 1890. 6*d*.

Four hundred parts of vinegar of "3½ or 4 degrees of strength, 16 parts of kitchen salt, 1 part each of Sumatra or crushed cayenne pepper, green ginger, acetate of potash, and a mixture of the four spices nutmeg, cloves, cinnamon, and laurel" are mixed, allowed to stand for 15 days, and the meat, fish, &c. to be preserved immersed therein. An alternative plan is to paint the perishable articles with the mixture. However prepared, the materials to be preserved are powdered with a mixture of talc and maize flour "preferably of the second quality," and hung up until sufficiently desiccated. Powdered starch, wood ashes, and other absorptive substances may be substituted, and desiccation aided by causing a current of air to circulate round the objects to be preserved. The constituents and proportions of the first bath may be varied, and its use, though desirable, is not indispensable.—B. B.

Name and Origin of Wine.	Specific Gravity of the Mineral Ash.	Specific Gravity at 15.5° after Remoistening the Alcohol.	Specific Gravity at 15.5° of the Distillate.	Potassium Sulphate in 20 Grms. (Mean).	Alcohol per Cent. by Weight.	Extract (Calculated).	Extract Found.	Total Acid (Calculated as Tartaric Acid.	Volatile Acid (Calculated as Acetic Acid.	Non-volatile Acid (Calculated as Tartaric Acid.	Grape Sugar.	Glycerol.	Tartaric and Carbonic Acids.	Mineral Constituents.	Sulphuric Acid. In 100 cc.	Sulphuric Acid. In per Cent. of the Ash.	Phosphoric Acid. In 100 cc.	Phosphoric Acid. In per Cent. of the Ash.	Chlorine. In 100 cc.	Chlorine. In per Cent. of the Ash.	Acetic Acid. In per Cent. of the Ash.	Acetic Acid. In 100 cc.	Grms. K_2SO_4 corresponding to H_2SO_4 found in 1 Litre.
1. Costa Rotonda Bianco	0·1650	1·0000	1·0000	0·0	11·91	··	2·47	0·63	0·11	0·51	··	1·02	0·0276	0·0559	22·33	0·0125	13·37	0·0075	0·0023	1·37	0·0	0·0	0·0	1·1217
2. La Mancha Liste Rosse	0·1650	1·0007	1·0007	0·0	11·91	··	2·26	0·63	0·11	0·45	··	0·91	0·0244	0·0494	30·58	0·0151	13·37	0·0066	0·0033	1·63	0·0	0·0	0·0	1·0991
3. Marsala Italia	0·1650	1·0014	1·0014	0·0	10·15	··	3·01	0·63	0·13	0·49	··	1·22	0·0276	0·0494	28·57	0·0141	13·37	0·0066	0·0033	1·63	0·0	0·0	0·0	1·1084
4. Vittoria Pesto, No. 1	0·1650	1·0004	1·0004	0·0	9·70	··	2·72	0·63	0·13	0·49	··	1·22	0·0276	0·0553	24·15	0·0133	13·37	0·0066	0·0033	1·63	0·0	0·0	0·0	1·1239
5. Vittoria Pesto, No. 2	0·1665	1·0005	1·0004	0·0	10·00	··	2·95	0·63	0·13	0·49	··	1·22	0·0276	0·0553	24·15	0·0133	13·37	0·0066	0·0033	1·63	0·0	0·0	0·0	1·1239
6. Vittoria Pesto, No. 3	0·1650	1·0005	1·0004	0·0	10·00	··	2·95	0·63	0·13	0·49	··	1·22	0·0276	0·0553	24·15	0·0133	13·37	0·0066	0·0033	1·63	0·0	0·0	0·0	1·1239
7. Barolo vecchio	0·1650	1·0006	1·0006	+ 0·3	10·15	··	2·72	0·63	0·13	0·49	··	1·22	0·0276	0·0553	24·15	0·0133	13·37	0·0066	0·0033	1·63	0·0	0·0	0·0	1·1239
8. Barolo extra	0·1665	1·0008	1·0008	+ 0·12	9·85	··	2·58	0·72	0·11	0·59	··	1·48	0·0276	0·0553	24·15	0·0133	13·37	0·0066	0·0033	1·63	0·0	0·0	0·0	1·1239
9. Falerno	0·1672	1·0024	1·0024	− 0·37	11·41	··	3·32	0·95	0·19	0·76	··	1·91	0·0276	0·0553	24·15	0·0133	13·37	0·0066	0·0033	1·63	0·0	0·0	0·0	1·1239
10. Chianti extra vecchio	0·1667	1·0005	1·0006	+ 0·3	9·85	··	2·58	0·69	0·11	0·53	··	1·32	0·0276	0·0553	24·15	0·0133	13·37	0·0066	0·0033	1·63	0·0	0·0	0·0	1·1239
11. Costa di Romani Rosso	0·1643	1·0005	1·0005	+ 0·06	9·85	··	2·57	0·63	0·11	0·51	0·26	1·03	0·0244	0·0494	24·13	0·0125	13·37	0·0066	0·0033	1·63	0·0	0·0	0·0	1·1084
12. Lacrima Christi Rosso	0·1650	1·0004	1·0004	+ 0·3	10·00	··	2·64	0·72	0·12	0·60	··	1·44	0·0276	0·0553	24·15	0·0133	13·37	0·0066	0·0033	1·63	0·0	0·0	0·0	1·1239
13. Malvasia	0·1662	1·0008	1·0008	+ 0·6	11·41	1·85	3·53	0·82	0·15	0·66	1·09	··	··	··	24·34	0·0129	13·37	0·0071	0·0033	1·75	0·0	0·0	0·0	1·1239
14. Marsala	0·1645	1·0029	1·0029	− 2·24	11·41	0·50	6·15	0·54	0·11	0·43	2·93	··	··	··	21·86	0·0115	13·37	0·0066	0·0033	1·63	0·0	0·0	0·0	1·1084
15. Marsala vecchio	0·1665	1·0038	1·0038	− 2·26	11·41	0·83	6·30	0·54	0·11	0·43	3·26	··	··	··	21·86	0·0115	13·37	0·0066	0·0033	1·63	0·0	0·0	0·0	1·1084
16. Marsala extra	0·1676	1·0028	1·0028	− 2·28	11·93	7·62	7·35	0·93	0·13	0·80	3·85	··	··	··	23·22	0·0121	13·37	0·0066	0·0033	1·63	0·0	0·0	0·0	1·1239
17. Moscato	0·1695	1·0029	1·0029	− 2·24	11·91	1·71	4·10	0·90	0·16	0·74	2·68	1·22	0·0345	0·0622	29·49	0·0154	13·37	0·0071	0·0033	1·75	0·0	0·0	0·0	1·1239
18. Amarone	0·1691	1·0032	1·0032	− 2·43	11·93	2·02	5·20	0·84	0·16	0·68	3·55	1·52	0·0414	0·0829	23·10	0·0120	13·37	0·0066	0·0033	1·63	0·0	0·0	0·0	1·1084
19. Vino dolce Bianco	0·1625	1·0026	1·0026	− 2·0	13·41	1·53	12·19	0·44	0·13	0·38	11·25	··	··	··	19·36	0·0087	4·52	0·0020	0·0009	0·27	2·22	1·000	0·45	0·1338

An Improved Process and Apparatus for Preserving Meat and other Alimentary Substances. G. Dosmond and F. Rozes, Paris, France. Eng. Pat. 3995, March 14, 1890. 6*d*.

Charcoal, coal or other suitable carbonaceous material is heated in a retort and the gases evolved passed through a refrigerator into a "clearing chamber" and thence to a gas-holder, whence they are pumped as required into vessels containing the meat or other matter to be preserved. The conservation of perishable foods is said to be complete and the appearance after removal from the preserving chamber unaltered. Vessels filled with the preservative gases can be used for the transport of perishable substances.—B. B.

Improvements in the Manufacture of Ferments, Peptones, and Peptonised Food Products. O. Imray, London. "From The Mosquera Julia Food Co.," Detroit, U.S.A. Eng. Pat. 19,178, November 25, 1890. 4*d*.

Plants of the *Bromeliaceas* family (of which the pine-apple is the best known type), contain, it is said, a ferment whose action upon albumen or albuminoids is analagous to the action of pepsin, and which can digest them in the same manner. Its action upon some albuminoids appears to be even better than that of pepsin. The active substance may be prepared by expressiog the juice from pine-apples free from rind, filtering it, and evaporating the filtrate *in vacuo* at a temperature below 45° C. When concentrated it is purified by precipitation with salt or by dialysis, to free it from inert saccharine matter, after which it may be obtained as a paste, powder or "scale-compound."

Other portions of the plant contain the ferment but in less quantity than the juice.

Peptonised foods may be prepared by digesting albuminoids sueh as are contained in lean meat with pine-apple juice, the proportion being about 4 kilos. of meat (finely chopped) to 450 cc. of juice diluted with an equal bulk of water, at a temperature of 45°—50° C. for 3—4 hours, the mass being constantly stirred. The temperature is then raised to 60° C., solution being thereby completed.

Peptones may be prepared from this solution by dilution, filtration and evaporation at a temperature not exceeding 60° C. The product is pure and contains a high percentage of nitrogen, viz., about 11 per cent.—B. B.

Improvements in and relating to Sterilising Apparatus. E. Cohn, Berlin, Germany. Eng. Pat. 20,348, December 13, 1890. 8*d*.

The apparatus described is designed so that the bottles or other vessels containing the substance to be sterilised can be closed by mechanical means, either synchronously with the opening of the sterilising oven or at a definite period before or afterwards. According to Koch, "complete sterilisation is only possible when the vessels are closed by streaming vapours," and the object of the patentee is to secure such "streaming" at the time of closing the vessels with sterilised contents.

Various simple mechanical devices for this purpose are figured and described. Generally speaking the mechanism actuating the lid or door of the sterilising chamber is coupled to a bar acting upon the closing-pieces of the bottles. By varying the position of the opening bar or lever relating to that effecting the closure of the bottles, the two operations can take place successively, either being in advance of the other as may be desired or synchronously.—B. B.

Improvements in the Process of and in the Apparatus for Preserving Articles of Food. L. Bregha, Vienna, and F. Breza, Krems, Austria. Eng. Pat. 20,946, December 23, 1890. 6*d*.

The process patented consists in preserving perishable articles of food by coating them with a layer of coagulated albumen by exposure to the vapour of glacial acetic acid. The process is conducted in a closed vessel with a perforated false bottom, below which is a layer of felt or sponge saturated with the acid. The cover being adjusted a valve-cock attached to the cover is allowed to remain open until the vapours of the glacial acetic acid commence to escape through the same. This is certain proof that the air is entirely driven out. The cock is then closed and the materials to be preserved are exposed to the action of the unmixed acid.—B. B.

(*B.*)—SANITARY CHEMISTRY.

PATENT.

On the Improvement of Inferior Brewing Water by Sand Filtration. W. Schultze. Allgem. Zeits. f. Bierbr. u. Malzfabr. 1891, **19**, 1.

A water from a cleanly-kept well had a conspicuously bad taste, although it appeared clear as seen in a drinking glass, and a chemical analysis afforded no evidence of substances capable of affecting the taste of the water injuriously. The cause was ultimately found in the presence of a trace of very finely-divided clay which became visible when the water was placed in a long tube, and was removed by slow passage through a sand filter, after which the water acquired a mild normal taste. An examination of 48 waters conducted in the same way showed the presence in all of the same kind of impurity and demonstrated the improvement effected by suitable filtration through sand, and a consequent improvement in the taste of the beer brewed with it. Such filtration was also effectual in reducing the number of germs in a contaminated water from 5,000 bacteria to 8 spores per cc. It is essential that the filtration should be slow, as a rapid filtration can make the water worse by detaching accumulated bacteria from the filtering substance. An arrangement of plant is described for conducting the filtration on a large scale.—G. H. B.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES AND EXTRACTS.

Contributions to our Knowledge of the Aconite Alkaloids. Part I. On the Crystalline Alkaloid of Aconitum Napellus. W. R. Dunstan and W. H. Ince. Proc. Chem. Soc. 1890—1891, No. 95, 36—38.

The authors have investigated the properties of a crystalline alkaloid obtained from the root of *Aconitum napellus* by extraction with amyl alcohol, as suggested by the late Mr. John Williams. For a supply of the material they were indebted to the kindness of Messrs. Howards and Sons, of Stratford.

The yellowish indistinct crystals melted at 188·4° (corr.). The original substance appears to have the formula $C_{33}H_{45}NO_{12}$, which is that proposed for aconitine by Wright and Luff (Trans. Chem. Soc. 1879). The alkaloid was purified by repeated crystallisation from a mixture of alcohol and ether, or more readily by conversion into its bromhydride and regeneration of the alkaloid from the salt, or by regeneration from its crystalline aurichloride. It crystallises in tabular prisms belonging to the rhombic system. The crystals are very slightly soluble in water and light petroleum, more soluble in ether and alcohol, most soluble in benzene and chloroform. They melt at 188·5° (corr.). Contrary to the statements of previous observers, who found aconitine to be lævo-rotatory, the authors found an alcoholic solution to be *dextro-rotatory* $[\alpha]_D + 10·78°$; the aqueous solution of the bromhydride is, however, lævo-rotatory, $[\alpha]_D - 30·17°$. On analysis, the alkaloid afforded results which agree best with the formula $C_{33}H_{45}NO_{12}$.

Two crystalline *aurichlorides* were obtained. One melting at 135·5° (corr.) ($C_{33}H_{45}NO_{12}HAuCl_4$); the other, a basic aurichloride ($C_{33}H_{45}NO_{12}AuCl_4$) melting at 129° (corr.).

These compounds are obtained without difficulty, and afford trustworthy means of identifying aconitine. The alkaloid may be readily recovered from them in a pure state.

Aconitine is not appreciably affected by heating at a temperature below its melting point, but at this temperature it is gradually converted into the uncrystallisable base aconine. Prolonged boiling in aqueous solution induces a similar change, but not to the same extent unless an alkali is present. Boiling with water acidulated with hydrochloric acid also produces decomposition of the alkaloid.

Dehydraconitine or *apo-aconitine* may be readily procured by heating aconitine with saturated aqueous tartaric acid in closed tubes, as recommended by Wright and Luff. The crystals of this substance melt at 186·5 (corr.). It forms crystalline salts, and in other respects closely resembles the parent alkaloid. The results of analyses agree well with the formula $C_{33}H_{43}NO_{11}$.

An *amorphous base* was obtained from aconitine, together with benzoic acid, by prolonged heating with water in a closed tube, and appears to be identical with the *aconine* of Wright and Luff. The same substance is formed together with a resinous substance when aconitine is heated with an alkali.

In subsequent discussion Dr. Alder Wright said it was greatly to be regretted that preparations were largely sold under the name of aconitine of which only a very small fraction actually was aconitine, the greater part consisting of relatively inert, other alkaloids. Dr. Thudichum referred to the uncertainty and danger attending the use of "aconitine" owing to absence of uniformity in the products of English, French, and German manufacture. A final determination of the properties and mode of preparing the active principles of the various kinds of aconite would, he said, be a work of great value.

Professor Dunstan said that all the commercial aconitines were more or less impure, chiefly from the presence of amorphous alkaloid, which appeared to be non-toxic. Dr. Waller, of St. Mary's Hospital, intended to fully examine the alkaloids contained in *A. ferox* and *A. saponicum*.

Lavender: Its Cultivation and Distillation. J. C. Sawyer. Chem. and Drug. 1891, **38**, 397—400.

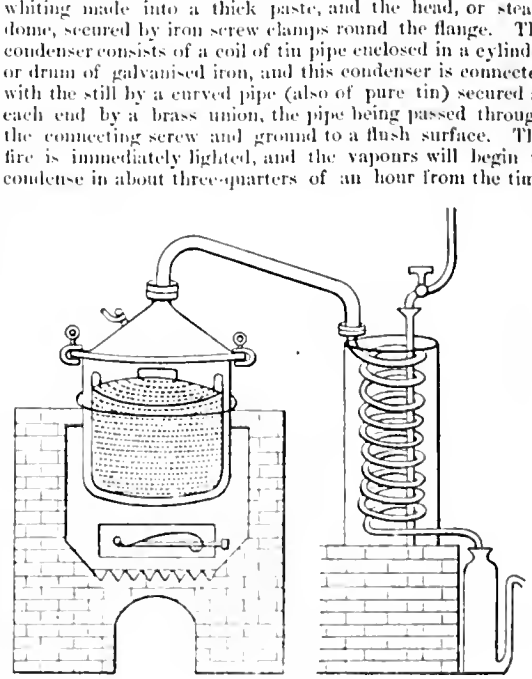
The principal lavender plantations are in the districts of Mitcham, Carshalton, and Beddington in Surrey, Hitchin in Hertfordshire, Grove Ferry near Canterbury in Kent, and until recently, at Patcham in Sussex. The Surrey and Hertfordshire plantations are situated on the outcrop of the chalk which surrounds the London basin. The most suitable conditions of soil are found to be light brown loam over chalk—the depth of the loam being very slight, varying from 6 to 18 inches.

The Harvest depends upon the season; white frosts in May retard the growth (especially of plants near overhanging trees), but black frosts do not so injure them. As a general rule the harvest may commence the first week of August if the weather be dry. The cutting usually commences as early as possible in the morning, before the dew is off. Flowers so cut seem to yield more oil than those cut in the heat of the day, but the necessity of getting the whole lot cut quickly, when once ripe and ready, requires cutting to go on all day long, unless many men be employed. In wet weather none should be cut.

The spikes when cut should be kept as much as possible straight together in large bundles and carried near to the stillery, being laid on the ground in the shade in long rows. Some growers allow these heaps to sweat (or partly ferment and partly dry) for some little time before distilling. This is quite a mistake—the oil already exists in purity in the ducts of the flower, and is not an after-product or a "ferment oil," *i.e.*, not an oil produced by after fermentation of the vegetable juices. If the oil as it exists requires oxidation, it is preferable to allow that process to take place after distillation, and not in presence of organic matters which may act injuriously upon it.

The distillatory apparatus may be varied in form according to the amount of work to be done, &c., but the main principle applies in all cases. The body of the still should be very shallow compared with its diameter, otherwise the steam generated at the commencement of the operation, in the lower part of the charge, would condense in its upper part and remain there until volatilised a second time by the rising heat. The less time the oil is subjected to the action of heat the finer its aroma will be.

The basket in which the flower is packed is a copper cylinder, three-fourths the depth of the body of the still; it is perforated at sides and bottom with holes of one-eighth of an inch diameter—to allow free circulation of water. It is provided with a copper lid similarly perforated, and has a lug or ring on each side to allow of its being lifted in and out of the still; this is done by overhead differential pulleys. The Tangye chain pulley can be used, or, for larger work, a swing crane, but several small stills are preferable, for many reasons, to one large one. The sketch shows the still without the pulleys. The copper basket fits within an inch of the still, at sides, and has three or four legs an inch long to rest it on the bottom of the still. The quantity of water put into the still should reach to within one-fifth the height of the basket. The flange at the top of the still is then spread with a lute composed of equal parts of flour and whiting made into a thick paste, and the head, or steam dome, secured by iron screw clamps round the flange. The condenser consists of a coil of tin pipe enclosed in a cylinder or drum of galvanised iron, and this condenser is connected with the still by a curved pipe (also of pure tin) secured at each end by a brass union, the pipe being passed through the connecting screw and ground to a flush surface. The fire is immediately lighted, and the vapours will begin to condense in about three-quarters of an hour from the time



Distillation of Lavender.

of lighting; this is ascertained by feeling the connecting pipe. A copious supply of cold water is then turned into the condenser (which was previously filled); this descends by a piece of zinc pipe to the bottom of the condenser, and the overflow of heated water is carried off at the top into a gutter. The condensed oil and water are collected in a Florentine receiver, the oil, of course, floating on the top and the waste water escaping into a waste pipe. The whole of the oil, or the finest part of it, will condense during the first twenty minutes or so of the upper part of the condensing worm becoming hot; this can be verified by watching the receiver and noting the depth which the oil attains on the surface of the water. The last oil which condenses is slightly inferior and it is not advisable to collect it with the first portion. This is managed by substituting another receiver towards the end of the operation. The flow of cold water through the condenser can then be stopped and the furnace door opened to damp the draught. The connecting pipe should be carefully unscrewed with a spanner,

detached, and the clamps removed. The steam dome is then lifted off, and the cylinder with its contents hauled out by the overhead tackle, which hooks on to the lugs by chains. The great weight of this is easily pulled up if differential pulley blocks are used, and, being raised out of the boiling water above the edge of the still, is dragged aside by another rope hooked on to it, and lowered into a barrow or truck. The spent flower is stacked in a heap to rot. The use of the perforated basket is two-fold—first, it enables the operator to pull out the charge clean, all at once, without drawing the fire, so that the still is ready for a fresh charge; second, and most important, it prevents the flower from scorching by contact with any part of the still.

The oil which has collected on the surface of the water in the Florentine receiver is drawn off by a pipette and put into a large bottle to clarify, or deposit watery particles mechanically held in solution. The clear oil is afterwards poured into Winchester quarts, which should only be filled to within 1 inch of the top (not counting the neck); the oil, being expansive on increase of temperature, would otherwise overflow. The oil as first collected has a very slight empyreumatic odour; this is prevented as much as possible by the flowers being enclosed in the inner cylinder to avoid contact with the sides of the boiler. There is also a herby odour noticeable in freshly-distilled oil. If the bottles be put in a very cool place, in the dark, and left *uncorked*, but loosely plugged with cotton-wool, these odours will pass off in about two months. Preferably the bottles should be placed in vessels of cold water up to the neck.

The herby odour is probably due to particles of water of vegetation being held in suspension or in solution. It may be remedied by drying the oil with calcium chloride.

Spirits of wine should not be added to *new* oil; it would cause a slight etherification, the odour of which is very unpleasant.

Oil of Lavender.—The newly-distilled oil is almost colourless, or very pale straw-colour, when viewed in bulk. It is mobile, lighter than water, and of a specific gravity of about 0·876 to 0·880, the lightest and most fragrant, having the lowest boiling point, being the first to come over from the still. It appears to be a mixture, in variable proportions, of oxygenated oils and a hydrocarbon, $C_{10}H_{16}$. It contains in solution a stearoptene, or body identical with camphor.

The oil improves or mellows (like brandy or wine) by keeping. This improvement is distinctly noticeable during the first five years, after which, unless kept under exceptional conditions, it deteriorates, oxidises, and resinifies; this can be prevented by admixture of 20 per cent. of grape-spirit.

Re-distillation or rectification is said to improve the quality, but this is very questionable. The author thinks the less it is submitted to the action of heat the better. However, if he wished to rectify it, the first step would be to wash it thoroughly by agitation with an equal volume of cold water in which a little carbonate of magnesia had been mixed, allow it to rest in a cool place to separate, then draw off the supernatant oil, and distil it with an equal bulk of fresh water in a vacuum still at a low temperature, the heat being applied by a steam jacket, and the distillate collected in two portions, the first four-fifths being retained, and the remaining fifth kept apart as inferior.

By reason of its high price, the English oil of lavender is frequently met with in commerce adulterated largely with the French oils of *L. vera* and *L. spica*. This can be detected by comparing a sample of known purity with the suspected sample. Apart from the keen sense of smell possessed by accustomed buyers (and acquired by experience), the boiling points, specific gravities, and optical effects under the polariscope (which are different with all these oils) can be observed.

When the density is below 0·87 there is reason to suspect adulteration.

The pure oil is completely soluble in three volumes of alcohol of a specific gravity of 0·894; a less solubility indicates that it contains oil of turpentine.

The presence of alcohol may be detected by agitating the oil with a few small pieces of dried calcium chloride; these remain unaltered in a pure essential oil, but dissolve in one containing alcohol, and the resulting solution separates, forming a distinct stratum at the bottom of the vessel. When only a very little alcohol is present the pieces merely change their form, and exhibit the action of the solvent on their angles or edges, which become more or less obtuse or rounded.

Santaline (the yellow colouring matter of santal-wood) is nearly insoluble in pure oil of lavender, and exerts no marked influence on it, but it is freely soluble in oil of lavender adulterated with alcohol or rectified spirit.

By distilling in a water-bath any essential oil which has a higher boiling point than spirit, it is certain that if spirit be mixed with it as an adulterant, the spirit will be the first liquid condensed in the receiver (with only a trace of oil). This spirit may be recognised by the smell and taste; should, however, a doubt exist, add to the distillate a little acetate of potash and strong sulphuric acid, when, on heating, acetic ether is formed if alcohol were present. The presence of fatty oils may be readily detected by placing a drop of the suspected oil on a piece of white paper, and exposing it for a short time to moderate heat; if the oil is pure it will entirely evaporate, but if adulterated with a fixed oil a greasy or translucent stain will be left on the paper. Fixed oils will also remain undissolved when the oil is agitated with three times its volume of rectified spirit.

Lavender Perfumery Formulæ.—Oil of lavender enters into the composition of many perfumes, but its principal use is for the manufacture of "lavender water." This consists of a solution of the volatile oil in spirit of wine, generally with the addition of a little essence of musk or ambergris, to "fix" the perfume, and a little rose-water or orange-flower water to soften it. There are various formulæ, scarcely any two manufacturers adopting precisely the same—oils of rose, bergamot, neroli, cloves, rosemary, &c. being blended in according to taste. The manufacture of good lavender-water is an art of itself, and one of the main secrets in this art is to employ *pure* materials of the finest quality. The spirit employed should be pure French grape-spirit, unadulterated with the spirit from beetroot, potato, or corn. Most of the lavender-water vended by chemists and druggists is a very inferior compound of French oil, English spirit, and cheap civet, with sometimes the addition of oils of geranium and bergamot.

Synthesis of Citric Acid. A. Haller and A. Held. Monit. Scient. 1890, 1221—1225.

This acid was first made synthetically by Grimaux and Adam (Compt. Rend. **90**, 1252), afterwards by Kekulé (Ber. **13**, 1686), and again by Dunschmann (Inaug. Dissert. Erlangen, 1886). Grimaux and Adam took symmetric acetone dichloride as their starting point; Kekulé made it from malic acid; and Dunschmann began from acetone dicarbonate. The last method was, strictly speaking, not a perfect synthesis because, up to the present time, acetone dicarbonate has only been made from citric acid itself, by treating the latter with concentrated sulphuric acid.

The authors have made citric acid, starting from the ether of aceto-acetic acid. This ether was first chlorinated, forming γ-chloro-aceto-acetic ether. By the action of potassium cyanide upon this, the chlorine was displaced by CN, forming γ-cyano-aceto-acetic ether. By saponification this body was then converted into the ethyl ether of acetone dicarbonate.

The following equations indicate the above reactions:—

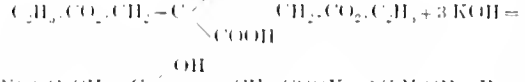
1. $CH_3.CO.CH_2.CO_2.C_2H_5 + Cl_2 =$
Ethyl-aceto-acetate.

$CH_2Cl.CO.CH_2.CO_2.C_2H_5 + HCl$
γ-chloro-aceto-acetic ether.

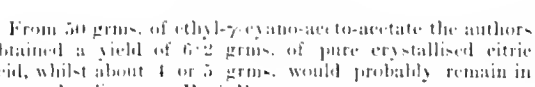
2. $CH_2Cl.CO.CH_2.CO_2.C_2H_5 + CNK =$
$CH_2CN.CO.CH_2.CO_2.C_2H_5 + KCl$
γ-cyano-aceto-acetic ether.

3. $CH_2CN.CO.CH_2.CO.C_2H_5 + C_2H_5OH + HCl + H_2O =$
$C_2H_5.CO_2.CH_2.CO.CH_2.CO_2.C_2H_5 + NH_4Cl$
Ethyl-acetone-dicarbonate.

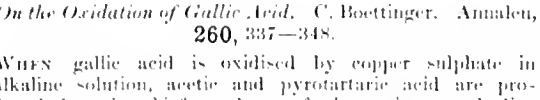
The ethyl acetone dicarbonate thus obtained was then converted into the cyanhydrine by the action of hydrocyanic acid, and this, by hydrochloric acid, into ethyl citrate, which, by treating with KOH, yielded potassium citrate, as shown in the following equations :—



Cyanhydrine of ethyl-acetone-dicarbonate.



Ethyl citrate.



Potassium citrate.

From 50 grms. of ethyl-γ-cyano-aceto-acetate the authors obtained a yield of 6·2 grms. of pure crystallised citric acid, whilst about 4 or 5 grms. would probably remain in the mother-liquors.—H. S. P.

On the Oxidation of Gallic Acid. C. Boettinger. Annalen, **260**, 337—348.

When gallic acid is oxidised by copper sulphate in alkaline solution, acetic and pyrotartaric acid are produced, but the chief products of the action are bodies which combine with phenylhydrazine, and which are insoluble or very slightly soluble in water.

Gallic acid is boiled for half an hour with an alkaline solution of copper sulphate, the thick dark brown liquid deposits a fine precipitate. The filtered solution is acidified with sulphuric acid, and distilled; a small quantity of volatile acid passes over, which consists chiefly of acetic acid, accompanied by a small quantity of what is probably pyrotartaric acid.

The concentrated residue deposits a large quantity of sodium sulphate. The mother-liquor is shaken with one quarter its volume of acetic ether. A black mass resembling carbon is not taken up by the ether and a further quantity of sodium sulphate is deposited. The ethereal solution is separated and filtered, and the acetic ether distilled off. The residue is boiled repeatedly with water to drive off the volatile acids, although, owing to decomposition, this could not be completely done, and was then neutralised with lime water, whereby soluble and insoluble lime salts are obtained.

The insoluble salts contain, besides calcium carbonate, calcium oxalate and a calcium salt of an acid which the author has named gal acid (galsaure). This acid is not soluble in dilute hydrochloric acid, and is separated by taking advantage of this. It is hardly soluble in cold water, but easily in hot water, yielding a brown solution, which, however, does not deposit the substance on cooling, but this is brought about by the addition of a mineral acid. Nitric acid oxidises it to oxalic acid. Its elementary composition corresponds with the formula $C_{14}H_{14}O_{13}$ or $C_{14}H_{12}O_{12}$, and its derivatives indicate the formula $C_{14}H_{10}O_{12}$ or $C_{14}H_{12}O_{12}$. A lead salt is obtained by adding lead acetate to a solution of the acid; it forms a powdery precipitate, $C_{14}H_8Pb_2O_{12} + 3\frac{1}{2}H_2O$. A barium salt is prepared by precipitating a solution of the acid neutralised with ammonia with a solution of barium chloride; it forms a voluminous precipitate, which shrinks very much on drying (this is characteristic of the salts of this acid); its formula is $C_{14}H_8Ba_2O_{12}.2H_2O$. By the action of bromine on the acid in a cooled aqueous solution, a bromine derivative, $C_{14}H_4Br_4O_{12} + 4H_2O$, is obtained. When the action takes place at the ordinary temperature, a tetrabrominated compound is produced. The acid combines with hydroxylamine, and yields a nitrogenous compound, which, however, is not an oxime. With phenylhydrazine acetate it yields a brown substance.

Returning to the solution containing the soluble calcium salts, from which the calcium salt of gal acid had been separated. When this is boiled it throws down a precipitate which redissolves on cooling. This precipitate is a calcium salt; the free acid prepared from it has a formula $C_4H_4O_5$. The calcium salt has a composition $(C_4H_3O_5)_2Ca$. The barium salt is also precipitated on boiling its solution and redissolves on cooling. Phenylhydrazine acetate gives with it a yellowish-red compound.—A. L. S.

The Principal Constituent of Oil of Polei. M. Pleissner. Annalen, **262**, 1—37.

Spanish oil of polei, from *Mentha Pulegium* (Schimmel and Co.) is a light yellow or greenish, moderately thick liquid, with a smell recalling that of oil of peppermint. On distilling the oil (62 grms.) under the ordinary pressure considerable decomposition takes place, and below 212° only a small quantity (3 grms.) of a liquid, consisting principally of water, passes over; the fraction boiling at 212—216° weighs 50 grms., and consists principally of pulegon (see below); between 216—223° a small quantity (4 grms.) of a dark yellow liquid distils over and the brownish residue then left in the retort weighs 5 grms.

Pulegon, $C_{10}H_{18}O$, the principal constituent of Spanish oil of polei, can be obtained in a pure condition by fractionating the liquid, boiling at 212—216°, under a pressure of 60 mm. It is an agreeably-smelling oil with an odour somewhat like that of peppermint, and a specific gravity of 0·9323 at 20°; it is dextro-rotatory, turns yellow on keeping, even in closed vessels, and does not solidify in a freezing mixture of ice and salt. Pulegon is isomeric with camphor, and, like the latter, it shows the behaviour of a ketone; it combines with hydroxylamine, at the same time taking up the elements of one molecule of water yielding *pulegonoxime*, $C_{10}H_{18}O.NOH$, a crystalline compound, melting at 157°, which is levo-rotatory $[\alpha]_D = -83°44'$.

Pulegonoxime combines with benzoic chloride to form a crystalline ethereal salt of the composition—

$$C_{10}H_{18}O.NO.CO.C_6H_5$$

which melts at 137—138° with decomposition, and with acetic chloride, the oxime also gives a crystalline compound which melts at 119°, and has the composition—

$$C_{10}H_{18}O.NO.CO.CH_3$$

When pulegonoxime is heated with concentrated hydriodic acid and a little amorphous phosphorus until a reaction sets in and the mixture then kept for some time, it is converted into *pulegonamine*, $C_{10}H_{19}O:NH$, a compound which is isomeric with menthonoxime. Pulegonamine combines readily with benzoic chloride, yielding a crystalline benzoyl derivative, $C_{10}H_{18}ON.CO.C_6H_5$, and when boiled with concentrated potash it is converted into pulegon. When a well-cooled solution of pulegon in light petroleum is saturated with dry hydrogen bromide, and the solvent then evaporated at the ordinary temperature, a compound of the composition $C_{10}H_{18}O.HBr$ is deposited in small colourless crystals, melting at 10°5; this substance is reconverted into pulegon on treatment with silver or lead hydroxide, but when reduced with zinc dust and alcohol it yields an oil which has the same composition and almost all the properties of menthon; the only difference between this oil and levo-menthon which could be detected with certainty is a difference in the melting points of their oximes. When the menthon obtained from pulegon is treated with sodium, it behaves like the menthon prepared from menthol, and is converted into a mixture of isomeric menthols, from which by treating with benzoic anhydride, the benzoyl derivative of natural levo menthol can be obtained in large quantities.

Samples of pure Spanish polei oil (from *Mentha Pulegium*) can be distinguished from oils of less value by means of the crystalline oxime or hydrobromic acid derivative of pulegon; Algerian and American oils do not yield these compounds in a crystalline condition. The fact that menthol can be prepared from oil of polei, which contains neither menthol nor menthon, is perhaps also of interest from a commercial point of view.—F. S. K.

The Alkaloids of Delphinium Staphisagria. C. Stara-Stojanow. Pharm. Zeits. Russl. 1890, **29**, 641, 657, 673, 689; Chem. Zeit. Rep. **15**, 6.

To obtain the alkaloid of *Delphinium staphisagria* the seeds are ground to powder and extracted with 80 per cent. alcohol. After distilling off the greater portion of the alcohol the residue is treated with its own volume of water, when a resin separates out and the liquid forms two layers, one oily and the other aqueous. The alkaloids are chiefly contained dissolved in the fatty oils, from which they can be separated by shaking with water acidulated with sulphuric acid. The acid solution thus obtained is made alkaline with sodium bicarbonate and extracted with ether, the above aqueous solution being also worked up with it. The alkaloid *delphinine* separates first in beautiful crystals from the ethereal solution, whilst two other products—*delphisine* and *delphinoidine*—remain in solution.

Delphinine forms rhombic crystals melting at 191·8°. It has the formula $C_{31}H_{49}NO_7$. It gives no colour reactions, those stated by previous investigators being due to impurities in the commercial product. The sulphate and nitrate both form microscopic rhombic crystals.

Delphisine separates from the above ethereal solution before the other alkaloid, delphinoidine, and can be purified by washing with alcohol and recrystallisation from ether. It forms fine needles, almost insoluble in water, readily soluble in chloroform, and has the probable composition $C_{31}H_{59}NO_7$.

Delphinoidine is separated from the ethereal residue by concentrating it at 40° C. and then adding petroleum ether, when it is obtained as a white flocculent precipitate. When dry it forms a colourless powder, having a bitter taste, almost insoluble in water, readily so in dilute acids. It has the composition $C_{25}H_{42}NO_4$. Its haloid salts and also the nitrate are amorphous, and readily soluble in water.

—C. A. K.

The Colouring Matter of Red Carbolic Acid. E. Fabini. Pharm. Post. 1891, **24**, 2, 25, 41, and 105; Chem. Zeit. Rep. **15**, 25 and 45.

See under III., *page* 453.

A New Alkaloid from the Seeds of Conium maculatum. E. Merck. Chem. Zeit. Rep **15**, 25.

The highest boiling portions of crude conine contain a new base, which can be separated by repeated fractional distillations in vacuum and subsequent crystallisation. It crystallises in needles melting at 98°, and dissolves readily in alcohol, ether, and chloroform; it boils at 230°—233°, and has the composition $C_8H_{17}NO$. It is therefore isomeric with conhydrine, and the name pseudo-conhydrine has been suggested by Ladenburg, who has examined the alkaloid.

—C. A. K.

Muawinum, a New Alkaloid. E. Merck. Chem. Zeit. Rep. **15**, 25.

Muawinum is the name given to an alkaloid contained in the muawi tree, which is found in Mozambique. The rind of the tree is supposed to possess similar tonic properties to the sassy bark (*Erythrophloeum guineense*), but is quicker and more powerful in its action. The free alkaloid is amorphous and syrup-like, readily soluble in alcohol, ether, and chloroform, and closely resembling erythrophleïne. None of the salts have been obtained in a crystalline condition. The hydrobromide is a white powder, soluble in water, alcohol and chloroform. The physiological action is similar to, but not identical with, that of erythrophleïne.—C. A. K.

A New Codeïne Derivative. E. Merck. Chem. Zeit. Rep. **15**, 25.

In the preparation of apocodeïne a second crystalline base is formed which closely resembles codeïne. It is a strong base, and differs from apocodeïne in its power of crystallisation. It is distinguished from codeïne by its high melting point (182°), by being less soluble than codeïne in the ordinary reagents, in the crystalline form both of the free base and of its hydrochloride, and by its being precipitated by ammonia both from the hot and cold aqueous solutions of its salts in the form of small needles. Its physiological action is similar to, but less powerful than, that of codeïne, so that it does not appear likely to be of any therapeutical value.—C. A. K.

New Alkaloids from Sabadilla Seeds. E. Merck. Chem. Zeit. Rep. **15**, 48.

The author has isolated two new alkaloids, *Sabadine* and *Sabadinine*, from sabadilla seeds.

Sabadine is obtained pure by decomposing its nitrate with a solution of sodium carbonate and then extracting the separated base with ether. The freshly precipitated alkaloid dissolves readily in ether and crystallises from this solvent in short needles. In the crystalline condition the base is difficultly soluble both in water and in ether. The crystals melt with decomposition at 238°—240° C., whilst the portion of the same that dissolves in ether possesses no definite melting point and is left behind after evaporating off the ether in the form of a gum, which becomes crystalline. The base crystallises best from alcohol, as a porcelain-like mass, melting at 238°—240°; a gum-like modification was observed in this case.

When the alcoholic solution is allowed to evaporate slowly, well-defined crystals are deposited. Sulphuric acid (conc.) first gives a yellow colouration with a greenish fluorescence, which latter gradually disappears, whilst the colouration changes to blood-red and then to violet. Concentrated nitric acid does not appear to effect any change. The base produces sneezing, but to a less marked degree than veratrine; its composition corresponds to the formula $C_{29}H_{51}NO_8$. The hydrochloride crystallises from water in white needles, containing two molecules of water of crystallisation which they lose at 101° C.

Sabadinine is got from the sulphate by decomposing it with sodium carbonate and extracting the base with either ether or chloroform. It separates from the former solvent, in which it is difficultly soluble, in the form of hair-like needles, which begin to melt at 160° and decompose gradually on further heating. The alkaloid is fairly soluble in water, readily so in alcohol. Concentrated sulphuric acid produces a stable blood-red colouration, whilst concentrated nitric acid is without effect. The base does not give rise to sneezing. Analysis points to one of the two formulæ $C_{27}H_{43}NO_4$ or $C_{27}H_{45}NO_5$. The hydrochloride forms well-defined crystals, which contain water of crystallisation and are readily soluble in cold water.

Both sabadine and sabadinine are characterised by remaining dissolved when separated from their salts by the addition of alkalis, alkaline carbonates, or ammonia, and only being precipitated, in a flocculent form, on warming the solution.—C. A. K.

Preparation of Bromoform. M. Denigés. Répert. de Pharm. 1891, **47**, 12.

One hundred cc. of soap-lye and 100 cc. of water are mixed together and 20 cc. of bromine added. When the reaction has ended the mixture is treated with a sufficient quantity of acetone (10 cc.) to remove the yellow colour of the

hypobromite. A liquid, almost colourless layer of bromoform separates, which is separated, washed, and rectified. The portion of boiling point 148°—150° is pure bromoform. The yield is only 60—70 per cent. of theory, owing to some of the bromine being lost as bromide and bromate of sodium. The process is analagous to that of Snilliot and Raynaud for the preparation of iodoform (this Journal, 1889, 240 and 477).—C. A. K.

Californian Soap Plant. H. Trimble. Amer. Journ. Pharm. 1890, **62**, 600.

The Californian soap plant (*Chlorogalum pomeridianum*) belongs to the natural order *Liliaceæ*, and is found on the Pacific coast between Oregon and Central America. The tubers of the plant produce a lather when placed in water and are greatly valued by the Indians and Mexicans as a substitute for soap. This property is due to the presence of saponin in the tubers, which in the dried state contain up to 6·95 per cent.; they also contain a red-brown crystalline glucoside which is soluble in water and may be extracted with ether.—C. A. K.

The Preparation of Aurous Chloride. J. Löwe. Dingl. Polyt. J. **279**, 167.

The author finds that a solution of auric chloride when evaporated to dryness on the water-bath always gives a small quantity of metallic gold, the amount depending upon the time the operation lasts. He ascribes this to the formation of aurous chloride, which decomposes in contact with water into auric chloride and metallic gold. If a solution of pure auric chloride be heated uninterruptedly on the water-bath in a porcelain basin, a brown deposit will separate. This increases according to the length of time the heating is continued. Whilst the solution darkens from the formation of this deposit, dull dark brown crystals, probably of auro-auric chloride, appear, and after some time the whole contents solidify and form a dark half-amorphous, half-crystalline mass. On further heating light yellow points appear on the dark residue and these gradually pass into a light yellow powder of aurous chloride. The conversion of auric into aurous chloride takes place only slowly at the temperature of boiling water; a gold chloride solution prepared by dissolving 4 grms. of pure metallic gold in aqua regia required several days' heating to completely convert it into aurous chloride.—J. B. C.

PATENTS.

Improvements in the Manufacture and Production of Hydroxyl or Peroxide of Hydrogen, and in the Apparatus Employed therein. F. Bale, Droitwich, and T. C. Sims, Cheltenham. Eng. Pat. 3628, March 7, 1890. 8*d*.

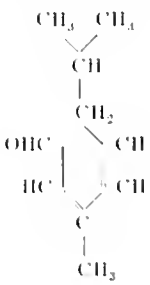
Barium carbonate, alone or mixed with charcoal, coke, or small coal, is heated in a retort or other suitable vessel to a white heat, whereby "carbonic acid and oxide of barium" are formed. A stream of air, steam or other gas may be passed over it to aid its decomposition. The resulting barium oxide is either allowed to cool somewhat in the same vessel or reheated to a lower temperature in another vessel, and air, preferably purified, or oxygen, is passed in, barium peroxide being formed. The product is suspended in ice-cold water and decomposed by a stream of carbon dioxide, which may be derived from the decomposition of another portion of barium carbonate in a second retort, or may be of extraneous origin. The precipitated barium carbonate is collected and used over again, starting, as before, with the preparation of barium oxide. The operation may thus be made continuous, and the barium carbonate used repeatedly.—B. B.

Improved Process and Apparatus for the Production of Oxygen Gas. R. D. Bowman, East Dulwich. Eng. Pat. 7851, May 20, 1890. 11*d*.

Powdered manganese peroxide is added to molten caustic soda with constant stirring until a granular plastic mass is obtained. This is then dusted over with black oxide of copper and heated to full redness in a current of air. The granulated fragments are placed in retorts arranged to work in two sets alternately, and air and steam alternately passed in. As the steam enters the first retort the oxygen which is first evolved and which is diluted with air passes through pipes to an automatic cock. This has only one delivery port whilst the shell has two, opening respectively to the by-passes connected to the two series of retorts. The impure mixture thus passes to the other series of retorts in which the oxygen is absorbed. The pure oxygen which is now coming off from the first series passes, owing to the continued automatic rotation of the cock, to the cooler and thence to the gas reservoir. As soon as all the oxygen has come off steam is cut off from the first series and air passed in, communication with the nitrogen exhaust being opened. Meantime steam is travelling through the second series and so the cycle of operations begin "de novo." It is claimed also that, by the partial oxidation and reduction thus employed, the form of the granules are much more permanent than if a complete conversion took place in each series of operations. The patentee makes no general claim to the production of free oxygen by the action of alternate currents of steam and air upon manganate of soda. For details of the apparatus the specification and drawings must be consulted.—S. G. R.

Erratum.

In April number of this Journal, page 382, bottom of second column; for the formula there given for Geranial substitute—



XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

Photography in the Colours of Nature. F. E. Ives. J. Franklin Inst. **131**, 1—21.

Heliochromic processes (processes of photography in natural colours) are of two kinds. In one the light itself produces the colours upon the sensitive plate. In the other, light does not produce colours, but regulates their distribution and combination.

The author refers to the results obtained by Seebeck in 1810, by Niepce de St. Victor, Becquerel and Zenker, and thinks that the older productions were better in colour. He comes to the conclusion that there is no scientific basis for a belief that any material improvement can ever be made in processes depending upon the production of colours by the light upon the sensitive plate.

The author then reviews the other kind of heliochromic processes and mentions a paper of H. Collen (British Journal of Photography, October 27, 1865), which he considers to

be a first step towards a solution of the problem of heliochromy, and amounting to a suggestion to make three photographic negatives, one by the action of red, one by yellow, and one by blue light. He then describes the process patented in 1868 by Ducos Duhauron, of Paris, very similar to Collen's, but no more practicable. The suggestions of C. Cros and Poirée, of Paris, of a similar nature could not be carried out, because no photographic plates were sufficiently sensitive to yellow, orange and red rays.

It was only the discovery of colour sensitisers by Vogel which supplied the means for carrying out either Collen's or Poirée's idea. Passing on to the progress made by Duhauron and Albert, the author mentions the attempt of F. Stolze to solve the problem by the use of three suitable selective colour screens in connexion with colour sensitive plates and of a fourth ordinary negative. The plan of Vogel to sensitise plates specially for each region of the spectrum is too complicated, and could not be carried out for want of the necessary dyes.

In February 1888 the author demonstrated a procedure based upon the observation that all the colours of nature can be counterfeited to the eye by three type colours, and mixtures thereof. The process was proved by photographing the spectrum. Promising results were obtained, but the solution of the problem was incomplete until a new principle was discovered which permitted to reproduce not only the spectrum, but also all the hues of nature. This new principle, first announced in November 1888, is that of making sets of negatives by the action of light rays in proportion as they excite primary colour sensations, and images or prints from such negatives with colours that represent primary colour sensations. The principle involves, according to Maxwell's measurements, the production of one negative by the joint action of the red, orange, yellow, and yellow-green rays in definite proportions to represent the red sensation, one by the joint action of the orange, yellow, green, and green-blue rays, in definite proportions to represent the green sensation and one by the joint action of the blue-green, blue, and violet rays, in definite proportions to represent the blue sensation.

Negatives of the required character can be made by exposing a Cyanine-stained gelatin-bromide plate through a double screen of Chrysoidine orange and Aniline yellow of suitable intensity for the red sensation, a Cyanine-erythrosin gelatin-bromine plate through a screen of Aniline yellow of suitable intensity for the green sensation, and an ordinary gelatin-bromide plate through a double screen of Crysophenin yellow and Methyl violet R R for the blue sensation.

The plates and screens are correct when they will secure negatives of the spectrum showing intensity curves substantially like the curves in Maxwell's diagram.

There are two ways of making the heliochromic pictures from these negatives. The first method does not produce a permanent picture, but a screen projection.

Lantern slides made from the heliochromic negatives and exactly reversing their light and shade must also represent the effect of the object upon the respective colour sensations. One lantern positive, when seen by transparency in red light, reproduces the effect of the object upon the primary red sensation. Another, viewed in the same manner by green light, reproduces the effect of the object upon the green sensation. The third, viewed by blue-violet light, reproduces the effect upon the blue sensation. Evidently, the combination of these three images into one must form a reproduction of the object as seen by the eye, correct in form, colour, and light and shade. Such a combination is effected by projecting the three pictures with a triple optical lantern so that they exactly coincide upon the screen.

The process is capable of giving results which are above criticism. The most serious objection to this method of solving the problem is that its only commercial value would lie in its application to the illustration of popular lectures.

In the projecting method, the luminous image is built by adding light to light. White light is produced by the mixture of the three coloured lights used for projection, and black by their suppression. But when by the process it is intended to produce permanent pictures, the paper which may form the basis of the picture is itself white, and it is the shadows that are built up by the superposition of colour prints.

Nevertheless, the colour print has exactly the same function to perform as the lantern positive, *i.e.*, to absorb and suppress, by its shading, light affecting one primary colour sensation. If three positives be removed from the lantern, the screen is evenly illuminated with white light. If the one representing the green sensation be replaced, its shadows will absorb the green light, with the result that the screen bears a picture in the complementary colour, pink, on a white ground. In the colour print method, the first step, a white surface, which corresponds to the fully illuminated screen, and the shadows of the colour print representing the green sensation, when laid upon this surface, absorb the same kind of rays as the shadows of the positive in the lantern, and with the same result, a pink monochrome picture on a white ground. Superposing the other two colour prints upon the first one on paper is like inserting the other two positives in the lantern. This explains why the primary sensations are represented by prints having shades of the complementary (absorbing) colour. It is the lights and not the shades of the colour prints that represent the effect upon the respective primary colour sensation. It is only necessary to use dyes that completely absorb red light, but neither green nor blue-violet for the print representing the red sensation, green but neither red nor blue-violet for the green sensation, blue-violet but neither red nor green for the blue sensation, in order to obtain from the author's negatives a colour print heliochrome that exactly fulfils all theoretical requirements, provided that it be examined in the same kind of white light that is obtained in the screen projections, by mixing red, green, and blue-violet rays. The dyes mentioned by the author in his paper of November 21st, 1888 (Prussian-blue, Magenta, and Aniline yellow), fulfil this requirement, and colour print heliochromes made therewith according to his instructions must, therefore, reproduce all the colours of nature under the conditions of illumination just stated.

This is, then, a theoretically perfect and, at the same time, practicable process of reproducing all the colours of nature in permanent prints from three negatives. Composite heliochromy must always remain a comparatively costly process when carried out in a manner calculated to yield the finest results, and can most profitably be brought before the public in the form of optical lantern lecture illustrations, not with the triple lantern, but with transparent colour print heliochromes mounted as lantern slides. If the colour prints are made by the Woodbury-type process, such heliochromic lantern slides, infinitely superior to hand-painted ones, can be made in quantity at a cost not exceeding one dollar each.—D. H.

Photography in Colours. G. Lippmann. Compt. Rend. **112**, 274—276.

The author has succeeded in photographing the image of the spectrum in its true colours, using only the sensitive substances, developers, and fixing agents hitherto employed for photographic purposes.

The sensitive film employed must be transparent and free from grain visible under the microscope, or if the film is granular to any extent, the size of the grains must be negligible in comparison with the length of a wave of light. For this reason ordinary photographic plates cannot be used, but the author has prepared plates employing albumen, gelatin, or collodion as the substratum and iodide or bromide of silver as the sensitive medium, which are almost transparent, possessing only a faint blue opalescence. The plate thus prepared is placed in contact with a reflecting surface of mercury in a suitably arranged cell, in which the film side of the plate is in contact with the mercury. The exposure, development, and fixing of the plate is conducted as usual, and the result, in the case of the spectral colours, is a coloured image which is permanent to the most intense lights. This image is a positive by reflected and a negative

by transmitted light. In the former case the original spectral colours are seen in their due order, in the latter each is represented by its complementary colour.

This result is due to the interference of the incident ray of light, and that reflected from the surface of the mercury, whereby a series of luminous maxima and dark minima are formed within the film. The maxima alone affect the plate so as to render the sensitive medium amenable to development, and at these points a deposit of metallic silver is formed after development. The film is thus divided up by a number of thin deposits of silver, separated from one another by the distance of the points of maximum action, that is, by the distance of half a wave length of the incident light. These deposits are therefore situated at exactly the distances required to produce the originally incident light when looked at by reflexion.

The colours are of the same nature as those of soap-bubbles, but they are purer and more brilliant when a good reflecting surface of silver has been got; this is essentially the case when the number of reflecting surfaces is large. A sensitive film $\frac{1}{20}$ mm. thick will contain about 200 thin deposits of metallic silver.—C. A. K.

XXII.—EXPLOSIVES, MATCHES, Etc.

PATENTS.

Improvements in Explosives. H. H. Lake, London. From S. H. Emmens, Emmens, Penn., U.S.A. Eng. Pat. 3852, March 11, 1890. *6d.*

The inventor steeps unsized paper or paper pulp for two minutes in the mixture of nitric and sulphuric acids used in the manufacture of gun-cotton, then washes it with cold water and places it in a solution of ammonium carbonate until effervescence ceases. The paper is then removed to another bath containing a strong solution of picric acid heated to 100° C., in which it is left for ten minutes. After removal from the picric acid solution it is exposed to the action of gaseous ammonia, when the adhering picric acid is converted into ammonium picrate. After drying the material is ready for use as an explosive.—W. M.

Improvements relating to the Manufacture of Explosives, and to Apparatus therefor. H. H. Lake, London. From H. S. Maxim, Vienna, Austria. Eng. Pat. 5209, April 3, 1890. *1s. 3d.*

This is a long and complex specification copiously illustrated by drawings. In the manufacture of nitroglycerin according to this invention the acids and glycerin are mixed by injectors operated by cold compressed-air, both liquids coming into contact when in the form of fine spray, and in the presence of air which is rapidly expanding, and being blown into and conveyed through a mixing pipe from 100 to 200 ft. in length and 1½ in. in diameter at the part surrounding the injector, increasing, about 20 in. from the injector to 3 in. in diameter. This part of the pipe is surrounded by a water jacket, and finally delivers into a tank containing a large quantity of water. The chemical reaction is completed during the passage of the liquids through the pipe, which has a fall of 1 in 15, and a jet of water is injected into the pipe just before the contents discharge into the tank containing the water.

When the space available is not sufficient for this long mixing pipe, the injectors are arranged over a tank containing the acid mixture which is drawn out of the tank and re-discharged into it, having in its course met with the glycerin in the form of fine spray. When cotton is being nitrated the material is fed in the form of long rolls to a carding wheel which revolves in the mouth of a tube communicating with an injector worked by cold compressed air. The suction draws the cotton in the form of single fibres into the acid.

Smokeless powder is produced by moistening the gun-cotton with ether, acetone or other suitable solvent and then mixing it with nitroglycerin previously mixed with castor oil. The mixture is then treated with acetone vapour in a chamber from which the air is exhausted. The material is then thoroughly kneaded in a special machine and afterwards pressed through suitable dies to form rods or strips of the desired shape.

The inventor states that explosive material composed of 75 parts of gun cotton, 24 parts of nitroglycerin, and 1 part of oil cannot be efficiently worked with rolls, when produced by the processes hitherto adopted, a much larger proportion of nitroglycerin being required to make the material soft enough to be worked; but according to this invention any desired composition can be made in such a manner that it can be easily worked between rolls.—W. M.

Improvements in Percussion Fuses. R. Low, London. Eng. Pat. 5535, April 11, 1890. *8d.*

This invention "relates to percussion fuses wherein an annular or tubular piece or guard is so fitted upon the needle, striker, or pellet that it will keep the needle and the cap or detonator out of contact with each other until the projectile or shell is discharged from a gun, when the said guard will be forced backward upon the needle or pellet by the shock of the discharge, so that both the said needle or pellet and the guard are free to move forward upon impact of the shell." The specification is illustrated by drawings.—W. M.

Improvements in the Manufacture of Explosives. C. O. Lundholm, Stevenston, Ayr, N.B., and G. H. Hosie, Saltcoats, Ayr, N.B. Eng. Pat. 7301, May 10, 1890. *4d.*

Nitro-cellulose, nitro-oxycellulose, or nitro-hydrocellulose is mixed with aniline, toluidine or other suitable amine, and after subjecting the mixture to heat and pressure it forms a clear celluloid mass which may be worked in various shapes. The amine may afterwards be dissolved out either wholly or in part, or other bodies may be incorporated with the explosive, such as potassium nitrate, hydrocarbons, and their nitro-derivatives, nitro glycerol and carbon.—T. A. L.

XXIII.—ANALYTICAL CHEMISTRY.

INORGANIC CHEMISTRY.—QUALITATIVE.

Boiler Feed-Water containing Magnesium Chloride. A. Goldberg. Chem. Zeit. **15**, 31.

See under I., *page* 118.

Action of Hydrofluoric Acid on Gutta-Percha. W. Hampe. Chem. Zeit. **14**, 1777.

Hydrofluoric acid gradually attacks gutta-percha, taking up organic matter and sometimes alkalis. Where the acid is used in the determination of ferrous salts in silicates, the results on titrating with permanganate will evidently be too high, after mixing the hydrofluoric acid and sulphuric acid in the process. Therefore, the author adds just sufficient potassium permanganate to colour, and then proceeds as usual. All error is best avoided by keeping the acid in platinum bottles.—T. L. B.

Sulphuretted Hydrogen Free from Arsenic. W. Hampe. Chem. Zeit. **14**, 1777.

For ordinary analytical purposes sulphuretted hydrogen may be freed from arsenic by passing through two or three wash-bottles containing a solution of caustic soda or sodium

sulphide. For special purposes the gas is best generated by the action of dilute sulphuric acid (1 to 10) on crystallised sodium sulphide free from arsenic.—T. L. B.

Freeing of Chlorine from Admixed Hydrochloric Acid. W. Hampe. Chem. Zeit. **14**, 1777.

This is sometimes done by passing the gas over heated manganese dioxide, but the author prefers to use a strong solution of potassium permanganate. The removal is declared to be complete.—T. L. B.

An Oxide of Gold. W. Hampe. Chem. Zeit. **14**, 1778.

Using a fine sheet of gold as positive electrode in a sulphuric acid or nitric acid solution, the author found that the same became coloured brown, and finally a reddish-brown powder fell to the bottom of the electrolysing dish. This was proved qualitatively to be a hydrate of gold formed by the oxidising action of the electrolytically-evolved oxygen. On drying over sulphuric acid, and then heating, it exploded violently.—T. L. B.

Silver Peroxide. W. Hampe. Chem. Zeit. **14**, 1779—1780.

By electrolysing a concentrated solution of silver nitrate the author obtained, as long ago as 1873, a crystalline deposit at the positive pole. A quantity of this crystalline body, which evolves a quantity of oxygen under water, was kept in a sealed tube. After some years the tube exploded, evolution of oxygen being doubtless the cause. The substance contains silver nitrate, which persistently remains in combination. The formula $AgNO_3.4\,AgO.aq.$ has been proposed, but this the author cannot accept as correct; he considers that a mixture of various bodies is present.

—T. L. B.

INORGANIC CHEMISTRY.—QUANTITATIVE.

A Study in Thermo-Chemistry; the Reduction of Metals from their Ores. W. N. Hartley. Scient. Proc. Roy. Dublin Soc. 1891, **7**, 35—42.

See under X., *pages* 467—468.

The Carbon of Spiegel Iron. B. Rathke. Ann. **260**, 333—337.

Berzelius has observed that when spiegel iron is dissolved by oxidising agents, there remains a residue closely resembling humic substance, inasmuch as it is acid and dissolves partly by alkalis to a brown solution. It appeared to the author that a further investigation of this residue would throw some light on the mode in which the carbon was combined with the metal. A ferro-manganese was employed containing 66 per cent. of manganese. The metal was finely powdered and oxidised with bromine in a flask with a condenser attached; the distillate contained, besides bromine, some carbon tetrabromide together with a little tetrachloride produced from chlorine present as an impurity in the bromine. The chief proportion of the carbon remained in the residue as a black powder, and was purified by treatment with hydrochloric acid. It was then carefully washed and dried; 30 grms. of ferro-manganese yielded 3·7 grms. of this residue. In appearance it resembled gunpowder, and coloured soda solution but slightly. It was digested with hydrofluoric acid, and washed until the wash-water gave no acid reaction, although the powder itself still continued to redden litmus paper. An analysis of the dried powder gave the following:—Carbon, 49·97 per cent.; hydrogen, 2·12 per cent.; bromine, 21·25 per cent.; chlorine, 1·47 per cent.; oxygen, 25·19 per cent. A weighed quantity of the purified powder was boiled with sodium carbonate and filtered. The filtrate was evaporated to dryness and ignited, and the bromine and chlorine in the residue determined; 13·94 per cent. of bromine and 1·58 per cent. of chlorine had been removed from the original substance.

The residue weighed 92·19 per cent. of the original substance, and contained: Carbon, 50·71 per cent.; hydrogen, 2·13 per cent.; bromine, 7·41 per cent.; sodium, 7·39 per cent.; oxygen, 32·36 per cent.

As it was possible that the sodium might be present as sodium bromide absorbed by the carbon, some of the original carbon was digested with a concentrated solution of sodium chloride, when it was found that practically none was absorbed by the carbon.—A. L. S.

Determination of Titanium in Ores. W. A. Noyes. J. Anal. and Appl. Chem. January 1891; Eng. and Mining J. 1891, 474.

For a quantitative determination by Weller's method (Ber. **15**, 2592), 0·1 grm. of the finely powdered mineral is mixed in a platinum crucible with 0·2 grm. of sodium fluoride, also finely powdered. 3 grms. of sodium pyrosulphate are then added without mixing. The mass is carefully fused and heated gently till effervescence ceases and copious fumes of sulphuric acid are evolved. This takes only two or three minutes. When cold the mass in the crucible is dissolved in 15 to 20 cc. of cold water and the solution filtered. The filtrate and washings need not exceed 30 cc. If a residue remains it can be treated again by the same method after burning the filter, but the amount of titanium found by a second fusion is usually very small.

To the solution 1 cc. of hydrogen peroxide and a few cc. of dilute sulphuric acid are added, and the colour obtained is compared with that of solutions containing known amounts of titanium. For a standard solution, titanic oxide is dissolved in hot concentrated sulphuric acid and the solution diluted till 1 cc. contains 1 mgrm. of TiO_2. In diluting it is best to use dilute sulphuric acid at first, to prevent the precipitation of titanic oxide.

The author cannot entirely confirm Weller's statement that the colours produced are not affected by small amounts of iron. He finds that even 2 mgrms. of ferric oxide in the form of sulphate have a very decided effect on the tints produced, especially when the amount of titanium is small. It is advisable, therefore, to add to the comparison tubes an amount of ferric sulphate corresponding approximately to that in the solution which is tested. A solution of iron ammonium alum answers well for this purpose, and all that is necessary is to match the colour of the solution of the mineral before adding hydrogen peroxide to it. If this be done, titanium can be readily determined in the presence of very considerable amounts of iron. Thus, 0·02 mgrm. of titanic oxide can be detected in 30 cc. of water in the presence of 0·1 grm. of ferric oxide in the form of sulphate. This would correspond to 0·02 per cent. for 0·1 grm. of a mineral.

A qualitative test for titanium can be made in five minutes as follows: Mix a little of the powdered ore with sodium fluoride, add sodium pyrosulphate and fuse as above. Cool by dipping the crucible in cold water. Add two or three cc. of dilute sulphuric acid and 10 cc. of water. Dissolve by boiling. Divide the solution into two portions, and to one add a few drops of hydrogen peroxide. A comparison with the solution to which no hydrogen peroxide has been added will show at once whether titanium is present or not.

This method works very well with magnetite and other iron ores.

Volumetric Determination of Oxygen by means of Nitrogen Oxide. L. de Koninck. Zeits. f. angew. Chem. 1891, 78—80.

This paper deals with Wanklyn and Cooper's (see also this Journal, 1890, 980) application of Priestley and Cavendish's method for estimating oxygen by means of nitric oxide. The author's investigations on this method lead him to the conclusion that it is inapplicable for analytical purposes,

the results varying between 77 and 122 per cent. of the theoretical quantity, and depending to a great extent on the quantity of the reagents employed.

A priori, a mixture of air and nitric oxide, in presence of water, should react according to the equation—

$$2\,NO + O_2 = 2\,NO$$
$$2\,NO_2 + H_2O = HNO_2 + HNO_3$$

And therefore the contraction following the mixing of the two gases will be the measure of the oxygen originally present, the disappearance of three volumes being equivalent to one volume of oxygen. However, the author's figures for contraction vary between 2·32—3·47 volumes when using air, 2·86—3·76 volumes when using oxygen containing 17·6 per cent. of nitrogen, and 2·93 volumes for pure oxygen. From these considerations, the reactions represented by the following equations become probable:—

$4\,NO + O_2 + 2\,H_2O = 4\,HNO_2$ (1 vol. O = 5 vols. contraction).

$4\,NO + 3\,O_2 + 2\,H_2O = 4\,HNO_3$ (1 vol. O = 2·33 vols. contraction).

In fact the presence of nitric oxide in the gas mixture is accompanied by an increase in the quantity of nitrous acid formed. In absence of nitric oxide, nitric acid alone is formed. Dilution with indifferent gases also favours the formation of nitrous acid.

The nitric oxide required is obtained from dilute nitric acid (sp. gr. 1·11) and copper foil, and the precaution is adopted of shaking the gas with water in the burette to absorb any nitrogen peroxide formed. Two Winkler-Hempel burettes, containing measured volumes of the gases, are then connected by means of a capillary tube filled with water, and the oxygen is thus introduced in the nitric oxide burette.—H. A.

A New Method for the Analysis of Silicates. P. Jannasch. Meeting of the Chemical Society, Heidelberg, January 23, 1891. Chem. Zeit. **15**, 150.

The powdered silicate is placed in a platinum vessel of special construction, moderately concentrated hydrochloric acid added, and the whole enclosed in a hard glass tube and heated at 190—200 for 10—15 hours. The details of the method will be given in a special communication. The advantages claimed for the method are a saving of time and also of substance, since the alkalis and other constituents can be determined in one and the same quantity of the substance.—A. K. M.

The Analysis of Chrome Iron Ore. R. Namias. Stahl u Eisen, 1890, **10**, 977.

One grm. of chrome iron ore is mixed with 8—10 grms. of acid sodium or potassium sulphate in a platinum crucible, and the whole kept in a state of fusion for one hour. 2—3 grms. more of acid sulphate are then added, after allowing to cool, and the heating continued for a few minutes. This second fusion suffices to convert any basic sulphates that may have been formed during the prolonged heating, into neutral sulphates. The melt is extracted with water and hydrochloric acid, and the silica separated as usual; if it contains any chromium, the fusion must be repeated. One-third of the filtrate from the silica is taken for the determination of the chromium. It is first neutralised with caustic alkali, and then treated with 0·5 grm. of magnesia, suspended in water and warmed. The precipitate, after being filtered, washed, and ignited, is fused in a platinum crucible with potassium chlorate and fusion mixture (potassium sodium carbonate), the melt extracted with water, and the solution of chromate thus obtained reduced and precipitated with ammonia.

To determine the manganese, one-tenth of the filtrate from the silica is tested colorimetrically, after removing the chromium by means of barium carbonate, the sulphuric acid present being first precipitated with barium chloride.

The iron is determined volumetrically by potassium permanganate. The colour due to the chromium salts does not interfere as long as the solution is sufficiently dilute.—C. A. K.

Arsenic in Phosphorus. W. Hampe. Chem. Zeit. **14**, 1777.

The author has found as much as 0·53 per cent. of arsenic in sticks of phosphorus.—T. L. B.

Estimation of Sulphur in Lead. W. Hampe. Chem. Zeit. **14**, 1778.

About 50 grms. of lead, in the condition of filings, are gradually added to 100 grms. of nitre, kept molten in a porcelain crucible. Oxidation is complete in about an hour, the mass being stirred from time to time. The melt is poured out, a current of carbon dioxide is then passed into hot water containing it, after which the whole is boiled up and filtered. The solution again has carbon dioxide passed into it to remove the lead completely, and the filtrate is then evaporated down on the water-bath. The nitrate is got rid of by hydrochloric acid in the usual way, and the sulphur determined as barium sulphate. Results obtained are reliable.—T. L. B.

The Employment of Bromic Acid in Quantitative Analysis. W. Feit and K. Kubierschky. Chem. Zeit. **15**, 351—352.

The use of bromic acid, more particularly, in volumetric analysis, is based on its great oxidising power; and on the fact that it liberates from potassium iodide an equivalent amount of iodine which may be accurately titrated with a standard solution of sodium thiosulphate. In effecting an oxidation bromic acid is reduced to bromine thus:—

$$2\,HBrO_3 = H_2O + Br_2 + 5\,O.$$

In practice a solution of potassium bromate is employed. 30 grms. of the salt are dissolved in about 300 cc. of water, and the solution is boiled with sufficient sulphuric acid to decompose any potassium bromide that may be present, in accordance with the equation—

$$5\,KBr + KBrO_3 + 3\,H_2SO_4 = 3\,K_2SO_4 + 3\,H_2O + 3\,Br_2$$

The solution is cooled and diluted to 1,000 cc. Two cc. of the solution are mixed with potassium iodide and sulphuric acid in excess, and the liberated iodine is titrated with sodium thiosulphate. The bromate is then further diluted so that 1 cc. of it equals 10 cc. of decinormal thiosulphate. In carrying out an analysis, an excess of bromate solution, acidified with sulphuric acid, is placed in a graduated flask, the solution of the body to be analysed is added, and the whole is boiled for five minutes to expel the liberated bromine. The liquid is cooled, diluted to the mark, and the residual potassium bromate is determined in an aliquot part of the solution in the manner indicated above.

The method is applicable to the estimation of sulphur in mono- and poly-sulphides, sulphurous, and thiosulphuric acids (all of which are completely oxidised to sulphuric acid), nitrous and oxalic acids, iron in ferrous salts, &c. It is hardly necessary to point out that the solution to be analysed must contain no chlorine, bromine, or iodine compounds. The test analyses given are quite satisfactory.—H. T. P.

The Estimation of Dissolved Oxygen in Water. W. Kisch. Zeits. f. angew. Chem. 1891, 105—108.

L. W. Winkler (this Journal, 1889, 727) gives a method of estimating dissolved oxygen in water. This has led the author to make a critical examination of the existing methods, viz., (*a*) the Bunsen-Tiemann, (*b*) Mohr's, and (*c*) the Schützenberger-Risler.

Three sets of experiments were made with each method on (1) water direct from the main; (2) the same water after agitation with air; and (3) distilled water after agitation with air; the result being that the author

considers Winkler's method to give good and accurate results, and in addition, to be the easiest and most reliable method. Methods (*b*) and (*c*) gave very similar results, while (*a*), the Bunsen-Tiemann, gave undoubtedly too low results, for which the author was unable to account.

He recommends Winkler's method as the most practical and simple for the estimation of dissolved oxygen in water. —D. A. S.

Determination of Albuminoid Nitrogen in Water. E. Wagner. Jour. Pharm. Chim. 1891, **23**, 5.

KJELDAHL'S method is well adapted for determining nitrogen in water, contaminated with animal refuse. To prevent loss of nitrogen through the action of free nitric acid on the organic substances, the water must first be deprived of this acid. This is effected by using Gladstone and Tribe's zinc-copper element, which reduces nitric acid to nitrous acid and finally to ammonia. Strips of zinc are dipped into a 3 per cent. copper sulphate solution washed with distilled water and dried as soon as there is a sufficient deposit of copper formed. Before use these strips are moistened with distilled water. About 500 cc. of the water to be analysed is filled into a glass-stoppered bottle, acidified with sulphuric acid, and about 25 sq. cm. of the element left in the water until metaphenylenediamine is no longer coloured yellow. After removing the strips, the water is evaporated to a small volume, filled into a 100 cc. flask with a long neck, and still further evaporated, until about 5 cc. are left.

On cooling ·05 grm. of cupric oxide and 10 cc. of a mixture of 6 parts of ordinary with 4 parts of fuming sulphuric acid are added and the mixture heated gently at first and finally boiled. The reaction is complete as soon as the liquid is coloured a clear green. Water is now added and a slight excess of a solution which contains 300 grms. of caustic soda and 350 grms. of seignette-salt in one litre; generally 60 cc. are sufficient to produce an alkaline reaction. The ammonia is then distilled off and titrated.—A. R.

ORGANIC CHEMISTRY.—QUALITATIVE.

Testing Ferrum Citricum Oxidatum. H. Warnecke. Pharm. Zeit. **35**, 784.

ACCORDING to the Pb. Germ. III. ferric citrate only gives a deep blue colouration and not a precipitate of Prussian blue on addition of potassium ferrocyanide to its aqueous solution; the precipitate only forms on the addition of hydrochloric acid. The addition of hydrochloric acid is also advisable in testing ferric citrate for ferrous citrate by means of potassium ferricyanide.—C. A. K.

Glycerinum. Ph. Germ. III. E. Ritsert. Pharm. Zeit. 1890, **35**, 802.

THE silver nitrate test for the purity of glycerol is conducted as follows:—A mixture of equal parts of the sample and of ammonia are heated to boiling, with constant stirring. The flame is then removed and the silver solution added, when there should be no deposition of metallic silver and no yellow colouration after standing for five minutes.—C. A. K.

Santonin. T. Salzer. Pharm. Zeit. **35**, 808.

SANTONIN (0·01 grm.) when shaken with 1 cc. of sulphuric acid and 1 cc. of water is said to give no colouration, but on addition of one drop of ferric chloride solution a violet colouration results. The author states that the addition of the acid always gives a yellow colour to the solution, and that the violet colouration only forms after boiling, this being probably due to the fact that the santonin must first be converted into iso-santonin before the reaction can take place.—C. A. K.

New Test for Sesamè Oil in Olive Oil. Lalande and Tambon. J. Pharm. Chim. [5], **23**, 234.

THE reaction with hydrochloric acid containing sugar being unreliable, the following is proposed:—15 cc. of oil are shaken up in a test tube for a couple of minutes with 5 cc. of colourless nitric acid of sp. gr. 1·4; a yellow colouration of the acid on settling indicates presence of sesamè oil. Olive oil, earth-nut oil, and cotton-seed oil leave the acid colourless. In some cases, as, for instance, with old olive oil used for machinery, a yellowish colouration may be obtained without sesamè oil being present. But if the nitric acid be carefully decanted and cleared, the presence of sesamè oil is confirmed by the formation of a turbidity on addition of water.—T. L. B.

Guaiacol. Pio Marfori. Gass. Chim. 1890, **20**, 537.

ONE part of guaiacol dissolves in 60 cc. of water, the solubility being decreased by any impurities present and by an increase in the boiling point of the substance. Heated with chloroform and solid caustic potash pure guaiacol gives a purple-red colouration, whilst the impure product gives a less marked reaction. With sulphuric acid (conc.) the pure product gives a stable purple-red colouration, but the least impurity detracts from the purity of the colour formed. 3—4 cc. of guaiacol given to a dog, appeared in the urine in the form of guaiacol-sulphuric ester.—C. A. K.

Testing Oil of Bitter Almonds. E. Merck. Chem. Zeit. Rep. **15**, 26.

THE author points out that the presence of chlorine in artificial benzaldehyde in the form of chlorinated products does not serve to distinguish it from the natural oil of bitter almonds, because the latter does at times contain chlorine compounds, whilst, further, the artificially prepared product is obtained to-day practically free therefrom. —C. A. K.

The Value of Furfuraldehyde (Furfurol) Reactions for the Detection of Fusel Oil in Spirits. Neumann-Wender. Zeit. f. Nahrungsmitkl-Untersuch. u. Hygiene, **5**, 1.

THE author's experiments on the subject point to the following conclusions:—

1. Jorissen's test is not sufficiently delicate, because it only indicates the small quantity of furfuraldehyde contained in the fusel oil. Also it is not reliable, because furfuraldehyde is formed in all fermentative processes, and passes over with the products of distillation. In cases of sweetened or coloured brandy, or when essences have been added, the product must be first distilled, and this renders the test useless.

2. The diamidobenzene reaction of Uffelmann is open to the same objections as the above, because it also is really only a test for the furfuraldehyde.

3. Muller's and also Ekmann's test for fusel oil is unreliable because ethereal oils and other admixtures also colour concentrated sulphuric acid, and therefore the comparison with the colouration produced with pure amyl alcohol is inaccurate.

4. Uffelmann's test by means of the spectroscope is not reliable in presence of ethereal oils.

5. Udransky's furfuraldehyde reaction (this Journal, 1889, 309) is only of value when the sample contains no products, beyond amyl alcohol, which give any colouration either with sulphuric acid alone or with sulphuric acid and furfuraldehyde.—C. A. K.

ORGANIC CHEMISTRY.—QUANTITATIVE.

The Examination of Commercial Toluidine. F. F. Raabe. Chem. Zeit. **15**, 116 and 179—80.

With the view of introducing a uniform method for the commercial examination of toluidine, the author gives a detailed account of the method proposed by himself.

The toluidine is first examined with regard to its colour and clearness, and also to that of a solution of 10 cc. of the toluidine in 10 cc. of hydrochloric acid and 80 cc. of water. 100 cc. of toluidine are then distilled from a flask of 180—200 cc. capacity, to which is fitted a two-bulb tube holding the thermometer, the position of the latter being so adjusted that the upper end of the bulb is 0·5 cm. below the lower edge of the side tube; the rate of distillation recommended is two drops a second. The specific gravity is determined either by weighing or by means of a hydrometer (Lunge, this Journal, 1885, 339). Of the various methods employed for determining the amount of paratoluidine present, the author states that, with certain precautions, Schoop's acetyl method can be employed with samples containing 30 per cent. or more paratoluidine. The oxalic acid method as modified by Lorenz (Annalen, **172**, 190) also gives very good results. A simple method, devised by the author, consists in adding known quantities of paratoluidine to the sample under examination, and then determining the temperature at which the mixture solidifies. For this purpose a thermometer with a range from 30° to 50° and divided into $\frac{1}{10}$°, is employed. With this method it is possible to detect differences of 0·2 per cent. paratoluidine. As in the other methods, it is necessary that the toluidine be free from water.—A. K. M.

On the Oxidation of Tanning Materials. R. Jahoda. Zeits. f. angew. Chem. 1891, 104—105.

See under XIV., *page* 472.

On the Estimation of Indigo. F. Voedler. Zeits. f. angew. Chem. 1891, 110—111.

F. Mohr's method for the estimation of indigo by means of potassium permanganate often leads to incorrect results on account of organic impurities present in indigo, which by reduction of permanganate show too high a percentage of indigo. Indigo is on this account frequently adulterated with reducing agents such as oxalic acid. The same fault applies to all the other oxidation methods. The reduction methods of Pugh and Fritsche, in which indigo is converted into Indigo-white and back to indigo, gives too high results, on account of other bodies usually present in commercial indigo, which are similarly affected.

Berzelius found that unadulterated indigo contained, in addition to indigo and ash, three other bodies which he named Indigo-gluten, Indigo brown, and Indigo-red. He extracts the above-mentioned bodies by treatment with hydrochloric acid or acetic acid, then with alkali, and finally with alcohol and hot water, after which the purified indigo is weighed. It as a rule, however, still contains silica and other mineral matters giving too high a result. The author modifies Berzelius' method. He extracts the pure indigo in the above way and estimates the nitrogen in it by Kjeldahl's method, and calculates the true percentage of indigo therefrom, the factor being 9·36. He found a difference of 0·175 per cent. nitrogen between commercial indigo and that purified by Berzelius' method, which he assumes to belong to the three above-mentioned constituents. Calculating all the nitrogen to Indigo-gluten by multiplying by the factor 6·25, it corresponds to 1·09 per cent. The complete analysis of a sample of commercial indigo gave:—

	Per Cent.
Indigo	77·76
Mineral matter	16·35
Moisture	6·48
Indigo-gluten, &c. containing nitrogen	1·41

The author found 99·85 per cent. of indigo in purified and sublimed indigo by this method.—D. A. S.

Ipecacuanha and Emetin. E. M. Arndt. Apoth. Zeit. **5**, 780.

Ipecacuanha contains, together with emetin, a volatile base, which on examination proved to be choliu. The quantity of emetin does not exceed 1 per cent., and may be determined in the following way:—10 grms. of the powdered root are ground up together with 5 grms. of sodium carbonate and 1 grm. of dry ferric chloride, and the whole extracted on the water-bath with 100 grms. of 60 per cent. methyl alcohol for one hour. The alcohol is distilled off after filtering the solution, and the residue taken up with 50 cc. of dilute ammonia water. This alkaline solution is extracted with chloroform, and the chloroform solution treated with acidulated water, which takes up the emetin. The solution thus obtained is then titrated with a potassium mercuric iodide solution, 1 cc. of which corresponds to 0·0189 grm. of emetin.—C. A. K.

On Italian Wines. C. Niederhäuser. Pharm. C. H. N. F. 1891, **12**, 15.

See under XVII., *page* 475.

ANALYTICAL AND SCIENTIFIC NOTES.

Heat Conductivity of Solutions. G. Jaeger. Rep. d. Phys. 1891, **27**, 42.

The results show that all solutions of salts are worse conductors of heat than water is, the diminution in conductivity being proportional to the quantity of salt. A mixture of salts dissolved in water brings about a diminution equal to the sum of the diminutions due to the constituents separately.—T. L. B.

The Solubility of Potassium Bitartrate. C. Blarez. Compt. Rend. **112**, 434—435.

The solubility of potassium bitartrate in water is a function of the temperature, and may be calculated by the following formula, in which Q represents the percentage of salt dissolved at any temperature t C.—

$$Q\,t = 0{\cdot}351 + 0{\cdot}00151\,t + 0{\cdot}00055\,t^2$$

For practical purposes the following simpler equation will be sufficiently accurate—

$$Q\,t = 0{\cdot}369 + 0{\cdot}000569\,t^2$$

Small amounts of potassium chloride added to a solution of tartar cause the precipitation of precisely equal weights of the latter. This fact is embodied in the formula—

$$Q\,t = (0{\cdot}369 + 0{\cdot}000569\,t^2) - \mathrm{KCl}$$

This equation only holds good so long as the potassium chloride added does not exceed the tartar originally present. In presence of larger amounts of potassium chloride the quantity of tartar dissolved depends on the temperature and is inversely proportional to the square root of the potassium existing in the potassium chloride added—

$$Q\,t = 0{\cdot}0189 + 0{\cdot}000005216\,t^3$$

$$\sqrt{\mathrm{K}}$$

Potassium bitartrate is completely insoluble at ordinary temperatures in the following mixture:—

	Parts
Alcohol at 90°	100
Water	100
Potassium sulphate	4
Tartaric acid	2

If the potassium sulphate in the above solution be completely or partly replaced by potassium bisulphate, the liquid will dissolve tartar.—H. T. P.

APPARATUS.—PATENTS.

An Improved Pinch-Cock for Regulating the Flow of Liquids and Gases in Elastic Tubes. P. Braham, Bath. Eng. Pat. 2658, February 19, 1890. *6d.*

The pinch-cock consists of two plates of any suitable material with V-shaped slots in them, and enclosing an elastic tube. By turning the plates one upon the other the elastic tube is compressed, and can thus be made to regulate the flow of the liquid. The invention is capable of application to feeding bottles, burettes, gas and water pipes, &c. (See this Journal, 1890, 255.)—E. S.

Improvements in Instruments for Estimating, Measuring, or Comparing Colour, Texture, and Appearance of Transparent or Opaque Bodies, and for Testing Colour Vision and Light Perceptive Power. J. W. Lovibond, Salisbury. Eng. Pat. 6221, April 23, 1890. *8d.*

This instrument, called by its inventor "the tintometer," has been previously described in Eng. Pats. 12,867 of 1886 and 3859 of 1887 (this Journal, 1887, 522; and 1888, 234 and 424). The improvements consist in making the instrument *binocular*, thus giving a better view of the objects under examination, and also of the standard with which it is compared; and, secondly, in rendering the instrument available for testing the colour-vision and light perceptive power of the eye. This is effected by the insertion in the tube of a central removable diaphragm, by which the two eye-pieces are made to command separate fields of view, which may be wholly or partly distinct, and partly common to both eye-pieces, as may be required.—E. S.

New Books.

A Dictionary of Applied Chemistry. By T. E. Thorpe, B.Sc., Ph.D., F.R.S., Treas. C.S., Professor of Chemistry in the Normal School of Science and Royal School of Mines, South Kensington. Assisted by eminent contributors. In three Volumes. Vol. II. 1891. London: Longmans, Green & Co.; and New York: 15, East 16th Street.

The notice of the issue of the second volume of this work appeared in this Journal, 1890, 219—220. Volume II. is like Vol. I., a handsomely bound book, 8vo. size, containing list of Abbreviations and of Contributors, followed by subject-matter covering 714 pages. With the text, as in the case of Vol. I., are interspersed numerous exceedingly well-executed wood engravings illustrative of plant, apparatus, &c. The article with which Vol. II. closes is Nux Vomica. As examples of specially interesting subjects treated of in this volume may be instanced the following:—Explosives, covering 34½ pages and illustrated by wood engravings. The subject embraces the following divisions; *Gunpowder*; its ingredients, Pebble and Prismatic powder, Mining powder, Brown or Coeoa powder. Gunpowder containing other nitrates than potassium nitrate, *e.g.*, barium nitrate, sodium nitrate and ammonium nitrate (*Amide powder*). *Gun-cotton, Nitrated gun-cotton, Tonite, E.C. powder, Johnson's powder, Nitrolignin, Nitroglycerin, Nitroglycerin preparations, Kieselguhr dynamite, Mica powder, Carbo dynamite, Blasting gelatin, Gelatin dynamite, Gelignite, Forcite, Judson powder, &c., &c., Fulminate of mercury, Sprengel's explosives, Picric acid and picrates. Measurement of the Intensity of Action of Explosives.*

Fermentation is the subject of another valuable monograph, covering 31 pages. Coal Gas is the subject of an article occupying 35 or 36 pages, and along with those following, on Oil Gas and Water Gas, gives a very complete account of the industry as a whole. The essay on Glycerin, by the late Mr. W. Lant Carpenter, is both a striking and a well-illustrated article. The Class of Colouring Matters known as the *Indamines and Indophenols* is treated at considerable length. Other ably treated and interesting articles are those on Iodine, Lakes, Lead, Leather, Artificial Manures, Matches, Milk, and Naphthalene.

Die Synthetischen Darstellungsmethoden der Kohlenstoff-Verbindungen. Von Dr. Karl Elbs. A.O. Professor an der Universität Freiburg, i. B. Zweiter Band, Leipzig: Johann Ambrosius Barth, 1891. London: H. Grevel & Co., 33, King Street, Covent Garden.

Octavo volume, in paper cover, price 9*s.* 6*d.*, forming the second volume of the work, the first volume having appeared in 1889 (see this Journal, 1889, 1015). This second volume in fact completes the work. Price for the two vols. is 17*s.* The text covers 452 pages, and the concluding 19½ pages are devoted to a copious alphabetical index. The second volume is devoted to the treatment of two branches of the subject, *viz.*, *Syntheses by decomposition* (*Abspaltung*), and *Syntheses by Electrolysis.*

The Syntheses by decomposition are subdivided as follows:—I. Syntheses by separation of hydrogen. II. By separation of oxygen. III. By separation of sulphur. IV. By separation of nitrogen. V. By separation of halogen. VI. By separation of halogen-hydrogen. VII. Syntheses through separation of water. VIII. By separation of hydrogen and water. IX. By loss of water and halogen-hydrogen. X. By loss of sulphuretted hydrogen. XI. By loss of ammonia, or amines, &c. XII. Simultaneous separation of several elements in the form of their hydrogen compounds. XIII. Syntheses by separation of inorganic acids, with or without simultaneous separation of water or halogen-hydrogen, &c. XIV. Syntheses by separation of organic acids, with or without simultaneous separation of water or halogen-hydrogen, &c. The latter part of the work is devoted to the subject of *Syntheses by Electrolysis.*

Coal, and what we get from it. A Romance of Applied Science. Expanded from the Notes of a Lecture delivered in the Theatre of the London Institution, January 20th, 1890. By Raphael Meldola, F.R.S., F.I.C., &c., Professor of Chemistry in the Finsbury Technical College, City and Guilds of London Institute. London: Society for Promoting Christian Knowledge, Northumberland Avenue, Charing Cross, W.C.; 43, Queen Victoria Street, E.C. Brighton: 135, North Street. New York: Ed. J. B. Young & Co. 1891.

Small 8vo. volume, price 2*s.* 6*d.*, part of a series known as the "Romance of Science Series." This particular book is dedicated to Dr. W. H. Perkin, F.R.S., "The founder of the Coal Tar Colour Industry." The author taking his work to be a presentation in popular form of an account of the industry which has arisen out of the great waste from gasworks, says of it, "In the strictest sense it is a romance of dirt." Yet dissatisfied with the superficial way in which the subject is often treated in lectures to popular audiences, the author has endeavoured to go somewhat beyond this and give some notion of the scientific principles underlying the subject of coal and its products. After the Preface and Table of Contents, follow the subject-matter, covering 204 pages, and Alphabetical Index. The text is illustrated by several well-executed wood engravings, and some interesting diagrams and tabulated matter.

Die Prüfung der Chemischen Reagentien auf Reinheit. Von Dr. C. Krauch. Zweite gänzlich umgearbeitete und vermehrte Auflage. Berlin: Verlag von Julius Springer, 1891. London: H. Grevel and Co., 33, King Street, Covent Garden.

This work appears to be one specially designed for manufacturers of pharmaceutical chemicals, though in some respects its scope extends beyond that of the branch referred to. It is an 8vo. volume, bound in cloth, price 6*s.*, and the present issue forms the second and revised edition. The volume opens with an Introduction followed by that to the first edition, and then by the one to the second edition. The text fills 246 pages, and the work concludes with an alphabetical index of the latinised terms followed by one of the German names of the reagents and chemicals treated of in the book. Not only are the qualitative methods of examination given, but also the most practical and useful quantitative methods.

Elementary Lessons in Heat, Light, and Sound. By D. E. Jones, B.Sc., Professor of Physics in the University College of Wales, Aberystwith. London and New York: Macmillan and Co. 1891.

Small octavo volume, bound in red cloth, price 2*s.* 6*d.* It contains Preface, Tables of Contents, Note on the Metric System of Weights and Measures, and 279 pages of subject-matter. Page 280 is devoted to Answers to Examples, and the work concludes with an Alphabetical Index. The book is well illustrated with some 24 or 25 well-executed wood engravings. The range of the book is well shown in the subdivision following:—Heat.—Temperature, Thermometers, Expansion of Heat, Specific Heat and Calorimetry, Hygrometry, Transmission of Heat, Conduction, Convection, and Radiation. Light.—Photometry, Velocity of Light, Reflection of Light, Spherical Mirrors, Refraction of Light, Lenses, Optical Instruments, Dispersion and Colour. Sound.—Vibratory Motion, Wave Motion, Velocity of Sound, Reflection, Pitch and Musical Intervals, Transverse Vibration of Strings, Resonance, Vibration of Air Columns, Organ Pipes.

Colour Measurement and Mixture. By Captain W. de W. Abney, C.B., R.E., D.C.L., F.R.S. Society for Promoting Christian Knowledge. London: Northumberland Avenue, W.C., and 13, Queen Victoria Street, E.C. Brighton: 135, North Street. New York: E. and J. B. Young & Co. 1891.

Small 8vo. volume, like the little work on Coal, by Professor Meldola, belonging to the *Romance of Science Series*. Price 2*s.* 6*d.* It commences with a frontispiece representing the Colour-patch Apparatus. This is followed by the title page and preface. In the latter the author points out that he had some years ago set himself to carry out three measurements of the spectrum, viz., 1st, the heating effect; 2nd, the luminosity; and 3rd, the chemical effect on various salts of the different rays of the spectrum. He, along with General Festing, was led in the second part of it, into a wider study of colour than was first intended. On the invitation of the Society of Arts, Captain Abney delivered a short course of lectures on the subject of Colour, and in this course the subject was treated from the point of view of his and General Festing's own methods of experimenting, and the lectures expanded and modified now form the basis of this little volume. The text covers 203 pages, and the work concludes with an alphabetical index. The text is illustrated by 11 woodcuts and diagrams.

Trade Report.

(From Board of Trade and other Journals.)

TARIFF CHANGES AND CUSTOMS REGULATIONS.

Recovered Sulphur in the United States.

The classification of recovered sulphur as refined brimstone, subject to duty at the rate of 8 dols. per ton, has been overruled by the Board of Appraisers, which decides that the article is entitled to free entry as recovered sulphur. —*Industries.*

The New Russian Tariff.

It is stated upon good authority that the following figures represent the principal alterations in the pharmaceutical section of the new Russian tariff, which will come into force within a few weeks:—

	Roubles per Poud.	
	Present Tariff.	New Tariff.
Carbolic acid	0·06	0·20
Benzol	0·06	0·20
Tar	0·06	0·10
Tar derivatives	0·06	0·10
Animal fats	0·36	0·60
Fish oils (including cod-liver oil) unpurified.	Free	0·75
Spermaceti (crude)	Free	0·75
Spermaceti (refined)	Free	2·00
Fats (purified), oleine, &c.	Free	1·20
Stearin	Free	2·00
Paraffin	Free	2·00
Vaselin (crude)	Free	2·00
Borax (refined)	Free	1·20
Argols (crude)	Free	0·75
Antimony	Free	4·00
Nitrate of soda	Free	0·65
Silicate of soda	Free	0·50
Caustic soda	Free	0·80
Caustic potash	Free	0·80
Caustic potash (refined)	Free	4·00
Quinine and its salts	Free	6·00
Castor oil	Free	2·40
Cocoanut oil	Free	1·00
Palm oil	Free	1·00
Crude glycerin	Free	1·00
Essential oils (non-alcoholic)	Free	6·00
Collodion	Free	15·00
Fruit essences	Free	15·00
Iodoform	6·00	10·00
Chloral hydrate	6·00	10·00
Chloroform	6·00	10·00
Opium	13·20	15·00

NEW RUSSIAN TARIFF—*continued.*

	Roubles per Pood.	
	Present Tariff.	New Tariff.
Lactucarium	13·20	15·00
Sulphur (raw)	Free	0·04
Sulphur (refined)	0·12	0·20
Liquorice juice	..	2·50
Soda bicarbonate	..	0·80
Magnesite (in lump)	..	0·04
Magnesite (ground)	..	0·10
Magnesium chloride	..	0·15
Magnesium sulphate (raw)	..	0·15
Ether (gross weight)	..	1·00
Copper sulphate	..	1·00
Zinc sulphate	..	1·00
Zinc chloride	..	1·00
Iron sulphate	..	0·50
Silver nitrate	..	10·00
Phosphoric acid	..	6·00
Benzoic acid	..	6·00
Bromine salts	..	6·00
Mercurial salts	..	6·00
Bromine	..	2·65
Iodine (crude)	..	2·65
Chlorate of potash	..	2·40
Permanganate of potash	..	2·40
Antifebrin	..	10·00
Phenacetin	..	10·00
Gallic and Pyrogallic acids	..	6·00
Salicylic acid and Salicylates	..	6·00
Bismuth salts	..	6·00
Sugar of milk	..	5·00
Iodoform	..	10·00
Iodine salts	..	6·00
Antimony sulphide (golden)	..	3·00
All chemical and pharmaceutical preparations unenumerated.	2·40	2·65

—*Chemist and Druggist.*

EXTRACTS FROM DIPLOMATIC AND CONSULAR REPORTS.

NEW GERMAN PATENT LAW.

Sir E. B. Malet, Her Majesty's Ambassador at Berlin, in a despatch to the Foreign Office, dated the 18th April, forwards translation by Mr. Trench of the new German patent law, which is to come into force on the 1st October next. The following is a full copy of this translation:—

First Part.—Patent Right.—Sect. 1. Patents are granted for new inventions which may be turned to account in trade.

No patent can be granted—

1. To such inventions as run counter to the laws of the land or to the laws of morality.
2. To newly invented articles of food, delicacies, or medicines, or substances produced by chemical agency, unless the invention consists in some definite procedure for the fabrication of such substances.

Sect. 2. An invention for which a patent is demanded pursuant to this law is not to be regarded as new if at the time of such demand it is already so described in (German) public prints issued within the last hundred years, or if it has been already so openly employed in Germany ("*im Inlande*") that its employment by other experts would thereby seem to be rendered possible.

The specifications of patents officially published in foreign States are placed on the same footing as the (German) public prints after the lapse of three months from the day of publication in cases where the patent is applied for by the same person who has applied for it in the foreign State, or by his legal representative. This favour, however, extends only to official specifications of inventions in those States whose reciprocity is guaranteed by a notice in the *Reichs-Gesetzblatt.*

Sect. 3. The right to a patent for a new invention rests with the first person who makes application for it pursuant to this law. No later application can establish a right to a patent where the invention is the subject of the patent demanded by the prior applicant. If this is the case in part only the latter applicant has only a claim to receive a patent with such restrictions as may be required in justice to prior applicant.

No claim to a patent is established by an application, the essential part of which is taken without permission from descriptions, drawings, models, implements or machines proceeding from some other person than the applicant, or from some process employed by such other person, and when the latter puts in a protest against the granting of the patent demanded. If such protest leads to the withdrawal or rejection of the application the protestor in case of his demanding a patent for his invention within one month from the receipt of advice from the Patent Office informing him of such withdrawal or rejection, can claim that his application be regarded as dating from the day before the publication of the previous application.

Sect. 4. The patent grants to its possessor the exclusive right in the way of business to manufacture, deal in, sell, or use the thing patented. When a patent is granted for a process its effects extend also to the immediate products of that process.

Sect. 5. The effect of a patent does not extend to a person who at the time of application was already employing the invention in Germany, or had already made the necessary arrangements for employing it. Such person has the right to employ the invention for the use of his own business on his own premises or elsewhere. This right can only be inherited or purchased along with the business itself.

The effect of a patent also ceases with regard to such use of it as is made by order of the Imperial Chancellor in the army or navy, or in any other manner for the benefit of the nation at large. Yet in this case the patentee has a claim to a suitable indemnity from the Empire or from the State for whose special benefit the patent has been restricted.

Such indemnity to be fixed by a court of law if private arrangement should prove unable to determine it.

The effect of a patent does not extend to contrivances in use on vessels which only come to Germany ("*in das Inlande*") at intervals.

Sect. 6. Claims for the granting of a patent and the rights proceeding from a granted patent are inheritable. Both claims and rights can be transferred to other persons *in toto* or in part by contract or by testamentary dispositions.

Sect. 7. The duration of a patent is 15 years, reckoned from the day after that on which it is applied for. If a new invention is made as an improvement on, or a supplement to, a previous invention already patented in favour of the applicant, the latter can demand a supplementary patent to expire at the same time as the patent for the prior invention.

If by the nullification of the original patent a supplementary patent becomes an independent one, its duration and the day on which its fees fall due are determined by the commencement day of the original patent.

The amount of the fees is reckoned from the commencement day of the supplementary patent.

The time which elapses between the day of application for the supplementary patent and the next following anniversary of the commencement of the original patent is reckoned as the first year of the new patent.

Sect. 8. For every patent a fee of 30 marks (about 30*s.*) must be paid in previous to its being granted (sect. 24, paragraph 1).

Except in the case of supplementary patents (sect. 7), a fee is to be paid on every patent at the beginning of the second and every following year of its duration amounting to 50 marks (2*l.* 10*s.*) the first time and increasing by 50 marks (2*l.* 10*s.*) every succeeding year.

This fee (paragraph 2) is to be paid within six weeks of the day on which it falls due. After the expiration of this term payment can be made during a second term of six weeks, but with the addition of 10 marks (10*s.*) by way of a fine.

To a patentee whose indigence is satisfactorily proved, a respite may be granted by allowing the payment of his fees for the first and second year of the duration of his patent to stand over till the third year, and remitting such payment if the patent lapses in the third year.

The payment of fees before they fall due is allowable. If the patent is withdrawn, declared null, or retracted, the fees paid in advance are returned.

A reduction of the fees may be made by a decree of the Federal Council.

Sect. 9. The patent becomes null and void if the patentee renounces it or if the fees are not paid in due time either to the Treasury of the Patent Office direct or to some post office within the German Empire for transmission to the said treasury.

Sect. 10. The patent is annulled when it is found—

1. That the thing patented is according to sections 1 and 2 not patentable.
2. That the invention is already patented to a previous applicant.
3. That the main contents of the application have been taken from the descriptions, drawings, models, machines, or appliances of another person, or from a process employed by him and without his permission.

Should one of these objections (1, 2, or 3) be found to exist in part only, a corresponding restriction of the patent is to be made.

Sect. 11. The patent can be revoked after the lapse of three years, reckoned from the day on which the grant was published (sect. 27, paragraph 1):—

1. When the patentee has failed to carry out his invention to a satisfactory extent within Germany ("*im Inlande*") or when he has neglected to take the necessary steps to secure its practical carrying out.
2. When it appears desirable for the public welfare that permission should be given to others to use the invention, and the patentee refuses to grant such permission for a suitable indemnity and under sufficient securities.

Sect. 12. Persons not residing in Germany ("*im Inlande*") have no claim to the granting of letters patent, nor can they exercise the rights granted to patentees otherwise than by a duly appointed representative in Germany ("*im Inlande*"). The latter is entitled to act as their attorney, both in proceedings under this law and also in civil suits regarding the patent, as well as to demand fines and punishments.

The place where the representative resides, or, failing this, the place in which the Patent Office has its seat, is to be regarded (in accordance with sect. 24 of the civil "*prozessordnung*") as the place where the property ("*ein mogensgegenstand*") exists.

With the consent of the Federal Council, the Imperial Chancellor is entitled to order the exercise of the right of retaliation against the subjects of a foreign State.

Second Part.—Patent Office.—Sect. 13. The granting, revoking, and annulling of patents is committed to the Patent Office.

The Patent Office has its seat at Berlin. It has a president, members who have qualified themselves for the office of judge or for the higher administrative service (*jurisprudents*), and members versed in one particular branch (*experts*). The members are appointed by the Emperor, the president by the Emperor on the recommendation of the Federal Council. The appointment of the jurisprudent members is, when they hold an office in the Imperial or State service, for the term of such office, in the other case for life. The experts are appointed either for life or for a term of five years. To the latter, the regulations in sect. 16 of the law of the 31st March, 1873, touching the legal relations of the Government officials of the German Empire do not apply.

Sect. 14. In the Patent Office there are:—

1. Departments to consider the applications made for patents.
2. A Department to consider demands for the nullification or revocation of patents; and
3. Departments for complaints and grievances.

In the Applications Departments only such experts may serve as have been appointed for life.

The experts of the Applications Departments may not serve in other Departments, nor the experts of the latter in the Applications Departments.

In the Applications Departments the presence of at least three members, two of whom must be experts, constitutes a quorum.

For the decisions of the Nullification Department and of the Departments for Complaints and Grievances, it requires two jurisprudents and three experts to form a quorum.

For other decisions the presence of three members suffices.

The regulations of the civil "*prozessordnung*" with regard to challenging those charged with the conduct of a trial are here also duly observed.

Experts who are not members may be called in to participate in the deliberations, but may not vote.

Sect. 15. The decrees and decisions of the Departments are given in the name of the Patent Office; they must be accompanied by the reasons which have led to them, must be set down in writing, and sent officially to all the parties concerned.

Sect. 16. Against the decisions of the Applications Departments and the Nullification Department complaints may be laid. In the consideration of a complaint, no member may take part who was concerned in the decision complained against.

Sect. 17. The formation of the Departments, the demarcation of their spheres of action, the form of their proceedings, the manner of conveying their decisions, and the business routine of the Patent Office will, whenever this law fails to make due provision, be regulated, with the consent of the Federal Council, by an Imperial decree.

Sect. 18. The Patent Office is bound, at the request of the law courts, to give its opinion on questions concerning patents whenever, in the course of legal proceedings, the opinions of experts differ from each other.

In other cases the Patent Office is not authorised to make decisions or give opinions outside its proper sphere of business without the approval of the Imperial Chancellor.

Sect. 19. At the Patent Office a register is kept, giving the subject and duration of the granted patents, as well as the names and residences of the patentees, and of such representatives as they may have appointed. The commencement, expiration, lapse, nullification, and revocation of patents must be entered in the register, and at the same time published in the *Reichsanzeiger*.

Personal changes of patent holders or their representatives, when announced to the Patent Office in a proper form, will also be registered and published in the *Reichsanzeiger*. Until this has been done, the former patentee or his representative retains his rights and liabilities as established by this law.

The inspection of the specifications, drawings, models, and specimens on the basis of which patents have been

granted, is free to everyone, except where a patent has been taken into use for the army or navy in the name of the Imperial Government.

The Patent Office publishes the essential part of all such specifications and drawings as are permitted to be inspected by everyone, in an official journal. In this journal will also be found the notices which this law requires to be published in the *Reichsanzeiger*.

Third Part. — Proceedings in regard to Patents. — Sect. 20. Applications for the granting of a patent for an invention must be made in writing, and must be addressed to the Patent Office. For each separate invention a separate application is necessary. The application must contain the request for a patent, and must clearly define the thing to be patented. In an annexed specification the invention must be so described as to make its use by other experts appear possible. Accompanying the specification must be a statement of what is claimed as patentable in the invention. The necessary drawings, diagrams, models, and specimens must also be sent in along with the application.

The Patent Office gives directions as to any further requirements regarding applications.

Previous to the decision for publishing the application, alterations in the same are permitted. Along with the application, 20 marks (about 1*l.*) are to be paid for the costs of the proceedings.

Sect. 21. The application is submitted to a preliminary examination by one member of the Applications Department.

Should the preliminary examiner find that the application does not fulfil the prescribed requirements (sect. 20), he advises the applicant of the deficiencies, and requests him to make good the same within a fixed period of time.

Should it appear from the preliminary examination that the invention is not patentable in the sense of sections 1, 2, and 3, paragraph 1, the applicant will be informed of this opinion and the reasons on which it is grounded, and will be requested to reply within a given space of time.

If the applicant fails to apply in due time, the application is regarded as withdrawn; if he replies in time, the Applications Department proceeds to a decision.

Sect. 22. If the prescribed requirements (sect. 20) have not been fulfilled, or if it appears that the invention is not patentable according to sections 1, 2, and 3, paragraph 1, the application is rejected by the Department.

In this decision the preliminary examiner, who has charged the applicant to make good deficiencies in his application, or to defend the patentability of his invention, is not allowed to take part.

If an application is to be rejected on grounds not already communicated to the applicant by the preliminary examiner, opportunity must be granted to him to express himself concerning these grounds within a stated period.

Sect. 23. If the Patent Office finds the application correct and the grant of letters patent not impossible, it decrees that the application shall be published. From the moment of this publication, the legal consequences of the patent (sections 4 and 5) as regards the subject of the application take effect provisionally for the benefit of the applicant.

The publication is made by a single insertion in the *Reichsanzeiger* of the applicant's name and the essential part of the demand contained in his application. Along with this publication notice is given that the subject of the application is temporarily protected against employment by others than the applicant.

At the same time the application, with all its supplements, is exposed for public inspection at the Patent Office. By the authority mentioned in sect. 17 of this law, it may be decreed that the application shall be exposed for public inspection at other places besides Berlin.

On the demand of the applicant the exposure for public inspection may be continued for a period of not more than six months. Exposure for as much as three months may not be refused.

In the case of an application made in the name of the Imperial Government for the protection of an invention to be employed in the army or navy, a patent may on demand be granted without any publication, in which case no entry is made in the Register of Patents.

Sect. 24. The first annual fee (sect. 8, paragraph 1) is to be paid within two months from the date of publication (sect. 23). If payment is not made during this period the application is to be regarded as withdrawn.

Within the same period protest may be raised against the granting of a patent. The protest must be delivered in writing, and must be accompanied with reasons.

It can only be based on the assertion that according to sections 1 and 2 the object is not patentable or that according to sect. 3 the applicant has no claim to receive a patent.

In the case mentioned in sect. 3, paragraph 2, only the injured party is entitled to protest.

After the expiration of the fixed time the Patent Office must decide as to the granting of a patent. In this decision the preliminary examiner who has charged the applicant to make good the deficiencies of his application or to defend the patentability of his invention (sect. 21) may not take part.

Sect. 25. In the preliminary examination and in the proceedings before the Applications Department the summoning and *viva voce* hearing of the parties, the examination of witnesses and experts, as also the taking of such other steps as may seem necessary to elucidate the matter under consideration, may at all times be resorted to.

Sect. 26. Against the decision by which an application is rejected the applicant can put in a protest, and against the decision as to the granting of a patent the applicant or the complainant can put in a protest in either case within one month after being informed by the Patent Office of the decision in question.

Along with the presentation of the protest 20 marks (about 1*l.*) are to be paid in for costs of proceedings; if this payment be not made the protest is regarded as not presented.

If the protest is in itself contrary to regulations, or if it be raised too late, it will be rejected as inadmissible.

If the protest be found admissible the further proceedings are regulated by sect. 25.

The summoning and *viva voce* hearing of the parties must be resorted to if demanded by one of them. This demand can be refused only when the party making it was already summoned to the proceedings before the Applications Department.

If the decision on the protest is to be based on other grounds than those taken into account in the decree complained against, the interested parties must have a previous opportunity granted them for expressing themselves thereupon.

It is left to the free judgment of the Patent Office to decide to what extent the costs of the protest shall be borne by the party whose case is rejected, and also whether the protest fee (paragraph 1) shall be returned to the party whose protest is found justifiable.

Sect. 27. When the granting of a patent is definitely determined on, the Patent Office makes the fact known in the *Reichsanzeiger* and then provides the patentee with letters patent.

If the application is withdrawn after its publication (sect. 23) or if a patent is refused this must also be made known.

In these cases the prepaid annual fee will be returned.

If a patent is refused, the preliminary protection is regarded as not having taken place.

Sect. 28. Proceedings for annulling or retracting a patent are only commenced when a complaint is raised against it.

In the case of sect. 10, No. 3, only the injured party has the right to lay a complaint.

In the case of sect. 10, No. 1, no complaint is allowable after the lapse of five years from the day on which the granting of the patent was published (sect. 27, paragraph 1).

The complaint must be made in writing and addressed to the Patent Office; it must state the facts on which it is based.

Along with the complaint a fee of 50 marks (about 2*l.* 10*s.*) is to be paid in. If this payment is not made no complaint is judged to have been received.

The fee is returned if the proceedings are terminated without summoning the parties.

If the complainant resides in a foreign country he must, on the demand of his opponent, find securities for the costs of the proceedings. The amount of such security is left to the free decision of the Patent Office, which informs the complainant of the sum demanded as security and the time within which it must be paid. If the security demanded is not paid within the time fixed the complaint is regarded as withdrawn.

Sect. 29. When it has been determined to commence proceedings the Patent Office informs the patentee of the complaint, and requests him to answer it within a month.

If the patentee fails to answer within the time fixed a decision may be formed at once without summoning or hearing the parties, and every fact advanced by the complainant may be regarded as proved.

Sect. 30. If the patentee replies in time, or if in the case of sect. 29, paragrah 2, the Patent Office does not at once decide according to the complaint laid, the necessary steps are taken by the Patent Office for elucidating the matter, in the former case the reply of the patentee being communicated to the complainant. The Patent Office may order the hearing of witnesses and experts who are then subject to the same regulations as in proceedings before the courts of civil law. The proceedings must be taken down by a sworn recorder.

The decision is made after the parties interested have been summoned and heard.

If a patent is to be revoked on the basis of sect. 11, paragraph 2, the final decision to do so must be preceded by the threat of revocation accompanied by reasons and fixing suitable term for deliberation.

Sect. 31. In the decision (sections 29 and 30) the Patent Office must determine, according to its free judgment, in what manner the costs of the proceedings are to be borne by the parties.

Sect. 32. The law courts are bound to lend judicial aid to the Patent Office, and on demand to impose fines on witnesses and experts who fail to appear or who refuse to testify or take oath, as well as also to command the appearance of witnesses.

Sect. 33. An appeal is permissible against the decisions of the Patent Office (sections 29 and 30).

Appeals go to the *Reichsgericht*. They must be sent to the Patent Office in writing within six weeks from receipt of decision, and must state the grounds of dissatisfaction.

In its sentence the law court has also to determine the question of costs with the same liberty as is granted to the Patent Office in sect. 31.

For the rest, the proceedings in the law court will be conducted according to regulations to be drawn up by the law court, and approved by Imperial decree, with the consent of the Federal Council.

Sect. 34. With respect to the language to be employed at the Patent Office, the regulations of the *Gerichtsverfassungsgesetz* regarding the language of the law courts apply also here. Written communications not drawn up in the German language will not be taken notice of.

Sect. 35. Any person who knowingly or in culpable ignorance makes use of an invention contrary to sections 4 and 5 is bound to compensate the injured party.

In case of an invention for a process for manufacturing some new substance, every substance of like composition is to be regarded as made by the patented process until the contrary is proved.

Fourth Part.—Penalties and Indemnities.—Sect. 36. Any person who knowingly makes use of an invention contrary to sections 4 and 5 is punishable by a fine not exceeding 5,000 marks (250*l.*), or by imprisonment not exceeding one year.

Prosecution is only resorted to when demanded. The withdrawal of a demand for prosecution is permissible.

If a punishment is decreed, the injured party is at the same time empowered to publish the sentence, at the expense of the condemned. The manner of publication and its limits as to time must be defined in the sentence.

Sect. 37. Instead of any and every indemnity obtainable under this law, an amercement not exceeding 10,000 marks (500*l.*) may be adjudged to the injured party on his demanding it. Each and all who are jointly condemned to such amercement are answerable for it with all their goods and chattels.

An adjudged amercement excludes the admissibility of all further claims for indemnification.

Sect. 38. In civil suits, where a plaintiff or defendant bases a claim on the provisions of this law, the decision is referred to the *Reichsgericht* as a last court of appeal according to sect. 8 of the introductory statutes of the law for the constitution of courts (*Gerichtsverfassungsgesetz*).

Sect. 39. Complaints of the infringement of patented rights fall under the statute of limitation after three years as regards each separate act on which they are grounded.

Sect. 40. A fine not exceeding 1,000 marks (50*l.*) is incurred by—

1. Whoever places a mark on wares or the packing of wares which is calculated to produce the mistaken belief that such wares are protected by a patent under this law.
2. Whoever in public advertisements, on signboards, on business cards, or by any other means of publicity makes use of a mark calculated to produce the mistaken belief that the wares thereby offered or alluded to are protected by a patent under this law.

Art. 2. The regulation given in sect. 28, paragraph 3, of Article 1 applies also to already existing patents with the restriction that complaints are admissible only within a period of three years from the day on which this law comes into force.

Art. 3. This law comes into force on the 1st October 1891.

The German Patent Office in 1890.

(*Chem. Zeit.* **15**, 180.)

The number of applications for patents during the past year was 11,882, showing an increase of 237 over the previous year. The annual numbers, starting with 1886, are as follows: 9,991, 9,904, 9,869, 11,645, and 11,882, the increase in the last years being possibly due to the greater confidence felt in the present conduct of the Patent Office. The number of patents granted was 4,680, that is, 39·5 per cent. of the applications, those granted during 1889 numbering 3,882.

A table shows the numbers of applications and patents granted in each of the 89 classes, and a good deal of other information of more or less local interest is also given.

The receipts of the Patent Office amounted to 2,080,713 marks, and the expenses 810,038 marks.—A. K. M.

Phosphate Mining in Carolina.

Mr. C. St. John, Her Majesty's Consul at Charleston, South Carolina, in his last report to the Foreign Office, gives the following information respecting phosphate mining, phosphates and fertilisers of Carolina:—

The phosphate mining and fertilising industry, so important a factor in the trade of Charleston and the State of South Carolina, has proved itself more profitable to those engaged in it this year than in any previous one, notwithstanding the discovery and partial development of the Florida rock deposits.

There are good reasons, however, why Carolina rock should maintain its ground. The supply is regular and of uniform quality, it has a high percentage of phosphate of lime, is low in carbonate, iron, and alumina, is of good colour when calcined, becomes crisp and dries well after being treated with acid, without afterwards absorbing moisture and becoming lumpy, and moreover it is easy to grind.

During the year phosphates and fertilisers were produced to the amount of 790,000 tons.

The year has been a very good one for the fertiliser business, the sellers having nearly their own way up to the end of the season. The companies have doubled their capacity during the year, new companies being formed, and the fertiliser interest more thoroughly advertised than ever among dealers and consumers.

Some of the Charleston's leading bankers have shown their confidence in the prospects of the business, and faith in the future of this town, by organising two new companies —the "Chicora" and the "Imperial."

These will add at least 50,000 tons to the supply for sale next year, and would seem to warrant the establishment of two mining companies to furnish the additional crude rock that will be required.

A favourable feature in this industry is the fact that the Western States, the great granary of the country, are beginning to use the Carolina fertilisers for the production of wheat, corn, barley, and oats. And it is believed that Chicago, Cincinnati, Detroit, Kansas City, and Minneapolis will soon become great fertiliser centres.

The total shipment of manufactured fertilisers from Charleston for the year was 261,650 tons.

The demand for commercial manures, constantly increasing in different directions, necessarily requires the importation of considerable quantities of chemicals used in their manufacture.

The imports of these chemicals during the year ended 30th September 1890 amounted to 33,935 tons, valued at 127,634*l*.—(*No.* 845, *Foreign Office Annual Series.*)

GENERAL TRADE NOTES.

The Naphtha Industry of Baku.

It appears from the *Messager Officiel*, which bases its information upon data received from the naphtha producers, that the industry in this product is greatly developing at Baku. In 1890 the quantity of naphtha extracted at the isthmus of Apcheron reached the figure of 239 million pouds (poud = 36 lb. avoirdupois), including waste, and the quantity of mineral oil employed as combustible. In 1889 the product at the same place was only 205,500,000 pouds; in 1888, 192,600,000 pouds; in 1887, 165,000,000 pouds; in 1886, 150,000,000 pouds; and in 1885, 116,000,000 pouds only. In five years the average of the increase in the production of naphtha has therefore been, in this peninsula, 24,600,000 pouds.

In 1890, it may be remarked, the production of naphtha at Apcheron has exceeded for the first time the production of the same mineral oil in Pennsylvania, which was only 230 million pouds. With the exception of 6,348,700 pouds of naphtha exported from Baku by the Caspian Sea or by the Transcaucasian railway, the remainder of this product has been refined on the spot at Baku. In 1890 there were sent from that port 169,551,300 pouds of different naphtha products, including 67,306,500 pouds of lighting oils, 4,600,900 ponds of lubricating oils, 522,200 pouds of benzene, gasolene, tar, &c., and 97,121,700 pouds of naphtha residues.

Tin Discovery in Mexico.

The *South American Journal* for March 28th, has the following:—

Additional news is to hand with respect to the discovery of tin in Durango State by Mr. John Pershmaker, who relates that the vein was revealed almost by accident. He had, it seems, gone to what is known as the Diabolt mine, 45 miles south-west of the capital of the State, for the purpose of examining the yield of metal-bearings ores, not knowing that tin had ever been found there. He found a shaft about 300 ft. deep, which had passed through two light veins of gold, iron, and silver-bearing ores. On making a close examination of the sides of the shaft, he noticed that the miners had passed through a large and very rich lead of oxide of tin, evidently without knowing it. After making his calculations as to the probable direction taken by the vein, he ran a horizontal tunnel for a short distance, striking a vein of ore alleged to be truly remarkable. It is stated to be 4 ft. wide, and composed of a solid mass of oxide of tin, assaying from 50 to 60 per cent. of the pure metal. It is quite free from sulphur, so that the work of reducing the ore simply amounts to the work of smelting and casting into ingots.

The Conditioning of Textile Fabrics in France.

The French *Monde Economique* of the 18th April gives the following information respecting the conditioning of textile fabrics in France:—

The operation of conditioning is one by which the proportion of moisture contained in textile fabrics is determined, as all these fabrics contain a certain quantity, or more correctly speaking, a proportion of moisture varying with the processes to which they have already been subjected, and also their temperature.

It will be easily understood that a salesman who buys his fabrics by weight has a decided interest in keeping them as moist as possible when he sells them by weight. Moreover, as is most frequently the case, this seller is only an intermediary, he cannot without considerable pecuniary risk sell his goods in a dryer condition than when he bought them, and in order to determine their actual proportion of moisture he must refer the matter to a third party. It is therefore necessary to have recourse to an arbitrator—an expert, whose impartiality is above suspicion. This arbitrator is the public condition house, which, officially organised, offers an absolute guarantee of secrecy as regards the transactions revealed to it. The following is the system adopted in arriving at the proportion of moisture:—

For some time it had been remarked that the quantity of moisture contained varied very little for the same fabric when it is placed for a sufficiently lengthened period under the average conditions of atmosphere and humidity. This constant figure seems to be established in the proportion of 9·5 per cent. for silk, 14·50 per cent. for combed or spun wool, 7·80 per cent. for cotton yarn, and 10·70 per cent. for linen. The above proportion, as regards silk, served as a basis for the primary processes employed in silk conditioning. The silk was spread out, and left exposed to the air for a long time in a well-ventilated place. The material was then weighed and the weight found was adopted by the seller and the buyer as the basis of the settlement of their account. This method of procedure could only give an approximation frequently varying with the season, and it will be easily understood what advantages would be derived by a person buying in a dry season and selling in a wet one. On the other hand, this method necessitated the establishment of drying places of considerable extent.

The true principle of conditioning was really established by the works of Talabot and D'Arcet upon the condition houses of Lyons. From their numerous experiences it resulted that silk exposed to a temperature above 100° soon threw off its moisture without in any way injuring its textile properties. The weight of the silk after desiccation was called "absolute weight." Later on, it was recognised that the same system might be adopted for other tissues, such as wool, cotton, and linen; but in order to attain absolute desiccation without injuring the fibres, it was found necessary that the temperature to which they were exposed should be lower than 100°, the point required by silk.

To obtain this weight accurately certain methods were invented by Talabot and perfected by Gamot, by which the weight of the tissues could be obtained while undergoing the drying process. It had been remarked that on emerging from the drying apparatus the textile fibre very rapidly absorbed water, and Persoz, in concert with Rogeat, of Lyons, invented the apparatus now in use generally throughout the whole of France, by which the heating is effected by a current of warm air proceeding from a stove.

Conditioning then really means the determining of the absolute weight of the goods presented for that purpose. To this absolute weight is added the amount agreed upon between the seller and the buyer as representing the quantity of moisture that ought legitimately to be contained and which is known as *reprise*. The total weight thus obtained is the "condition weight," serving as a basis for the making out of invoices.

In principle, the process of conditioning comprises two operations. The first consists in determining by the aid of a drying room how much humidity per cent. is contained in various samples. Experience has proved that when a sample does not exhibit further appreciable diminution in weight after exposure for a period of six minutes it may

be considered as absolutely dry. The weight is then taken independently by two employés, and the material is removed from the apparatus. By a very simple calculation a deduction is made from the primary weight and the absolute weight of the proportion of moisture contained in the sample which is known as the "proof."

The second operation is effected in the offices of the condition houses. This consists in applying the results to which attention has been directed above to the calculation of the condition weight, that is to say, to the amount the proof ought to weigh, and consequently the total weight if it only contained the proportion of moisture recognised as legal or legitimate, or *réprise* as it is called. It has been admitted, and the authorities have adopted it as a legal rate, that this *réprise* in the case of wool should be at the rate of 17 per cent. That means that if the net condition weight of a bale of wool is 117 kilos., there will be found 100 kilos. of wool absolutely dry and 17 kilos. of moisture. This wool therefore contains as moisture 17 out of 117, or 14·530 per cent.

At the same time as they determine the degree of moisture the condition houses indicate, when the article is spun, and when required, the numbering or weighing of the skeins. This number serves to distinguish the degree of fineness of the thread under investigation. The basis of this calculation is either the weight of a constant and uniform length of this thread (in the case of silk), or the length corresponding to a fixed and determined weight, which latter system is adopted for tissues other than silk.

The old category of silk threads was formerly estimated according to the number of coins (*deniers*) that would be required to counterbalance the weight of 400 ells of this thread. In metrical measure the *denier* is equivalent to 53·13 mgrms., and 400 ells correspond to very nearly 176 metres. These *deniers* and ells have no longer any legal value, their signification is even generally ignored, but the laws of routine are always sacred in France; the trade still insists upon these out-of-date expressions, and continues to make use of them now that the metrical system is in general use, as if the latter had never existed. The legal standard is determined by the weight in grammes and fractions of grammes of a skein of 500 metres. At various recent international congresses the opinion has been unanimously expressed (an opinion acted upon by some condition houses) that the category of silk should be determined by the number of decigrammes that 1,000 meters of the thread weigh, or which amounts to the same thing, by the number of grammes that a myrimetre will weigh.

As regards other tissues, it will be found that the numbering of the threads varies not only with the country, but even according to the various districts of each country, and yet nothing can be clearer than the terms of the decree of 1810 prescribing the numbering of threads. These are as follows. "All proprietors of spinning mills are to form skeins of the yarns of cotton, linen, hemp, or wool of a thread of 100 metres in length, and to make the hank of 10 of these skeins, so that the total length of the thread forming the hank shall be 1,000 metres; these threads shall be labelled with the number indicative of the skeins necessary to make up the weight per kilogramme." In short, the number of a thread is expressed by the number of thousand metres necessary to make up the weight of a kilogramme. Instead of saying, for example, of a thread that it is No. 35·2, which in Paris signifies that it requires 35 skeins and two-tenths of a skein to make up a half kilogramme, how much simpler it would be to express it as 50,000 metres. It would be at once understood that with a kilogramme of this thread a length could be made of 50,000 metres. Moreover, this thread, which in Paris is numbered 35·2, is known at Roubaix as No. 35, at Rheims it becomes No. 35·70, at Lyons No. 34·70, and elsewhere No. 17·50.

In all conditioning operations the apparatus used to determine the number of the threads is specially manufactured in Paris or Lyons, and is so constructed as to allow of either 20 or 24 skeins of 250 or 500 metres in length being made. In addition to the actual numbering, the condition houses have also to deal with another operation. The commercial value of textile fabrics is only really ascertained and determined when the threads have been assayed or conditioned—that is to say, only after the operations of weighing and *dévensage*, or boiling, which determine mathematically the thickness and the regularity of the thread. Moisture is not the only heterogeneous substance which increases the weight of textile fabrics; other substances are also mixed more or less with wool, cotton, and silk, which disappear after washing or scouring of the threads. These foreign substances are sometimes natural and sometimes the result of fraudulent practices. Silk, for instance, while still enclosed in the worm is a compound substance, a fibre wrapped up in an impervious envelope, the chemical composition of which, as is shown by analysis, is analogous to that of *osseine*. This envelope is technically called *grés de la soie*. By the process of boiling, the silk is divested of the *grés* which it contains. Raw wool is also heavily loaded with grease, dust, and other refuse. When worked up, other substances also, which have escaped the washing, are frequently discovered.

The *dévensage* of the silk is effected in the condition houses by two successive boilings in water in which soap of the purest kind is added. The comparison of the actual weight before and after the operation gives the percentage of foreign matter.

Wool is treated in a totally different way to silk. Samples of the raw wool are subjected to a scouring process, with a view to determine the actual condition of the mass. Another process, which should properly be termed the washing, has for its object the removal from the wool already worked up, combed, spun, or dyed, of foreign matter, grease particularly, with which it may be loaded. The treatment consists of steeping and washing it with lukewarm water, hydrochloric acid, and carbonate of soda.

The Mica Industry of the United States.

The production of cut mica in the United States in 1889 amounted to 49,500 lb., valued at 50,000 dols. In addition to this, 196 short tons of scrap or waste mica were sold for grinding purposes, with a value of 2,450 dols. The production in 1880, as given in the 10th Census Report, was 81,669 lb. of cut mica, valued at 127,825 dols.

A review of the annual production during the past nine years shows that the industry advanced in importance until 1885. Since then the tendency has been downward, though the fluctuations in the production of the different regions have caused much irregularity in the annual totals. The following table does not include statistics of scrap and waste mica, as there had been no attempt prior to 1889 to determine the amount of this waste which has been utilised:—

Years.	Amount.	Value.	Years.	Amount.	Value.
	Lb.	Dols.		Lb.	Dols.
1880	81,669	127,825	1885	92,500	161,000
1881	100,000	250,000	1886	40,000	70,000
1882	100,000	250,000	1887	70,000	142,250
1883	114,000	285,000	1888	48,000	70,000
1884	147,410	368,525	1889	49,500	50,000

During the years 1883 and 1884, when mica mining was in its most flourishing condition, the manufacturers of stoves consumed probably 95 per cent. of the product, and the fancy grades and large sizes of sheet mica which were then used found a ready sale at highly profitable prices. Under this stimulus of large profits many surface deposits or pockets were opened by farmers or other individuals of small means, who worked them occasionally when other business was dull and realised a considerable profit on their production. As long as the demand for large sizes continued this intermittent sort of mining could be carried on with a degree of success, but when the fashion in stove panels changed, and small sheets were used in place of the large ones, the demand for the latter fell off to a great extent. Mica suitable for cutting into large sheets was

much less abundant than that available for small sizes; therefore lower rates had always prevailed for the latter, and careful, steady, and systematic methods were necessary to produce such grades profitably. When the demand changed from large to small sizes the majority of miners were unprepared through lack of capital or for other reasons to adopt such methods. The result was a great reduction in the number of producing mines, and consumers were compelled either to raise the price of mica or look to foreign sources for their supply. Another factor in increasing importation came into existence with the extended manufacture of dynamos and other electrical apparatus, in which a great deal of mica is used. The foreign article, especially that produced in Canada, was, on account of its superior cleavage, preferred to the domestic for this purpose, but since miners have become more fully acquainted with the qualities desired for electrical uses it has been proved that the United States can produce mica for this purpose equal to any found abroad. The foreign supply, after gaining a foothold in American markets, has more than held its own, and as its tendency has always been toward a reduction in prices, there has been little inducement for the outlay of capital in mica mining.

Only a small number of mines were operated in 1889, and a few of these were worked steadily throughout the year. However, there was a fair amount of development work done in the different mica regions, and it is expected that the introduction of more systematic methods of mining will greatly increase the importance of the industry.

Occurrence.—The localities in which mica occurs in an available form are not very numerous, and it is only in New Hampshire and North Carolina that the industry has assumed much importance. In the West the most important deposits are located in the Black Hills, in the neighbourhood of Harteville, Wyo., and in the Cribbensville district of New Mexico.

The available deposits of mica occur in bands of coarsely crystalline granite. In these bands the three constituents of the granite (mica, feldspar, and quartz) have in a measure crystallised in separate masses, and the mica is found in bunches or pockets irregularly distributed throughout the mass. The deposits are of great interest aside from their commercial importance on account of the number of rare minerals which are nearly always present. Among these are beryl, tourmaline, garnet, columbite, and samarskite. In some cases one or more of these minerals are present in sufficient quantity and of such fine quality as to give value to the deposit. Some of the finest tourmalines in the world have been found at Mount Mica, near the town of Paris, Maine, in the mica deposit at that place. Tin ore is also an accompaniment of the mica deposits in the Black Hills region.

Treatment of the Crude Product.—Mica is used in two forms, sheet mica and ground mica, and the manner in which it is treated when taken from the mine depends upon the form in which it is to be used. If it is to be sold as scrap for grinding, all that is necessary is to remove the adhering fragments of quartz and feldspar and such parts of the mica as may contain foreign ingredients. If it is to be used in the sheet form the process is much more complicated, the blocks being first split into sheets thin enough to cut easily, then marked with a pattern of the size desired, cut along the lines marked, and the different sizes wrapped in paper, and packed for shipment. There is a great amount of waste about this operation. The amount of sheet mica obtained does not usually exceed from 4 per cent. to 8 per cent. of the block mica treated.

Uses.—The most common and well-known use for mica is in the panelling of stove and furnace doors. For this purpose the mica must be clear, free from spots, and of a uniform colour throughout the sheet. The most desirable colour is a wine-red, and next to this comes white mica, which is nearly as valuable. Another important use is in the manufacture of electrical apparatus, for which purpose its non-conducting properties render it valuable. The qualities required for this use are firmness of texture, toughness, and ready cleavage.

There is a greater range of use for ground mica than for the mineral in sheets, and, though the value of that part of the product made use of in this form is small, the many peculiar properties which ground mica possesses render it quite probable that its use will be widely extended. The difficulties to be overcome in grinding mica are considerable, and there are only two or three firms engaged in the business at present. Eight standard grades of ground mica are made. The coarsest of these are used to give frosted and spangled effects to the fancy grades of wall paper. The medium grades are employed in the manufacture of a lubricant for the journals of railway carriages, for heavy bearings generally, and for the axles of road vehicles. The finest grades are used in producing a uniform metallic white surface on wall paper. Scrap mica for grinding must be white and as free from specks or coloured matter as possible, since any impurities in the scrap will affect the colour and lustre of the product.

Production.—The greater part of the product in 1889 was taken from one mine in New Hampshire. Of the North Carolina mines none were in steady operation throughout the year, and the production of that State was the result of irregular and spasmodic efforts. In Virginia the production was confined to one mine, located at Amelia Court House, which was exhausted early in the year. In the Black Hills region, where, in 1884, 11 mines were operated, with a production of over 18,000 lbs. of mica, only one produced in 1889, and that only a small amount. In New Mexico a good deal of development work was done and a quantity of good mica was reported as taken out; but as none of this was marketed it has not been included in the totals for 1889.

The statistics of the industry in 1889 are shown in the following table:—

Distribution.	Production. Cut. Pounds.	Cut. Value.	Scrap. Short Tons.	Scrap. Value.	Expenses. Total.	Wages.	Men Employed.	Capital Invested.
		Dols.		Dols.	Dols.	Dols.		Dols.
New Hampshire	40,000	40,000	150	2,000	38,635	28,330	70	191,750
North Carolina	6,700	7,000	..	..	12,722	7,266	63	138,475
Virginia	* 2,800	3,000	* 36	150	† 4,728	† 4,528	26	..
South Dakota							3	13,300
New Mexico	..	..	..	..	2,250	2,050	12	14,700
Other States	..	..	..	..	..	..	11	30,325
Total	49,500	50,000	196	2,450	58,335	42,174	185	601,550

* Combined in order that operations of individual establishments may not be disclosed.
† Including Massachusetts, Wyoming, and Idaho.

The amount of manufactured mica imported into the United States since 1869 has been as follows:—

Year.	Value.	Year.	Value.	Year.	Value.	Year.	Value.
	Dols.		Dols.		Dols.		Dols.
1869	1,165	1875	..	1880	12,562	1885	28,685
1870	226	1876	562	1881	5,830	*1886	56,354
1871	1,460	1877	13,085	1882	5,175	1887	49,084
1872	1,002	1878	7,950	1883	9,884	1888	57,541
1873	498	1879	9,274	1884	28,284	1889	97,351
1874	1,204						

* Calendar years from 1886 to 1889; previous years ending June 30.

—*Eng. and Min. Journal.*

Fixation of Nitrogen by Electricity.

M. Berthelot, Director of the Meudon Station of Vegetable Chemistry, reports that experiments carried out during the past season, in continuation of a long series of researches, confirm previous conclusions as to the effect of electricity in facilitating the fixation of nitrogen by the soil and by plants. The operations necessary for obtaining results are too complicated and costly to be employed commercially in agriculture or horticulture; but they are interesting in so far as they show the connexion of electricity with fertility in the ordinary course of nature. The gain of nitrogen where electricity has been employed has been great, not only in soil covered with vegetation, but also in that kept bare, and in the open air as well as in closed receptacles. —*Standard Agricultural Reports.*

Remedies for Potato Disease.

The annual report of the Intelligence Department of the Board of Agriculture on injurious insects and fungi in 1890, travels of much the same ground as Miss Ormerod's report, previously issued, but it has the advantage of being published by the Queen's Printers at a nominal cost. The most interesting portions of it are those relating to remedies for potato disease, and the use of insecticides for fruit trees. The results of some experiments carried out by the United States Department of Agriculture in the application of *Bouillie bordelaise*, a mixture of sulphate of copper and quicklime, used for the vine mildew in France, are recorded. The details are not satisfactory, because neither the size of the plots (or "plats," as given in the report, American spelling being adopted) nor the total quantity of the mixture used during the season is given. The piece of land was divided into three parts, there being 75 hills of potatoes in each. To two of these plots a mixture consisting of 6 lb. of sulphate of copper, 4 lb. of quicklime, and 22 gallons of water was applied where the plants were a foot high, the application being repeated every fortnight until the 10th of September. The remaining plot was not treated. The results were yields of 346 lb. and 283 lb. on the dressed plots, and 164 lb. on the plot not sprayed. The proportions of the mixture are not the same as those used in France and Belgium, namely, two parts of copper sulphate to one part of lime. M. Petermann, of the Gembloux Agricultural Station, Belgium, has succeeded in reducing the proportion of diseased potatoes from 30 per cent. where no dressing was applied, to 7 per cent. where the mixture was used. He recommends one application, as soon as any signs of disease appear, of 44 lb. of sulphate of copper, 22 lb. of quicklime, and 220 gallons of water per acre, syringed over the potato tops. In the report it is stated that the wash is inexpensive; but it certainly would not be so if applied frequently, as in the American experiment. The quantities just named would cost about 7*s.* 6*d.* per acre at the present price of sulphate of copper, which might be doubled if there were any great demand for it, either for vines or potatoes. Mr. Petermann believes that sulphate of iron would do instead of copper sulphate, and this should be tried, as it is much less costly.

As it is probable that many persons will desire to try the remedy for potato disease, a description of the method pursued in preparing the mixture will be useful. The sulphate of copper is placed in a wooden vessel and dissolved in a few gallons of boiling water, the quantity not being material so long as it is measured. In another vessel the quicklime is dissolved by first slaking it, and then adding more water and stirring it well. If any lumps are left undissolved they should be removed and replaced with an equal weight of fresh lime. When both materials are dissolved the lime water is poured into the copper solution through a fine sieve to keep back any pieces of undissolved lime, and then the entire mixture is well stirred, and the rest of the water is added. When being used the mixture should be frequently stirred. It is recommended for hop mildew and onion mildew, as well as for potatoes and vines; but market gardeners may well be warned that it would not be safe to use the poison on onions which are to be pulled in a week or two.

Discovery of Asbestos in New South Wales.

The *Sydney Morning Herald* of March 16th says:—"Mr. C. S. Wilkinson, the Government geologist, has received from Mr. J. R. Edwards, a solicitor at Broken Hill, several samples of asbestos, which were discovered at Red Hill, near Broken Hill. The asbestos was obtained in a vein measuring from 2½ ft to 3 ft. in width, at a depth of 10 ft. from the surface. Some of it contains fibre 13 in. long, the texture being silky and flexible. The Broken Hill material is not, however, as strong or tough as the Italian asbestos. The colour, too, is different, as the Broken Hill asbestos is reddish in hue, owing to the influence of iron oxide. It is expected that a white mineral will be found at a greater depth. Several tons of asbestos have been brought to grass."

Papers of Interest to Technologists and Manufacturers.

The following articles in the *Board of Trade Journal* for May will repay perusal:—

"Cost of Production of Piece-Dyed Satins at Lyons," p. 505.

"French Mining Industries," p. 507.

"The Wealth and Resources of Alaska," p. 524.

BOARD OF TRADE RETURNS.

Summary of Imports.

	Month ending 30th April	
	1890.	1891.
	£	£
Metals	1,856,217	2,072,811
Chemicals and dyestuffs	785,767	843,379
Oils	435,581	481,971
Raw materials for non-textile industries	3,033,320	3,120,869
Total value of all imports	35,680,242	38,982,537

Summary of Exports.

	Month ending 30th April	
	1890.	1891.
	£	£
Metals (other than machinery)	3,785,367	3,663,725
Chemicals and medicines	750,584	800,492
Miscellaneous articles.....	2,881,162	3,091,150
Total value of all exports.....	20,314,367	20,919,066

Imports of Metals for Month ending 30th April.

Articles.	Quantities.		Values.	
	1890.	1891.	1890.	1891.
			£	£
Copper :—				
Ore..... Tons	9,889	5,579	71,997	41,780
Regulus ..... „	7,363	16,625	198,008	405,983
Unwrought .... „	2,788	3,323	137,216	183,268
Iron :—				
Ore..... „	512,869	265,659	451,081	215,138
Bolt, bar, &c.... „	5,957	3,110	60,429	28,846
Steel, unwrought.. „	290	514	3,230	6,519
Lead, pig and sheet „	12,001	12,995	152,049	161,621
Pyrites ..... „	55,683	55,648	190,543	165,781
Quicksilver..... Lb.	879,694	538,425	110,164	58,759
Tin..... Cwt.	33,777	62,806	151,283	281,912
Zinc ..... Tons	2,549	4,830	55,895	110,709
Other articles ...Value £	..	..	364,313	469,498
Total value of metals	..	..	1,856,217	2,072,814

Imports of Chemicals and Dyestuffs for Month ending 30th April.

Articles.	Quantities.		Values.	
	1890.	1891.	1890.	1891.
			£	£
Alkali..... Cwt.	3,071	7,668	1,588	4,119
Bark (tanners, &c.) „	53,469	41,073	22,566	16,104
Brimstone..... „	64,299	28,189	13,952	9,663
Chemicals..... Value £	..	..	113,755	113,787
Cochineal ..... Cwt.	902	625	5,989	3,889
Cutch and gambier Tons	1,400	2,417	39,244	56,328
Dyes :—				
Aniline ..... Value £	..	..	23,857	20,759
Alizarine ..... „	..	..	17,486	27,254
Other ..... „	..	..	2,549	739
Indigo ..... Cwt.	7,221	4,309	107,076	69,157
Madder ..... „	420	890	555	1,127
Nitrate of soda.... „	278,239	603,719	126,422	267,113
Nitrate of potash . „	28,575	37,659	25,194	32,314
Valonia ..... Tons	4,184	1,823	85,506	39,344
Other articles... Value £	..	..	171,028	181,682
Total value of chemicals	..	..	786,767	843,379

Imports of Oils for Month ending 30th April.

Articles.	Quantities.		Values.	
	1890.	1891.	1890.	1891.
			£	£
Cocoa-nut..... Cwt.	10,339	26,092	12,529	39,770
Olive ..... Tuns	2,068	1,314	71,959	55,298
Palm ..... Cwt.	61,729	74,585	64,890	86,648
Petroleum ..... Gall.	6,018,981	8,224,252	140,146	179,938
Seed ..... Tons	1,307	1,684	34,890	41,169
Train, &c..... Tuns	1,005	576	25,008	12,798
Turpentine ..... Cwt.	15,739	4,445	23,533	5,857
Other articles .. Value £	..	..	64,626	63,496
Total value of oils ...	..	..	435,581	484,974

Imports of Raw Materials for Non-Textile Industries for Month ending 30th April.

Articles.	Quantities.		Values.	
	1890.	1891.	1890.	1891.
			£	£
Bark, Peruvian .. Cwt.	11,349	9,820	31,212	23,195
Bristles..... Lb.	355,599	260,857	61,577	43,758
Caoutchouc..... Cwt.	20,817	20,563	251,404	406,479
Gum :—				
Arabic..... „	3,186	4,738	10,658	13,156
Lac, &c..... „	10,792	15,867	44,077	61,114
Gutta-percha .... „	8,201	6,138	100,588	61,236
Hides, raw :—				
Dry..... „	44,579	48,188	115,833	117,052
Wet..... „	46,610	34,355	103,936	78,341
Ivory..... „	1,130	1,048	58,714	59,027
Manure :—				
Guano..... Tons	3,843	3,669	22,166	17,557
Bones..... „	8,980	10,366	47,002	50,137
Paraffin..... Cwt.	38,507	60,944	47,771	88,185
Linen rags..... Tons	3,158	3,216	32,118	30,919
Esparto..... „	20,809	19,251	97,609	94,544
Pulp of wood .... „	11,940	12,390	59,868	59,031
Rosin..... Cwt.	151,852	193,355	30,070	26,470
Tallow and stearin „	134,448	181,172	161,442	221,052
Tar.....Barrels	5,471	2,820	3,132	1,274
Wood :—				
Hewn ..... Loads	194,593	199,443	380,254	340,215
Sawn ..... „	205,292	142,007	521,382	326,394
Staves ..... „	10,932	8,046	41,189	47,828
Mahogany ..... Tons	6,958	4,142	62,558	39,881
Other articles....Value £	..	..	748,760	907,732
Total value	..	..	3,633,320	3,120,869

Besides the above, drugs to the value of £8,683, were imported, as against £6,231 in April 1890.

EXPORTS OF METALS (OTHER THAN MACHINERY) FOR MONTH ENDING 30TH APRIL.

Articles.	Quantities.		Values.	
	1890.	1891.	1890.	1891.
			£	£
Brass..... Cwt.	8,559	9,091	10,333	13,841
Copper:—				
Unwrought..... „	67,950	73,703	179,851	204,596
Wrought..... „	17,518	36,905	58,966	102,562
Mixed metal.... „	14,831	24,887	43,079	69,786
Hardware ..... Value £	..	..	222,709	218,055
Implements..... „	..	..	108,696	116,536
Iron and steel..... Tons	316,354	287,422	2,710,075	2,612,179
Lead ..... „	3,868	4,241	54,031	62,182
Plated wares... Value £	..	..	35,592	30,036
Telegraph wires, &c. „	..	..	187,733	59,226
Tin ..... Cwt.	8,209	9,020	39,747	47,134
Zinc ..... „	11,578	17,614	11,089	19,478
Other articles .. Value £	..	..	86,863	78,211
Total value	..	..	3,785,367	3,663,725

EXPORTS OF MISCELLANEOUS ARTICLES FOR MONTH ENDING 30TH APRIL.

Articles.	Quantities.		Values.	
	1890.	1891.	1890.	1891.
			£	£
Gunpowder..... Lb.	659,860	1,058,000	11,078	23,974
Military stores.. Value £	..	..	132,816	116,926
Candles..... Lb.	912,500	1,357,700	16,951	26,433
Caoutchouc ..... Value £	..	..	98,152	114,575
Cement..... Tons	54,478	62,102	109,407	125,960
Products of coal Value £	..	..	130,297	179,669
Earthenware ... „	..	..	186,448	170,350
Stoneware ..... „	..	..	19,856	15,844
Glass:—				
Plate..... Sq. Ft.	330,400	240,823	19,946	14,264
Flint..... Cwt.	8,252	9,039	17,646	20,058
Bottles..... „	77,914	81,249	36,408	38,303
Other kinds.... „	17,518	17,331	16,065	13,150
Leather:—				
Unwrought .... „	12,225	11,814	109,867	107,762
Wrought ..... Value £	..	..	21,042	30,119
Seed oil..... Tons	5,861	8,271	134,756	185,670
Floorcloth ..... Sq. Yds.	1,164,000	1,305,700	66,457	65,636
Painters' materials Val. £	..	..	128,289	152,245
Paper ..... Cwt.	79,629	95,116	138,825	162,731
Rags..... Tons	1,413	3,613	31,520	29,527
Soap..... Cwt.	46,093	45,757	46,731	52,841
Total value	..	..	2,881,462	3,091,150

EXPORTS OF DRUGS AND CHEMICALS FOR MONTH ENDING 30TH APRIL.

Articles.	Quantities.		Values.	
	1890.	1891.	1890.	1891.
			£	£
Alkali..... Cwt.	600,373	524,749	184,514	197,862
Bleaching materials „	161,143	119,533	47,751	40,576
Chemical manures. Tons	20,279	21,817	147,813	181,810
Medicines..... Value £	..	..	77,938	97,253
Other articles ... „	..	..	292,558	282,961
Total value	..	..	750,574	800,462

Monthly Patent List.

* The dates given are the dates of the Official Journals in which acceptances of the Complete Specifications are advertised. Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the said dates.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

APPLICATIONS.

6797. G. Weigelin. *See* Class VIII.

6798. A. J. Boult.—From L. Falasconi, Italy. Improvements in kilns for furnaces. April 20.

6887. J. Peake. Improvements in or relating to kilns for various purposes. April 21.

7187. S. M. Lillie. Improvements in evaporating apparatus. Complete Specification. Filed April 25. Date applied for September 26, 1890, being date of application in United States.

7188. M. Merichenski. Improvements in carburettors. April 25.

7205. The Gaseous and Liquid Fuel Supply Co., Lim., and B. H. Thwaite. Improvements in apparatus for inducing the flow of, and injecting and spraying, gaseous and liquid fluids. Complete Specification. April 27.

7216. J. Jones. *See* Class XVII.

7336. A. J. Boult.—From G. Castanos and G. L. de Lara, France. Improvements in apparatus for extracting the juice from oily and pulpy substances. April 28.

7461. A. Hof. Improvements in carburating or carbonising apparatus. April 30.

7446. W. Birch. Improved apparatus applicable to the cleansing or filtration of sewage and other liquids. April 30.

7636. T. A. A. Pile and W. A. Pile. Improvements in machines for moulding and pressing clay or other plastic materials. May 2.

7704. H. Burgess and C. D. Davis. Vacuum evaporating apparatus. Complete Specification. May 4.

7725. A. Suiter. Improvements in fittings for compressed gas-vessels. May 5.

7770. A. Bridge and C. A. D. Evans. Improvements in devices for utilising the circulation of hot fluids in washing, dyeing, extracting, concentrating, and other analogous apparatus. May 5.

7867. W. P. Thompson.—From Wirth & Co., Germany. Improvements in evaporating apparatus for concentrating liquids. May 7.

7869. W. P. Thompson.—From Wirth & Co., Germany. Improvements in evaporating apparatus for concentrating liquids of a pulpy nature. May 7.

8047. J. T. Pearson. An improved means or apparatus for humidifying fibrous substances. May 11.

8167. R. D. Gates. Improvements in concentrating apparatus. Complete Specification. May 12.

8169. H. L. Callendar. Improvements in thermometers. May 12.

8177. F. Smith and W. Travis. Improved apparatus for drawing off liquids. May 13.

8475. W. P. Thompson.—From P. Marix, France. Improvements in and relating to the method of effecting by means of centrifugal force the reaction of bodies of different densities on one another. May 16.

Complete Specifications Accepted.*

1890.

1235. R. Mannesmann. Method and apparatus for compressing air or other gaseous fluid. April 29.

1236. R. Mannesmann. Method and apparatus for compressing air or other gaseous fluid. April 29.

10,380. J. Murrie. Improved pyrometers or thermometers. May 20.

10,788. H. M. Saint Denis. Centrifugal drying machines. May 6.

11,042. J. W. Gooch, C. A. Baker, and W. White. Electric thermometers and thermographs. May 20.

11,082. J. Whitehead. Supplying fuel to furnaces and apparatus therefor. May 20.

12,421. D. Bethmont. Apparatus for generating steam, or vaporising liquids. May 20.

12,542. E. Guigon. Circulation of water in surface condensers. May 13.

1891.

3187. A. W. Ellis. Stand for chemical or other purposes. May 13.

3435. E. Nelson. Treating heated liquid wastes, and apparatus therefor. May 20.

3997. C. Smith.—From A de Kunwald. Apparatus for pumping, forcing, or exhausting liquids or gases. May 6.

5175. S. C. Hauberg. Centrifugal apparatus for testing the composition of milk and other compound of fluids. May 13.

5555. R. Haddan.—From J. W. Evans. Evaporators. May 6.

6405. J. R. Whiting and W. A. Lawrence. Recovery and utilisation of certain vaporised solvents. May 20.

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* *See* Note * on previous page.

II.—FUEL, GAS, AND LIGHT.

Applications.

6741. C. H. Bolz and A. Lubning. Improvements in the manufacture of illuminating and heating gas. April 20.

6794. F. J. Jones. Improvements in apparatus for washing or scrubbing and purifying gas in gas or coke making. April 20.

6947. W. T. Cotton and E. F. B. Crowther. An improved fire clay (inclined) gas retort with fittings attached to feed and clear the retort. April 22.

7064. A. C. Caddick and Co. Improvements in apparatus for making gas. April 24.

7092. A. A. Lister. Improvements in apparatus for extracting tar and ammonia from gas. April 24.

7202. F. J. Jones. Improvements in the manufacture of coke. April 25.

7558. L. Loewenthal. Improved manufacture or production of gas, and means or apparatus for the storage and application thereof. May 1.

7583. J. D. Bourán. The improvement of coal-gas retorts. May 1.

7648. E. Stauber. Process and appliances for producing peat coke cakes. May 2.

7846. B. Egger. Automatic apparatus for indicating the presence in or absence from a space of gases of different specific gravity from the ordinary gaseous contents of such space. May 6.

7983. A. A. Dixon. Improvements in and in apparatus for the manufacture of crude peat into fuel. Complete Specification. May 9.

8067. T. Keetman and W. Bach. Apparatus for charging and discharging gas retorts and other vessels. Complete Specification. May 11.

8068. T. Keetman and W. Bach. Scoop for discharging gas retorts. Complete Specification. May 11.

8071. C. H. Fitzmaurice. Improved means and appliances for utilising petroleum and the like with steam for heating purposes. May 11.

8176. T. H. Cobley. Improvements in the preparation or manufacture of compressed or block fuel (briquettes), and materials employed therein. May 13.

8413. J. Clegg. Improved means of regulating the preparation of illuminants for incandescent electric lamps. May 15.

8479. J. Ruscoe. Improvements in apparatus for charging and drawing gas retorts. May 16.

Complete Specifications Accepted.

1890.

7252. R. C. Lindsay. Manufacture of illuminating gas, and apparatus therefor. April 29.

7739. J. von Langer and L. Cooper. Manufacture of water-gas. May 20.

7830. B. C. Sykes and G. Blamires. Conversion of solid into gaseous fuel, and purifying same. May 6.

8752. W. Cryer. Means for producing or separating oxygen and nitrogen from atmospheric air; applicable for manufacturing other gases. May 6.

8909. H. Woodhall. Apparatus for charging inclined gas retorts. April 29.

8930. L. S. d'Iszoro. Apparatus for charging and drawing gas retorts. May 13.

8958. J. Finey. Fire-lighter, and machinery for making same. May 6.

9331. J. A. Whitby. The magic fire-lighter. April 29.

10,155. J. Roscoe. Means and appliances for facilitating charging and drawing certain gas retorts. May 13.

11,079. J. Laing. Apparatus for destructive distillation of mineral oils. May 20.

11,106. J. E. Bott, W. Mortimore, and F. H. Lindley. Gas-producers. May 20.

14,052. L. H. Armour. Means for the manufacture of hard coke, distilling shale, washing ores, and similar operations. May 20.

1891.

2145. G. Hargreaves, J. P. Scranton, and E. W. Porter. Apparatus for carburetting air. April 29.

2889. W. P. Thompson.—From G. S. Sandford. Apparatus for the manufacture of gas from petroleum oil. April 29.

1834. A. Lutschaunig. Manufacture of fire-lighter or fire-lighting material. May 13.

IV.—COLOURING MATTERS AND DYES.

Applications.

6972. S. Pitt.—From L. Cassella and Co., Germany. Production of amidonaphtholsulpho acids and of dye-stuffs therefrom. April 22.

7258. J. Y. Johnson.—From The Badische Anilin and Soda Fabrik, Germany. Improvements in the manufacture and production of dyes belonging to the rhodamine series, and of new materials for use in their preparation. April 27.

7692. A. Fischesser. An improved process for producing azo-colouring matters and sulpho acid. May 4.

7713. J. Y. Johnson.—From The Badische Anilin and Soda Fabrik, Germany. The manufacture and production of diazo dyes, and of intermediate products in their preparation. May 4.

7803. A. Lembach, F. Schleicher, and C. F. Wolf. Improvements in the manufacture of ortho-oxy-quinoline and oxyquinoline derivatives. Complete Specification. May 6.

7963. O. Imray.—From The Farbwerke vormals Meister, Lucius, and Brüning. Manufacture of nitro- and amidomethyl-phenylpyrazolon. May 8.

7964. O. Imray.—From The Farbwerke vormals Meister, Lucius, and Brüning. Production of blue colouring matters. May 8.

8407. S. Pitt.—From L. Cassella and Co., Germany. Production of blue dyestuffs. May 15.

Complete Specifications Accepted.

1890.

8243. W. R. Lake.—From A. Leonhardt and Co. Manufacture of colouring matters. April 29.

8726. J. Y. Johnson.—From The Badische Anilin and Soda Fabrik. Production of a new compound, and of artificial indigo from phenyl-glycocoll or analogous compounds or derivatives thereof. May 13.

9200. R. W. E. MacIvor. Manufacture of ultramarine. May 20.

9676. J. Y. Johnson.—From The Badische Anilin and Soda Fabrik. Manufacture of substantive dyestuffs and of materials therefor. April 29.

9768. J. Dawson and R. Hirsch. Production of a new naphthylendiamiamonosulpho acid. May 6.

10,095. J. Y. Johnson.—From The Badische Anilin and Soda Fabrik. Manufacture of trioxy-benzo-phenone, a colouring matter of the oxyketone group. May 6.

10,401. W. S. Conrad. An instantaneous copying-ink. May 20.

10,509. J. Y. Johnson.—From The Badische Anilin and Soda Fabrik. Production of artificial indigo, and of a new material for use therein. May 13.

10,599. H. H. Lake.—From K. Oehler. Manufacture of colouring matters. May 6.

11,548. J. Imray.—From La Société Anonyme des Matières Colorantes et Produits Chim. de St. Denis. Manufacture of azo-colouring matters derived from azo-oxyamines. May 20.

V.—TEXTILES, COTTON, WOOL, SILK, Etc.

Application.

7158. S. C. Dhondy. Sizing compounds for cotton yarn. April 30.

Complete Specifications Accepted.

1890.

7123. W. Peters. Method and appliances for tarring, colouring, and preparing thread, hemp, jute, &c. for sewing. May 20.

10,285. T. J. Hutchinson. Method and means for removing fatty matters from textile fabrics. May 13.

17,531. R. W. Thom. Backing or back starching and finishing textile fabrics. April 29.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

Applications.

6862. A. E. J. Malieu. New or improved process for bleaching thread, yarn, and fabrics of linen, hemp, and other textile materials. April 21.

8064. J. C. P. Guthier. An improved vat-dyeing process. May 11.

Complete Specifications Accepted.

1890.

7198. W. H. Spencer. Bleaching textile fibres. May 6.

7786. A. F. S. George. Method and apparatus for producing coloured designs upon and through floor and wall-covering materials. April 29.

7787. A. F. S. George. Colouring and inlaying coloured designs upon and through linoleum and other materials. April 29.

10,323. W. Hutchinson. Apparatus for boiling, scouring, or cleansing textile fabrics. May 13.

11,100. A. H. Wardle. Machinery for dyeing hanks of silk and other yarn. May 20.

VII.—ACIDS, ALKALIS, AND SALTS.

Applications.

7362. C. Kellner. Improved apparatus for recovering sulphurous acid used in the manufacture of paper pulp from wood. Complete Specification. April 29.

7437. E. Fleischer. Improvements in and connected with the manufacture of alkali aluminates. April 29.

7654. G. F. Brindley. Improvements in the production of solid compounds of sulphuric acid and acid sulphate of sodium or potassium. May 2.

7757. C. H. Fish. Improvements in furnaces for burning sulphur. Complete Specification. May 5.

7893. J. J. Shedlock and T. Denny. *See* Class X.

8006. E. L. C. Martin. Improvements in the manufacture of caustic soda and caustic potash. May 9.

8018. G. Lunge and J. Dewar. A process for recovery of sulphur, carbonate of soda, and iron oxide from double sulphide of sodium and iron. May 9.

8293. H. H. Leigh.—From J. Elsner, France, and R. Gasch, Germany. Improvements in process and apparatus for procuring cyanogen and its compounds from gases. May 14.

8344. W. Bowman. — From J. H. Bowman, Canada. Improved process for the treatment of phosphate of alumina, phosphates of alumina and iron, and the like. May 15.

8470. G. Bamberg. Improvements in the manufacture of silicate of soda and carbonate of soda, and in apparatus for that purpose. May 16.

Complete Specifications Accepted.

1890.

7247. H. Baudouin and P. F. Escarpit. Process and apparatus for manufacture of ammonia. May 20.

7527. J. Vivian and G. Bell. Apparatus for use in manufacture of bicarbonate of soda by the ammonia process. April 29.

8901. R. H. Davidson and R. H. Davis. Treatment of alkali waste for production of sulphuretted hydrogen. May 13.

9112. F. Ellershausen. Manufacture of caustic soda. May 6.

10,115. H. Precht. Process and apparatus for purifying double carbonate of potassium and magnesium. April 29.

12,717. H. B. Yardley. Utilisation of gases which form insoluble or partially insoluble precipitates. May 20.

1891.

2019. W. Walker. Process and apparatus for obtaining silicates for making glass, and the production of hydrochloric acid. May 13.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

Applications.

6797. G. Weigelin. Improvements in the methods and appliances for drying moist material, for instance, newly formed bricks, pipes, flags, and such like, by means of artificial heat. Complete Specification. April 20.

6924. E. Bilton. A method of glazing pottery, porcelain, and similar bodies. April 22.

7040. W. A. Kerr. *See* Class IX.

7456. J. S. Williams. Decoration on china. April 30.

7547. J. Morton. Improvements in kilns for burning retorts, pipes, quarries, and other refractory substances. May 1.

7773. T. H. Catlow and A. H. Vass. An improved construction of kiln for burning bricks and like goods. May 5.

7826. J. G. Sowerby. Improvements in the formation of glass bottles. May 6.

7885. C. Blount, V. Ward, and A. Fisher. Translucent cloisonne enamel. Complete Specification. May 7.

7896. F. W. Drayeott. An improved device for use in supporting pottery ware whilst being fired. May 7.

7908. J. E. Bousfield.—From F. Schultz, Germany. Improvements in the manufacture of stove-tiles, mouldings, rosettes, and the like, and in apparatus therefor. Complete Specification. May 7.

7909. Craven, Dunnill, and Co., Lim., and F. R. Smith. Improvements in the manufacture of tiles, ceramic, mosaic, and the like, and in apparatus therefor. May 7.

7988. T. C. J. Thomas. Improvements in the manufacture of glass. May 9.

7999. H. S. Berge. An improved glass-melting furnace. May 9.

8090. G. Gehring. Improvements in and relating to enamel for metals, glassware, earthenware, and other materials. Complete Specification. May 11.

8221. C. J. Chubb and J. G. Ivey. An improvement in or connected with the manufacture of colourless or light coloured glass, and such like ware. May 13.

Complete Specifications Accepted.

1890.

9172. R. J. Withers. Roof and hanging tiles. April 29.

9867. W. H. Hilde. Manufacture of hollow glass-ware, and apparatus therefor. May 13.

9942. O. Dillmann. Producing coloured designs on glass. April 29.

11,279. Gibbons, Hinton, and Co. Manufacture of ornamental tiles. May 20.

12,212. G. F. Chance, and Chance Bros. and Co., Lim. Lears for annealing sheets of glass. May 6.

1891.

2019. W. Walker. *See* Class VII.

5782. A. J. Boult.—From L. T. Harras and G. Hoffmann. Manufacture of glass letters and the like. May 13.

6118. H. Warrington. Kilns or ovens for bricks, earthenware, porcelain, and similar material. May 20.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

Applications.

6937. G. Haynes. An improved combination of materials for paving, coping, and other purposes. April 22.

7040. W. A. Kerr. An improved composition or compound designed to serve as a substitute for wood, and also applicable for the manufacture of bricks and crucibles, retorts, and other articles of earthenware. April 23.

7043. S. Snell. An improved combination of materials for producing ornamental work and mouldings. April 23.

7184. W. W. Horn.—From W. L. Mason, T. W. Blakey, and J. A. Wright, United States. An improved artificial stone. April 25.

7190. E. M. Thomlinson. Improvements in the manufacture of cement. April 25.

7717. F. W. S. Stokes. Improvements in apparatus connected with the continuous treatment of lime, cement, and the like materials, and in the lining of kilns and furnaces for burning basic materials. May 5.

7773. T. H. Catlow and A. H. Vass. An improved construction of kiln for burning bricks and like goods. May 5.

7845. H. Faija. Improvements in continuous or running kilns for the calcination of cement. May 6.

8017. O. Imray.—From F. Zernikow, Germany. Improved apparatus employed in the manufacture of artificial sandstone. Complete Specification. May 9.

8347. C. Wittkowsky. A composition of matter consisting in casein-cement. Complete Specification. May 13.

Complete Specifications Accepted.

1890.

8993. V. L. Daguzan. Cementing material. April 29.

10,036. J. P. Bayly.—From W. Lenderoth. Manufacture of porous earthenware building material. May 6.

11,796. E. Dupont. Manufacture of compound slabs of plaster, cement, &c. May 20.

1891.

6118. H. Warrington. *See* Class VIII.

X.—METALLURGY, MINING, Etc.

Applications.

6808. J. Lang and F. H. Wigham. A process for protecting iron and steel against oxidation. April 20.

6844. J. Carlton and J. Reid. Improvements in annealing or treating steel or iron. April 21.

6883. C. T. J. Vautin. Improvements in the recovery of gold from solutions. April 21.

6942. W. Beardmore. Improvements in the manufacture of armour plates, and in apparatus therefor. April 22.

7022. J. O'Neill and J. E. Hartley. Improvements in the process of bronzing metallic surfaces. April 23.

7050. F. M. Lyte and C. H. M. Lyte. An improved method of coating iron and steel with lead. April 23.

7069. J. Willis. Improvements in the manufacture of iron or steel ingot moulds or chills. April 24.

7088. J. C. Butterfield. Improvements in the treatment of bluestone and other sulphurised ores. April 24.

7150. N. Lébédeff. Improvements in the manufacture of iron and steel. April 25.

7585. H. L. Herrenschmidt. Improved processes for the treatment of silicated nickel ores and pyritic ores of nickel and copper, or nickel, copper, and cobalt. May 4.

7625. A. Tropenas. Improvements in the manufacture of steel, steel castings, or ingot iron, and in apparatus and appliances employed therein. May 2.

7673. W. C. Morison. Improvements in and connected with the reduction of ores. May 4.

7676. A. J. Campion. Improvement in the manufacture of pewter, solder, Britannia metal, metal sheathing, and anti-friction and other hard metals. May 4.

7718. J. A. Mays Improvements in amalgamation, and in amalgamating apparatus. May 5.

7777. W. P. Thompson.—From F. J. Clamer, United States. Improvements in or connected with the cooling of certain metals or metal articles with other metals or alloys. Complete Specification. May 5.

7824. W. Skaife. Improvements in or relating to galvanising metals. May 6.

7893. J. J. Shedlock and T. Denny. Improvements in the process of and apparatus for the treatment of sulphides and other analogous metallic compounds. May 7.

8083. L. Mond. Improvements in manufacturing nickel alloys. May 11.

8111. B. J. B. Mills.—From W. L. Brockway, United States. Improvements in the treatment of waste tinned steel or iron. Complete Specification. May 12.

8122. B. Krantz and H. Zeissler. A method of decorating metal articles with other metals deposited thereon. Complete Specification. May 12.

8127. W. G. Richards. Improvements in process of and moulds for making castings. Complete Specification. May 12.

8137. S. Pearson and J. H. Pratt. New or improved metallic alloys. May 12.

8115. A. W. Warwick. A process for extraction of antimony from its ores, and separation of other metals therefrom. May 15.

8471. W. F. Shand. Improvements in means and apparatus for the manufacture of steel. May 16.

8472. W. F. Shand. Improvements in the manufacture of steel, iron, and other metals. May 16.

Complete Specifications Accepted.

1890.

1369. G. C. Fricker. Cleaning and annealing iron and steel, and apparatus therefor. April 29.

7827. S. Fox. Application of water-gas to the manufacture of iron and steel in connexion with Siemens' and other gas-furnaces. May 6.

10,062. J. Bradbury. Utilisation of iron oxide obtained as a by-product in extracting copper from pyrites, or from spent oxide produced in the manufacture of sulphuric acid. April 29.

10,783. A. McDougall. Process for recovering tin from tin-plate, in which zinc-white is produced as a by-product. May 20.

11,606. P. Rogers and J. Player. Apparatus for coating metal sheets, &c., with tin, lead, &c. May 20.

1891.

5107. H. Warrington. Fire grates for puddling, heating, and similar purposes. May 13.

5242. W. R. Hinsdale. Process of casting ingots. May 6.

6323. E. Taussig. Apparatus for smelting and casting. May 20

XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

Applications.

6767. W. Lucas and T. A. Garrett Improved means for the production of ozone electrically. April 20.

6793. P. C. E. Champion. The application of electricity for the production of pyrotechnic and other similar effects, and apparatus therefor. April 20.

7052. W. Boggett. Improved methods of obtaining electricity. April 23.

7168. G. Wester. Improvements in and relating to voltaic cells. Complete Specification. April 25.

7261. E. Dénorus. Improvements in and relating to the electro-deposition of metals upon fabrics, plants, animals, and the like. April 27.

7434. A. Nodon. Improvements in the electrolysis of chlorides, and in the utilisation of the liberated chlorine for the manufacture of chlorates, hypochlorites, and other compounds. April 29.

7697. C. P. Elieson. Improvements in electrical accumulators or storage batteries. May 4.

7700. H. J. Allison.—From P. Kennedy and C. J. Diss, United States. Improvements in storage battery plates. May 4.

7701. H. J. Allison.—From P. Kennedy and C. J. Diss, United States. An improved storage battery plate and method of making same. May 4.

7715. G. A. Washburn. Improvements in storage batteries. Complete Specification. May 5.

7831. H. Reynier. Improvements relating to the manufacture of insulating partitions for use in primary and secondary batteries. May 6.

7949. P. Goward. Improvements in secondary batteries. May 8.

7960. R. D. Sanders. Improvements in apparatus for use in the manufacture of metal tubes, cylinders, or other articles by electro-deposition. May 8.

7979. G. E. B. Pritchett. Improvements in electric accumulators or secondary batteries. May 9.

8126. G. J. Philpott. Improvements in compound dynamo-electric generators. May 12.

8218. A. R. Sennett and F. W. Cannon. Improvements in dry batteries. May 13.

8227. W. P. Thompson.—From H. O. Tudor, Germany. Improvements in electrodes for electric accumulators. May 13.

Complete Specifications Accepted.

1890.

8394. W. Wright. Battery compound. May 13.

8716. E. Edwards.—From T. Lange. Obtaining metallic zinc from solution of zinc sulphite by electrical decomposition. April 29.

9257. S. Wohle. Effecting electrolytic deposit with aluminium. May 13.

9991. T. Parker. Manufacture of iron by electrolysis. May 6.

10,038. A. Watt. Electrolytic treatment of metals. May 6.

1891.

3331. S. C. C. Currie. Secondary or storage batteries. May 13.

3799. A. Clark. Improved solution or composition for charging electric batteries. May 13.

5547. C. Kellner. Apparatus for electrolytic decomposition. May 20.

XII.—FATS, OILS, AND SOAP MANUFACTURE.

Applications.

6829. J. W. Gardner and T. Smithson. Improvements in the manufacture of toilet soap. April 21.

7251. W. N. Hartley and W. E. B. Blenkinsop. Improvements in the thickening of oil. April 27.

7428. D. T. Gardner.—From M. L. Lichtenstadt, Russia. Improvements connected with the manufacture of soap, and the employment of certain ingredients for that purpose. April 29.

8462. B. Goldmann. Improvements in the manufacture of paint oils and putty oils. May 12.

Complete Specification Accepted.

1891.

5870. J. E. A. Bokelund. Preparation for use as a substitute for linseed oil in the mixing of pigments. May 13.

XIII.—PAINTS, PIGMENTS VARNISHES, AND RESINS.

Applications.

6770. D. Everett and T. Claridge. Improvements in the manufacture or production of pigments. April 20.

6810. I. Singer and A. P. Berens. Improved manufacture of white lead, and apparatus therefor. April 20.

6916. T. Maxwell. An improved liquid preparation for the protection of bright or polished or unpolished metallic surfaces, and which may also be used as an anti-fouling and anti-corrosive composition. Complete Specification. April 22.

7036. G. H. Smith. Improvements in the treatment of gums, and the preparation of varnishes therefrom. April 23.

7516. W. K. Breavington. A new and improved powder for the manufacture of ink. April 30.

7798. T. Rowley. Improvements in the process of vulcanising articles or fabrics composed either wholly or partially of india-rubber by what is termed the "dry heat process." May 6.

7848. J. Jeyes. A new or improved compound applicable as gum, size, cement, paint, or varnish, or the like. May 6.

7922. W. L. L. Grant and H. P. T. Dennys. An anti-fouling and preservative paint for protecting the bottoms of iron or wooden vessels, and other submerged surfaces. May 8.

8022. A. Houman and B. Vulliez. Improvements in the process of and apparatus for the manufacture of white lead. May 9.

8161. H. H. Lake.—From E. W. Dahl, United States. Improvements in the manufacture of white lead. Complete Specification. May 12.

8296. A. McLean, jun. Improvements in transparent coloured materials for decorative purposes. May 14.

8311. G. K. Chambers, A. F. Hodgson, and R. Hammond. Improvements in the manufacture of white lead. May 14.

8312. J. A. Egestorff. The manufacture of a paste blue for washing and industrial purposes. May 14.

8480. F. Ragon. An improved manufacture of material applicable as a blacking and for other purposes. May 16.

COMPLETE SPECIFICATIONS ACCEPTED.

1890.

8668. B. Piffard. Manufacture of varnishes. May 6.

16,757. T. W. Just, R. Weiler, and O. Heideprism. Improved ink. May 6.

XIV.—TANNING, LEATHER, GLUE, AND SIZE.

APPLICATIONS.

6852. E. Drew. An improved substitute for leather. Complete Specification. April 21.

7106. A. Huillard. An improved process of decolourising and clarifying tanning liquors or tannic extracts. April 24.

7548. J. W. Whinyates. Improvements in the manufacture of leather from hides and skins. May 1.

7734. A. A. Hunting. Improvements in apparatus for treating or preparing leather. Complete Specification. May 5.

8096. C. S. Hull and P. S. Burns. Improvements in the treatment of skins and hides. Complete Specification. May 12.

COMPLETE SPECIFICATION ACCEPTED.

1891.

2808. W. Barton. *See* Class V.

XV.—AGRICULTURE AND MANURES.

APPLICATIONS.

8154. F. W. Saatmann. Improvements in the manufacture of superphosphates. May 12.

8402. A. Knorre. Improvements in the manufacture of artificial manure. May 15.

XVI.—SUGARS, STARCHES, GUMS, ETC.

APPLICATION.

7272. W. P. Thomson.—From A. H. Jacques, Belgium. Improvements in and apparatus for converting amylaceous substances into soluble products. April 27.

COMPLETE SPECIFICATIONS ACCEPTED.

1890.

11,473. J. Duncan. Treating molasses or syrup to improve its flavour. May 20.

1891.

581. H. H. Leigh.—From W. V. Fry. Process for the defecation of sugar-cane juice. May 20.

XVII.—BREWING, WINES, SPIRITS, ETC.

APPLICATIONS.

7140. S. Mason, jun. Improvements in the method of and apparatus for purifying and refining alcoholic liquors and other fluids. Complete Specification. April 25.

7216. J. Jones. Improvements in apparatus for mixing, rousing, aërating, and fermenting malt and other liquors. April 27.

8302. A. Bandholtz. A new or improved apparatus for the direct production of alcohol from mash. May 14.

COMPLETE SPECIFICATIONS ACCEPTED.

1890.

7268. W. Dawson. Improvements in distillers' safes, applicable for check sampling spent wash at outlets of "patent" stills. April 29.

8850. E. J. Taylor. Manufacture of whisky and other spirits. April 29.

9183. C. R. C. Tichborne, A. E. Durley, M. F. Purcell, and S. Geoghegan. Method and appliances for collecting and utilising the carbonic acid gas and other products given off during fermentation. May 13.

9442. L. C. Best. Apparatus to facilitate the fining of beer. May 20.

9940. D. A. Boullanger and A. Scheunert. Process and apparatus for purifying alcoholic liquors. May 6.

10,436. W. P. Thompson.—From T. Bolland. Distilling apparatus. May 13.

1891.

2294. H. H. Lake.—From G. Guignard and A. Hedouin. Manufacture of alcohol, and apparatus therefor. April 29.

5004. J. Mitchell. Apparatus for drying distillers' or brewers' draff or dreg, also applicable for drying other similar materials. April 29.

6317. M. Schwab. Method and apparatus for regulating the egress of spent liquor from distillatory apparatus. May 20.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

APPLICATIONS.

A.—Chemistry of Foods.

7335. W. P. Thompson.—From F. Lanholf. Improvements in the preparation or treatment of rice or other cereals. Complete Specification. April 28.

7340. N. Browne.—From L. Nagaels, Belgium. Improvements in the manufacture of bread, and materials employed therein. April 28.

7345. R. Rick and O. Dahm. A process for the manufacture of artificial "human milk," and other easily digestible foods. April 28.

7485. H. Warry. Improvements in food preservation. Complete Specification. April 30.

8483. D. J. Fereire. New method of preserving organic substances; also applicable for disinfecting purposes. Filed May 16. Date applied for April 20, being date of application in Germany.

B.—Sanitary Chemistry.

7466. W. Birch. *See* Class 1.

7554. G. Knowles and W. H. Cave. A new or improved method of treating vitiated or other air. May 1.

8084. H. Lockwood. Improvements in or connected with the treatment or purification of sewage or other liquids. May 11.

8271. H. Whiley. Improved destructor furnace for refuse, and apparatus connected therewith. May 14.

8426. W. Birch. Improved apparatus applicable to the cleansing or filtration of sewage and other liquids. May 16.

8496. J. Price. Improvements in the treatment of sewage. May 16.

Complete Specifications Accepted.

A.—Chemistry of Foods.

1890.

8804. W. H. Gover. Improvements in and connected with the manufacture of substances of food. May 13.

10,563. F. A. Raedler. Sterilising milk. May 13.

1891.

4291. W. Robertson. Article of food or solidified malt extract jelly. May 20.

B.—Sanitary Chemistry.

1890.

6397. F. B. Hill. Treatment of sewage, and apparatus therefor. April 29.

7419. W. Walkington. Refuse destructor. May 13.

11,048. T. Douglas. Removing gases from sewers, and disinfecting and disposing of them. May 20.

C.—Disinfectants.

1890.

8997. G. Walker. Preparation of disinfectants for more convenient carriage, storage, and general application. April 29.

9103. J. Y. Johnson.—From F. von Heyden. Manufacture of disinfectants or antiseptics. May 13.

XIX.—PAPER, PASTEBOARD, Etc.

Applications.

6981. W. W. Horn. — From H. Cunningham and S. McDonald, United States. An improved roofing paper. April 22.

7985. E. F. Fleet. Improvements in the manufacture of paper and the like. May 9.

8394. W. Reissig. Improvements in the manufacture of white washable writing tablets. May 15.

8487. A. Sheldon. Improvements in apparatus for the manufacture of paper pulp. May 16.

Complete Specifications Accepted.

1890.

9958. A. Gray. Manufacture of a new material, to be called "lacrepap." May 6.

10,259. J. F. N. B. Simons and S. Smith. Manufacture of paper pulp. May 6.

15,776. F. Hawke. Manufacture of copying paper. May 13.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES, and EXTRACTS.

Applications.

6786. J. Y. Johnson.—From The Badische Anilin and Soda Fabrik, Germany. Improvements in and relating to the manufacture of hydrazine or diamidogen and its salts. April 20.

7026. B. Willcox.—From The Farbenfabriken vormals F. Bayer and Co., Germany. Improvements in the manufacturre of iodine substitution products of phenols and cresols. April 23.

7282. W. H. Claus. A new and improved process for the manufacture of pyrogallic acid. April 28.

Complete Specification Accepted.

1891.

48. G. Link and R. Avenarius. Manufacture of artificial perfumes. May 6.

XXI.—PHOTOGRAPHIC PROCESSES and MATERIALS.

Applications.

6762. F. Schraivogel and M. Hering. Proceeding and apparatus of half-tint decomposition for the production of photographical netting plates of half-tint in hatching and grain for cliehés of high and low pressure. April 20.

7312. W. W. J. Nicol. Improvements in photographic printing processes. April 28.

7376. B. Krantz and H. Zeissler. Improved apparatus for printing, developing, and finishing photographic prints. April 29.

7635. E. Hackh. Improvements in magnesium lights for photographic and signalling purposes. Complete Specification. May 2.

7785. B. Krantz and H. Zeissler. Method of and apparatus for reproducing photographs. Complete Specification. May 5.

8401. C. N. Staniland and C. J. Staniland. Improvements relating to electro-photography and to electro-photographic apparatus; applicable also to the preparation of printing surfaces. May 15.

XXII.—EXPLOSIVES, MATCHES, Etc.

Applications.

7087. H. Schlund. Improvements in distance fuses. April 24.

7193. J. Y. Johnson—From J. A. C. de Latouche, France. Improvements in military and sporting ammunition. April 25.

7256. V. Alder. Improvements in or connected with the manufacture of priming caps or exploders. April 27.

Complete Specifications Accepted.

1890.

5376. H. de Chardonnet. Nitration and denitration of cellulose, regaining the acids employed; and apparatus therefor. April 8.

10,263. K. R. Malstrom. Percussion fuses. May 6.

XXIII.—ANALYTICAL CHEMISTRY.

Complete Specification Accepted.

1891.

5175. S. C. Hauberg. *See* Class I.

Printed and Published by Eyre and Spottiswoode, East Harding Street, London, E.C., for the Society of Chemical Industry.

THE JOURNAL

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NOTICES.

In accordance with the provisions of Rule 18 of the Bye-laws, notice is hereby given that those Members of Council whose names are placed in italics in the annexed list will retire from their respective offices at the forthcoming Annual General Meeting.

Professor J. Emerson Reynolds, F.R.S., has been nominated to the office of President; and Mr. E. Rider Cook has been nominated Vice-President under Rule 11.

Dr. John Evans, F.R.S., Mr. A. Norman Tate, and Sir John Turney, have been nominated Vice-Presidents under Rule 8.

The Treasurer and Foreign Secretary have been nominated for re-election.

Messrs. Arthur Boake, John Christie, Wm. Crowder, Charles Dreyfus, Boverton Redwood, and Wm. Thorp have been nominated, under Rule 18, to fill four vacancies among the Ordinary Members of Council.

ANNUAL GENERAL MEETING.

OUTLINE PROGRAMME.

For selection of Proceedings and Excursions Members may wish to attend.

Tuesday, July 7th.

The Reception Room, Entrance Hall, Trinity College, will be open from 3 p.m., and on succeeding days of Meeting from 10 a.m. Tickets for the selected and necessarily limited Excursions, &c., will here await Members on arrival.

Wednesday, July 8th.

11.0 a.m.—Annual Meeting, Examination Hall, Trinity College.
1.0 p.m.—Luncheon by invitation of the Reception Committee.
2.30 p.m.—Excursion by Steamer in Dublin Bay.
Or—Excursion to Bray, County Wicklow, 3 p.m.
8.0 p.m.—Conversazione by invitation of the Reception Committee.

Thursday, July 9th.

10.30 a.m.—Parties will leave the Reception Room and proceed by Tram Car from College Green to Messrs. Power & Son's Distillery, John's Lane, and thence to Messrs. A. Guinness, Son, & Co.'s Brewery, by invitation of the Firms.
Or—Inchicore Railway Works, 10.30 a.m.
4.0 p.m.—Garden Party, if possible.
7.0 for 7.30 p.m.—Annual Dinner.

Note.—From 2 to 4 o'clock on Wednesday and Thursday the following can be visited:—

Factories, &c.—United Alkali Co., Messrs. Goulding's Manure, Alliance Gas Co., Poplin Weaving, Whiskey Distillery Cos., Messrs. Johnston & Co.'s and Boland's Bakeries, Mineral Water, &c.

Other Places of Interest.—Library, Trinity College, National Library, Science and Art Museum, Bank of Ireland (Old Irish Parliament House), National Art Gallery, St. Patrick's and Christ Church Cathedrals, Dunsink Observatory, Zoological Gardens, Phœnix Park, Royal Dublin Society's Buildings, Ball's Bridge, College of Science, Botanic Gardens, Royal Irish Academy.

Friday, July 10th.

Excursion to City Waterworks at Roundwood, County Wicklow, probably returning by Glendalough and Seven Churches.

Or—Excursion to Enniskerry, Dargle, and Waterfall in Powerscourt Demesne, County Wicklow, by permission of the Right Hon. Viscount Powerscourt, K.P.

For particulars relating to above, see detailed Programme, which will be presented to Members on their arrival in Dublin.

Members desiring to extend their visit either North to Belfast and Giant's Causeway, or South to Limerick, Cork, and Killarney, on Saturday, can obtain all necessary information from railway and other agents at the Reception Room.

Tickets of membership will be found with the Ballot Lists in this number of the Journal.

Tickets will be provided for ladies for the Conversazione and Excursions and may be obtained on arrival in Dublin at the Reception Room, Entrance Hall, Trinity College.

Members who intend being present at the Dublin Meeting, and who have not already done so, are particularly requested to fill up and forward at once to the Hon. Secretaries, 35, Dawson Street, Dublin, the form of Outline Programme sent out in the last issue of the Journal.

It is suggested that Members wishing to prolong their stay in Ireland and visit other localities should make enquiries at their respective starting points as to whether by booking viâ Dublin to the further places they wish to proceed to, the advantage of reduced excursion fares may be secured.

Arrangements can be made in Dublin by which return tickets at reduced fares can be obtained by small parties who may desire to make independent excursions from Dublin.

Post Office Orders should be made payable at the General Post Office, London, to the Honorary Treasurer, E. Rider Cook, and should be forwarded to him at Bow, unless it be desired to notify a change of address.

Members who require extra sets or back numbers of the Journal are requested to make application to the General Secretary only, to whom also changes of address should be communicated.

Notice is hereby given, for the information of members and advertisers, that the advertisement columns of this Journal have been contracted for by Messrs. EYRE and SPOTTISWOODE, the Society's printers and publishers, to whom all communications respecting them should be addressed.

The Secretary is instructed to negotiate for the purchase of copies of the Society's Journal for January and May 1883, and January, February, and April 1886. Members possessing odd copies of these numbers are particularly requested to communicate at once, stating price required, with Mr. Cresswell. The stock of all other numbers is at present sufficient for the Council's requirements.

LIST OF MEMBERS ELECTED, 23rd JUNE, 1891.

Ballinger, John, Free Library, Cardiff, librarian.

Dunwoody, R. G., 369, Calhoun Street, Atlanta, Georgia, U.S.A., chemist.

Ellis, Wm. Hodgson, School of Practical Science, Toronto, Canada, professor of applied chemistry.

Fletcher, R. Jaques, 7, Earl Street, Finsbury, E.C., manufacturing chemist.

Fraser, Leslie McG., 98, Commercial Road East, London, E., chemical engineer.

Kressel, Edw., 11, Park Avenue, Wood Green, N., technical chemist.

Molineux, Roland, c/o C. T. Raynolds & Co., 106, Fulton Street, New York, U.S.A., paintworks chemist.

Mond, Robt. L., 20, Avenue Road, Regent's Park, N.W., chemist

Neilson, Wm., 3, Beckton Road, Canning Town, E., technical chemist.

Neman, Howard S., P.O. Box 35, Albany, N.Y., U.S.A., dyeworks chemist.

Parkinson, J. Howarth, Stretford, Manchester, gas condenser.

Post, Major Jas. C., 123, Victoria Street, London, S.W., United States Military Attaché.

Sach, Robert, 81, Kellett Road, Brixton, S.W., mining engineer and assayer.

Scott, Chas. K., Caixa 32, Pernambuco, Brazil, analytical chemist.

Smith, Francis P., cor. 21st Street and Avenue C., New York, U.S.A., chemist, Consolidated Gasworks.

Stephenson, Claud, 25, Cecil Street, Greenheys, Manchester, Saccharum Co.'s agent.

Stewart, Jeffrey, 15, Claremont Road, Forest Gate, Essex, sugar refinery manager.

Woollcombe, Dr. R. L., 14, Waterloo Road, Dublin, barrister-at-law.

CHANGES OF ADDRESS.

Ballard, E. G., l/o Eversley Park; 20, Curzon Park, Chester.

Briggs, T. Lynton, l/o Rodney Street; 357, Madison Street, Brooklyn, N.Y., U.S.A.

Corbould, W. H., l/o Sydney; Central Broken Hill Silver Mine, Broken Hill, N.S.W.

Crichton, D. G., l/o Sydney; Central Broken Hill Silver Mine, Broken Hill, N.S.W.

Davis, Dr. P. H., Journals to 106, Salcott Road, Clapham, S.W.

Deering, W. H. (incorrectly described in May No. as l/o Woolwich), Journals to 13, Hervey Road, Blackheath, S.E.; Woolwich address as before.

Dukes, T. Wm., Journals to c/o Dukes Bros., Caledon and Primrose Streets, Cape Town, S.A.

Hall, R. E., Journals to Box 12, Johannesburg, S.A.R.

Harrison, J., l/o Gardiner's Hill; 2, Temple Place, Ballintemple, Cork.

Hunt, Bertram, l/o Leeds; 5, Queen's Crescent, Glasgow.

Isherwood, O., l/o Salford; 36, Walkden Road, near Bolton-le-Moors.

James, Dr. J. Wm., Journals to 29, Redcliff Street, Bristol.

MacIvor, R. W. E., l/o Clapham Road; 85, Gracechurch Street, London, E.C.

Munro, Professor J. M. H., Journals to Churchfields, Salisbury.

Reid, W. Hamilton, Journals to 22, Shaftesbury Street, Stockton-on-Tees.

Richardson, C. T., l/o Jarrow; 18, Eldon Street, Newcastle-on-Tyne.

Sadtler, Dr. S. P., l/o University of Pennsylvania; 145, N. 10th Street, Philadelphia, Pa., U.S.A.

Shaw, Jno., Journals to Earlston, Uddingston, N.B. (not near Edinburgh).

Smiles, Jas., l/o Brandon Terrace; 19, Queen Street, Edinburgh.

Sowerby, W. M., l/o Jarrow; c/o United Alkali Co., Limited, Runcorn Works, Cheshire.

Stead, W. H., Journals to Orchard Place, Blackwall, E.

Stevens, W. J., Journals to 24, New Walls Road, Totterdown, Bristol.

Stone, F. B., l/o Norfolk Villa; Eardley Villa, Picardy Hill, Belvidere, Kent.

CHANGE OF ADDRESS REQUIRED.

Leese, J., l/o Fylde Road Mill, Preston.

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The names in italics are those of members of Committee who retire at the end of the current Session.

The following have been elected to fill the vacancies, and will take office in July next:—*Committee:* C. F. Cross, J. Heron, W. Kellner, G. N. Stoker, and F. Napier Sutton.

Meeting held Monday, May 4th, 1891.

MR. THOS. TYRER IN THE CHAIR.

THE TREATMENT OF HARD WATER.

BY L. ARCHBUTT, F.I.C., AND R. M. DEELEY, M.I.MECH.E.

It is just 30 years since Clark patented his well-known process for the softening of hard water. The kind of hard water with which he proposed to deal is that of which the hardness is due mainly to the presence of carbonates, and which can be softened by the use of lime alone. It appears that Clark did not invent the process of softening water by lime. According to the late Dr. Angus Smith (Report to the Local Govt. Board, 1882), the use of lime was first proposed about a century ago by Thomas Henry, F.R.S., of Manchester. It has also been pointed out by Prosser (Chem. News, **52**, 300) that the action of lime in softening water was referred to in a patent taken out by John Melville three years before the date of Clark's patent, and that Melville describes the action of lime as "well-known" in his time. According to this, the softening of hard water by lime was Henry's idea, and by Clark's process should be understood the means of adjusting the proper proportion of lime, consisting in the determination of alkalinity by a standard solution of oxalic acid, the detection of traces of free caustic alkali by the silver test, and the estimation of hardness by the soap test. On the other hand, the process of filtration for the removal of the precipitate was mentioned by Clark in his specification, though he did not indicate any method of filtering. Porter seems to have been the first to patent a filter for the purpose, and he made the softening process a continuous one, the lime water and the hard water being made to flow in regulated streams into a mixing vessel, and thence through filter presses into the storage tank. Atkins, subsequently to Porter, devised an arrangement of plant differing in the construction of the filters and in some other important details; and since then other, and presumably more perfect, filtering arrangements have been devised. So far as we are aware, these filtering arrangements have been limited, at any rate mainly, to the carrying out of the softening process as described by Clark, *i.e.*, to the removal from hard water of the temporary hardness alone; and from statements which have been published, it does not appear that filtration has been uniformly successful in the treatment of waters which have contained magnesium salts.

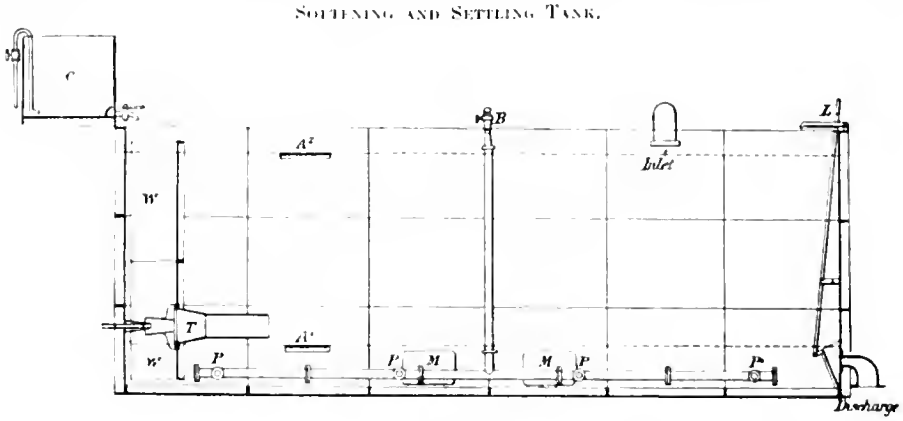
The alternative method mentioned by Clark, allowing the softened water to clarify by subsidence, has been considered in most places out of the question, because the process in

its simplest form is so slow that very large and costly tanks are required. Gaillet and Huet, proceeding upon the principle that a shallow stratum of turbid water will clarify by gravitation more rapidly than a deep one, have, within the last few years, invented a form of apparatus in which the continuous system of softening has been retained, but the ordinary transmission filter has been superseded by a gravitation filter. Several modifications of the Gaillet and Huet plant have been invented. The chemical treatment adopted with this system of filtration extends to the removal of both temporary and permanent hardness; and the character of the precipitate is immaterial so long as it will settle upon the plates. But, of course, the apparatus is more complicated and more costly than plain tanks of equal capacity would be.

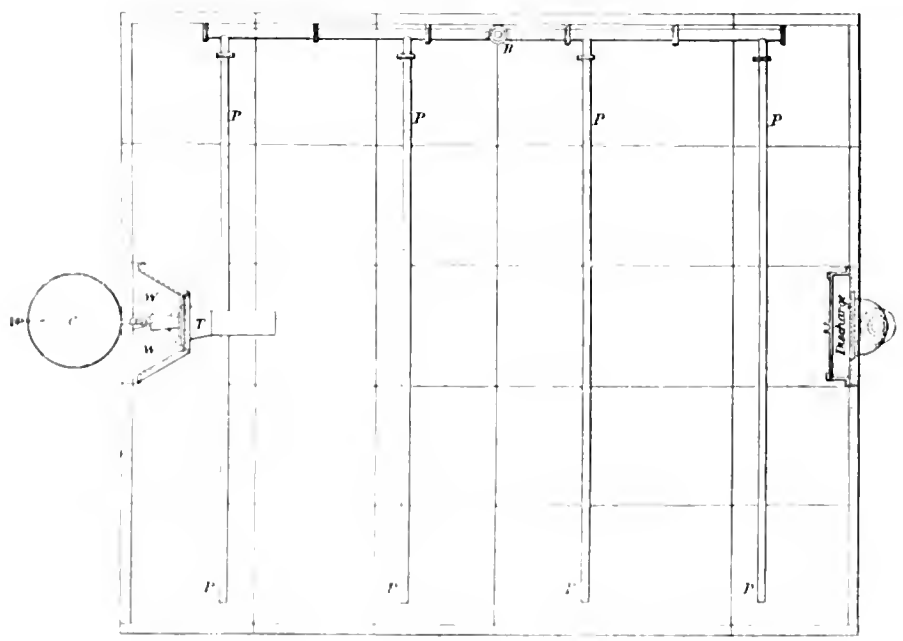
There is still another way of insuring a more rapid clarification of the softened water. It is to use a reagent which shall produce a coarse-grained precipitate which settles quickly; and there is no objection to this provided it does not involve the use of a too costly reagent such as sodium phosphate.

Whatever method of softening water becomes extensively adopted in the long run, it is certain that it must combine the use of the cheapest chemicals with the simplest and cheapest plant. It must also be applicable to all kinds of water, and the softened water produced by the process must be fitted in every respect for the purpose for which it is intended to be used. The process which will now be described is an attempt towards the realisation of all these conditions. We do not claim that it meets them all perfectly, but we do think the results obtained are of sufficient interest and importance to warrant us in bringing them before the Society. In our process, as in the simplest form of Clark's, the softening and clarification of the hard water are carried out in plain tanks; but owing to the rapid method we use for mixing the chemicals with the water, and the subsequent treatment which the water undergoes, the precipitate is caused to settle very quickly, and only comparatively small cast-iron tanks, such as the diagram represents, are required. Two of these tanks have been in use experimentally in the locomotive works of the Midland Railway Company at Derby for some time past, and another is now being put down by Mr. Johnson. The two experimental tanks have only been softening on an average about 20,000 gallons per day, but from the results obtained it is certain that with the three tanks, each 9 ft. high, and covering a space of 60 ft. × 24 ft. in all, it will be possible to treat 5 million gallons of hard water pumped from the River Derwent per week of 144 hours. These anticipations, based upon what is being done at the present time, are not likely to prove incorrect, for no filters are used, and there is no part of the apparatus which can give trouble when the plant is working to its full capacity. As an illustration of the important effect, the rapidity with which we are able to turn

Softening and Settling Tank.



Elevation.



Plan.

over the water has had upon the dimensions of the tanks required, we may recall the evidence of Mr. Homersham before the Royal Commission on Water Supply, in which he stated that at the Plumstead works, where 1 million gallons of hard water were softened per day, they had, in addition to smaller tanks, three large settling tanks, each capable of holding from 250,000 to 260,000 gallons. For treating 850,000 gallons per day our tanks are just one-tenth the size. Mr. Homersham also stated, with reference to Clark's process, that "it is essential for the process that it should be a clear spring water; a river water is not adapted for being softened by the process." Now, the water we are treating is a river water, which receives the sewage of Derby as well as the refuse of a number of works, before it is pumped into our softening tanks; yet we succeed in properly softening it and in causing a very rapid subsidence of the precipitate produced in the process, besides improving the quality of the water in other ways.

Referring now to the diagram, which represents one of our tanks, you will observe a piece of angle iron, A^1, fixed to one side of the tank, at a short distance from the bottom, below which the softened water is not pumped out; each operation is therefore commenced with the mud from previous softenings at the bottom of the tank, and clear softened water above this as far as the lower angle iron. The *modus operandi* is as follows: The tank is first of all filled with hard water as far as the upper angle iron, A^2, 20,000 gallons. While this is going on, the proper quantities of chemicals are weighed out and boiled up with a few gallons of water in the small chemical tank, C, and when the large tank is filled, the prepared liquid is caused to flow, by opening the tap, into the well, W, fixed to the middle of one side of the large tank. This well is constructed of ordinary tank plates bolted together, and is freely open to the water in the large tank at the sides and at the bottom. Near the bottom, opposite a pipe which projects into the tank, there is fixed a steam "trajector," T, for the purpose of creating a powerful current of water from the well, through the projecting pipe, into the tank. The action of the trajector would speedily empty the well were it not open at the sides and bottom; as it is, the well fills as rapidly as it empties, and thus a circulation of the water in the tank is set up, and the chemical reagents are very soon thoroughly mixed with the water. The reagents used for the Derwent water consist of lime and sodium carbonate, with crystallised aluminium sulphate in the proportion of $1\frac{1}{2}$ oz. per 1,000 gallons. Good results have lately been obtained, at less cost, with ferrous sulphate. After the admixture of the chemicals and the hard water is complete, which is the case in about five minutes, a test is made with silver nitrate, and if the proper reaction is not obtained, 2 lb. or 3 lb. more lime are slaked, and the milk is run into the well. When the mixing is finished, the trajector is put out of action. The clarification of the softened water is effected by subsidence; but if the turbid water were to be left as it is after turning off the trajector, the process of clarification would take a long time. Some assistance is derived from the aluminium or iron salt used; at any rate, we cannot get such good results without it at Derby, owing to the organic impurity in the water. But what we have found remarkably effectual in promoting the rapid subsidence of the precipitate is to stir up some of the old mud from the bottom of the tank, and diffuse it through the water. In order more completely to effect this than can the trajector alone, perforated pipes, P, are laid along the bottom of the tank, a few feet apart, and, by admitting steam to the blower, B, air is sucked down the orifice and forced out of the perforations in the pipes. The bubbles of air in rising set up currents, which carry up some of the mud, and when sufficient stirring has been effected, the blower is put out of action. The result of this operation is, that the precipitate settles rapidly, and the water becomes so clear in 30 minutes from the time of stopping the air current, that at a depth of 6 ft. from the surface the amount of suspended matter in the water does not exceed on an average about 1 grain per gallon—a quantity of such little importance where the water is required for steam boilers that the drawing off of the softened water may be at once commenced, while another tank is being filled and softened. One arrangement for drawing off the softened water rapidly without disturbing the sediment is shown at the right-hand end of the tank. The lever, L, closes the opening while softening and settling are going on. If more perfect clarification should be required, or if it were desirable to increase the output of a given plant, a floating orifice can be used. We find, however, that very little is gained in this way, as the great bulk of the precipitate goes down bodily.

With this arrangement, 20,000 gallons of water in one of these tanks is almost as completely under control as a pint of water in a beaker in the laboratory. The appliance for mixing is cheap and effective, and cannot get out of order, and each tankful of water may be treated with just whatever proportions and kind of chemicals we please, and the proper mixing of them with every drop of water is ensured. This is a very important, but not the only, advantage which the intermittent system of softening has over the continuous system. It may be thought that the process will be costly in labour. Extra labour would be necessary for the carrying on of even a continuous process dealing with such large volumes of water, and as a matter of fact the labour involved in our process is quite light, and consists largely in turning valves on and off. The weighing and mixing of chemicals will only occupy a few minutes every hour, so that one man and a lad will easily do all that is required, and the total cost of labour, including interest on the capital outlay, will not amount at Derby to one farthing per 1,000 gallons. This will be in addition to the cost of chemicals, which would of course be incurred by any process. There is also this advantage in our plant, that the cheapest chemicals, lime and sodium carbonate, can be used. Owing probably to the fact that some forms of plant are not adapted to use milk of lime, and that inconveniently large volumes of lime-water would have to be employed, it is the practice to use caustic soda for softening water, and unnecessary expense is incurred thereby, as well as, in some instances, a great waste of chemicals. We know a case where the softened water contained no less than 29·9 grains per gallon of sodium carbonate, as well as 4 grains per gallon of caustic soda.

Practically the softening of all waters is included by the four following equations, since nitrates and chlorides are treated like sulphates:—

(1.) $\underbrace{CaCO_3 + CO_2 + Ca(OH)_2}_{\text{Reagent.}} = \underbrace{2\,CaCO_3 + H_2O}_{\text{Precipitate.}}$

(2.) $\underbrace{MgCO_3 + CO_2 + 2\,Ca(OH)_2}_{\text{Reagent.}} = \underbrace{2\,CaCO_3 + Mg(OH)_2 + H_2O}_{\text{Precipitate.}}$

(3.) $\underbrace{CaSO_4 + Na_2CO_3}_{\text{Reagent.}} = \underbrace{CaCO_3 + Na_2SO_4}_{\text{Precipitate.}}$

(4.) $\underbrace{MgSO_4 + Ca(OH)_2 + Na_2CO_3}_{\text{Reagent.}} = \underbrace{CaCO_3 + Mg(OH)_2 + Na_2SO_4}_{\text{Precipitate.}}$

To use 2 NaOH instead of $Ca(OH)_2 + Na_2CO_3$ in equation (4) will cost more, in the proportion of about 100 : 73, if the NaOH is purchased as such. In our process it can be made, if desired, by simply boiling together the $Ca(OH)_2$ and Na_2CO_3 in the chemical tank, the $CaCO_3$ + 2 NaOH being run out as a milk into the hard water.

The water which we are softening at Derby gave the following results soon after the process was commenced:—

	Grains per Gall.	
Calcium carbonate	9·74	Containing CaO = 7·78 grains.
Calcium sulphate	5·64	
Magnesium carbonate	2·45	Containing MgO = 1·02 grains.
Magnesium sulphate.....	1·35	
Sodium sulphate	3·41	
Sodium chloride.....	2·81	
Silica	0·34	
	25·74	
Calculated hardness....	17·9	

The softened water, analysed at the same time, gave the following results:—

	Grains per Gall.	
Calcium carbonate	2·25	Containing CaO = 1·26 grains.
Magnesium carbonat	2·18	Containing MgO = 1·04 grains.
Sodium carbonate	0·85	
Sodium sulphate	11·56	
Sodium chloride	3·58	
Silica	0·45	
	20·47	
Calculated hardness	4·8	

Better results have been obtained since, as the following partial analyses show:—

	Grains per Gallon.						
						A.	B.
Lime (CaO)	0·98	0·83	0·82	1·32	1·20	2·00	1·37
Magnesia (MgO)	0·76	0·61	0·56	0·69	0·62	0·51	0·51
Calculated hardness	3·5	3·1	3·1	4·1	3·7	4·8	3·69

A. This analysis was made on the softened water after settling 30 minutes, and includes the $CaCO_3$ in suspension.

B. This analysis was another portion of sample A., after standing all night and then filtering.

The water before softening has a dirty brown colour in the tanks; after softening it becomes a deep green. An organic analysis made a few days ago shows how impure the water is when we get it, and also that the treatment which the water undergoes in the process of softening and clarification has the effect of purifying it to a large extent organically also.

	Water from the Mains as delivered into the Tanks.	The same Water after Treatment and 30 Minutes subsidence.
Free ammonia	1·15 per million	1·08 per million
Albuminoid ammonia	0·42 per million	0·28 per million
Oxygen absorbed in 15 mins. at 80° F.	0·112 per 70,000	0·059 per 70,000
Oxygen absorbed in 4 hours at 80° F.	0·294 per 70,000	0·106 per 70,000

The rapidity with which the precipitate settles in our tanks is due to a combination of causes, of which the stirring up of the precipitate produced in former operations is the most important. It is, however, difficult to determine the precise effect due to this cause alone. Something is gained by the use of the small quantity of aluminium or iron salt, something by the condition of the chemical solution; the circulation kept up by the trajector and the mere agitation caused by the blower are probably not without their effect. In addition to these comes the effect produced by the mud which the blower brings up from the bottom, the coarse particles of which attract and carry down with them the fine particles of precipitate. Some experiments made in February 1890 show the results obtained by operating in different ways.

In series A. and B. the aluminium sulphate was dissolved in a small quantity of water and run into the well by itself; 10 minutes later the lime was added as a milk, and 10 minutes later still the sodium carbonate solution was added. The trajector was used to mix these solutions with the hard water in both cases, but only in series B was the blower used to stir the mud. In series C and D the chemicals were boiled up together, and the milk was afterwards run out into the well, the trajector being used to mix the contents of the large tank in both series, but only in series D was the mud stirred by the blower.

Suspended Matter at a depth of 6 ft., after 30 minutes' subsidence (Grains per Gallon.)

Chemicals added separately.		Chemicals added together.	
A. Mud not stirred by Blower.	B. Mud stirred by Blower.	C. Mud not stirred by Blower.	D. Mud stirred by Blower.
6·94	1·06	4·65	1·40
8·12	1·12	1·87	1·20
9·44	1·12	..	1·18
	1·20		
	1·04		
	1·06		
	0·78		
	0·78		
	0·81		
Average 8·17	Average 1·00	Average 4·76	Average 1·26

The fact that we are operating upon so filthy a water, the organic impurity of which no doubt varies from day to day, may account for the variations in these results. Judging by the better results which we obtain when the water is at its cleanest, as compared with those obtained at other times, it may be safely asserted that when operating upon a clean well water more perfect average clarification would result. The hard water pumped into our tanks itself always contains suspended matter, and we deliver it with no more, often with less, and sometimes with considerably less suspended matter than we get it. Moreover, the traces of suspended matter in the softened water, after settling for half an hour, consist of nearly pure $CaCO_3$, and would admit of very easy separation by the ordinary sand or any other kind of filters if a perfectly bright water were required.

The advantage gained by stirring up the mud with the blower is well shown if we ascertain how long the water takes to clarify to an equal extent without effecting this disturbance. Only two experiments were made in this way, the chemicals being added separately, and the trajector used for mixing. The suspended matter at a depth of 6 ft. was:—

	Grains per Gallon.
At the end of 1 hour's subsidence	6·02
At the end of 2 hours' subsidence	1·20
At the end of 3 hours' subsidence	3·22
At the end of 4 hours' subsidence	2·24
At the end of 5 hours' subsidence	1·76
At the end of 6 hours' subsidence	1·47

In the second experiment there remained 2·10 grains at the end of 6 hours' subsidence. These figures must be compared with an average of about 1 grain at the end of 30 minutes' subsidence by our complete process.

The mud which accumulates at the bottom of the tanks is very easily removed. When it has reached about half-way up to the lower angle iron, it is stirred up with ordinary brooms, and in this condition it flows through openings, M, in the sides of the tanks into a brick trough which conveys it into the drain. As much as is retained by the flanges of the bottom tank plates is required to carry on the clarifying process.

The water treated by the experimental plant at Derby has, up to the present time, been used for the supply of a small battery of four stationary boilers of locomotive type which provide steam for one of the shops. These boilers had previously been supplied with hard water, and the first effect of the softened water was, as is always the case, to cause the old scale to begin to loosen and fall off. The boilers are now in excellent condition. On the copper fire-box plates and tubes there is practically no scale. The copper stays are coated with a soft deposit, easily rubbed

off, and not thick enough to hide the screw threads. On the iron outer shell the old scale still remains in places, but it is soft and loose, and portions of it which fall off are removed every time the boilers are washed out, which is done once a month instead of once a week as formerly.

Several months after the softening process had been in operation, when the improved condition of the boilers was such that the desirability of extending the process beyond the experimental stage was about to be considered by the locomotive superintendent, a difficulty of a peculiar kind presented itself. It was found that the softened water, which formed no scale in the boilers, had quite the opposite effect in the injectors, feed pipes, and clack boxes. The clacks began to give a great deal of trouble by sticking, and an examination showed that the whole interior of the feed apparatus was coated on the inside with a thick, soft, deposit, which was gradually choking everything up. We were not wholly unprepared for this result, having heard of a similar trouble some time before at a works where a hard magnesia water was being softened by another process. At this works, the boiler injectors had to be cleaned every few days, and the feed pipes at intervals of a few weeks. It was thought this deposit might be due to some imperfection in the softening process, or to imperfect clarification of the water; and we did not altogether anticipate the same result with the water softened and clarified by our process at Derby. It was, however, now evident that a drawback to the use of softened water in boilers did exist, and one which might partly account for the limited extent to which railway companies and other large steam users have adopted existing water softening processes. For, although the scale formed in locomotive boilers by hard water is the cause of very great expense to the companies, less tolerable results might follow from the use of water likely to interfere with and render uncertain the proper working of the feed apparatus upon which the safety of the boilers so greatly depends. The deposit removed from one of the feed pipes gave the following results on analysis, after drying at the ordinary temperature over sulphuric acid:—

Silica	11·05
Alumina	3·68
Ferrous oxide, Ferric oxide (Calculated to Fe_3O_4)	2·23
Calcium carbonate	42·58
Magnesium carbonate	3·33
Magnesium hydroxide	24·87
Organic matter, Water	10·79
Copper (from the feed pipe)	1·47
	100·00

The large extent to which magnesia enters into the composition of this deposit, and the fact that $CaCO_3$ and $Mg(OH)_2$ occur in it in proportions which are not far from equivalent, whilst in the water the ratio of magnesia to lime is very much less, afford good evidence that the formation of this deposit is attributable in some way to the magnesia contained in the water. The particular portion of deposit which was analysed was entirely formed in a fortnight, during which every tank of water was softened with the greatest care to avoid excess of lime. A clack which was put into one of the clack boxes clean, and was taken out at the end of this fortnight, is upon the table, and another which had been in use for a month is also shown. The deposit formed in the feed pipes during this period was much thicker than it is upon the clacks.

In order to determine whether the formation of this deposit was a property of the clear softened water free from any trace of suspended matter, some of the water was filtered, and the clear, bright water was heated for some time to nearly 200° F. in a closed glass flask. Nothing appeared to separate at first, but on shaking the water round in the flask, an exceedingly thin film peeled off the interior and broke up into little coils which floated about in the water. These films contained both CaO and MgO. The cause of the deposit was now apparent; the water, softened in the cold, gave a slight further precipitate on heating, and this, though only trifling in amount, was quite enough to account for the observed effects. The four boilers using softened water are all supplied by one exhaust injector, and through this injector and the feed pipes about 20,000 gallons of water pass in one day. If each gallon of water were to deposit in the hot injector and pipes only one-third of a grain of solid matter, the total deposited in one day would amount to nearly 1 lb. The proportion which actually adheres to the pipes must be less than this. The experiment was afterwards made of passing a little CO_2 into another quantity of the water before heating it in the flask, and this was found to prevent further precipitation. The remedy therefore lay in carbonating the softened water. Having obtained permission to make the experiment, between the softening tanks and the small donkey pump, which at present lifts the softened water into a small storage tank, we interposed a siphon pipe, the upper bend of which is elevated a few feet above high-water level in the softening tank. Entering the bend at the top of the siphon pipe a small branch pipe was fixed, communicating with a scrubber, and from the scrubber a pipe was carried into the chimney-stack. The chimney gases were thus aspirated through the scrubber into the descending column of water, and after passing through the pump the residual gases escape into the air from the end of the discharge pipe above the storage tank. The injector and feed pipes having been cleaned (an unnecessary proceeding, for we find the carbonated water soon cleans them) the carbonated water was used for a few weeks, and then the clack boxes were opened and examined, with the result that not a trace of deposit was found. But a longer trial was required, and as the smoke in the chimney gases gave trouble, the pipe was removed from the chimney and was made to draw the products of combustion from a Bunsen gas flame instead. A lengthened trial has proved that the process is completely successful and involves very little extra expense or trouble. A clack is exhibited which was taken out after four months' immersion in the hot carbonated water, and which is as free from deposit as the day it was put in. To use coal-gas, except for purposes of experiment, would of course be too expensive, and in the plant now being completed at Derby smokeless gases from a coke stove will be used. These will be pumped into the main which conveys the softened water into the storage tank, in definite proportion, so as to impregnate the softened water with just enough CO_2 to produce an excess. If the quantity used amount to 3 grains per gallon, the volume of gas required for 10,000 gallons will be yielded by the complete combustion of only 1·3 lb. of coke containing 90 per cent. of carbon, and the cost will of course be quite insignificant. The gases will not be scrubbed, as there is no need to do so. For if the coke used contain 2 per cent. of sulphur, if all this sulphur were to be oxidised to H_2SO_4, the quantity of H_2SO_4 per gallon of water would amount to only 0·055 grain, and as the softened water of 3 degrees hardness contains fully fifty times as much alkali as is required to neutralise this amount of acid, the sulphur in the coke cannot possibly do any harm whatever. No difference is perceptible in the condition of the boilers since the carbonating of the softened water was commenced. Not only is the softened water after carbonating in this simple and inexpensive manner more suitable in every way for feeding boilers, but it is better adapted than uncarbonated softened water for many other purposes, such as tanning and dyeing; it will also be more palatable; and it will form no deposit in town mains. It will, on the contrary, have a tendency to remove the deposit which has formed in old mains, though of course care would have to be taken that the solvent action of the carbonated water does not extend to the iron of the mains themselves. It would be easy to avoid this, as the proportion of CO_2 which is put into the softened water admits of easy adjustment.

A number of experiments have been made with the object of investigating the behaviour of dilute solutions of magnesium carbonate towards lime. A strong solution of magnesium bicarbonate was prepared by suspending washed magnesia in distilled water, passing CO_2 for some time, and filtering. 10 cc. of the clear solution contained:—

	Grm.
MgO (by alkalimetry)	0·0489 (=2 CO₂ 0·1070 grm.)
MgO (by precipitation)	0·0509
CO_2 (by absorption and weighing)	0·1054

According to the alkalimetric result, the solution contained 700 grains per gallon of $MgCO_3$. 30 volumes diluted with distilled water to 1,000 volumes made a solution containing 21·5 grains per gallon of $MgCO_3$, and this was used for the experiments. The amount of CO_2 contained in the distilled water used for diluting being known, it was easy to calculate the exact volume of lime-water needed for the reaction—

$$MgCO_3 + CO_2 + 2(Ca(OH)) = 2CaCO_3 + Mg(OH)_2 + H_2O$$

Three series of experiments were made, and in each series, besides a quantity with the equivalent proportion of lime, six quantities were mixed with decreasing volumes of lime water, and six with increasing volumes. The solutions were mixed in small flasks, closed by rubber stoppers, agitated at intervals during the first half-hour, and then allowed to stand overnight at the temperature of the laboratory, those in Series 3 being left for exactly 24 hours at a temperature of 52°–62° F. 50 cc. of each clear solution (in Series 1 and 2 after filtration; in Series 3 without filtration) were titrated by a standard acid of such a strength that 1 cc. = 0·001 grm. $CaCO_3$. The results obtained are given in the following table:—

Magnesium Bicarbonate Solution precipitated by Lime-Water

Approximate Deficiency or Excess of CaO used.	Alkalinity of the Softened Water calculated as $CaCO_3$.		
	Series 1.	Series 2.	Series 3.
Grains per Gall.	Grains per Gall.	Grains per Gall.	Grains per Gall.
3·0	0·2	8·2	5·9
2·5	5·7	0·45	5·1
2·0	5·1	5·75	4·75
1·5	4·3	5·35	3·9
1·0	3·6	4·05	3·1
0·5	3·7	4·55	3·1
+ 0·0	3·0	4·45	3·9
0·5	5·65	4·7	5·3
1·0	6·9	5·35	9·8
1·5	5·55	6·75	9·55
+ 2·0	5·8	9·7	9·0
+ 2·5	8·0	10·15	11·2
+ 3·0	7·4	8·05	11·0

These figures exhibit considerable discrepancies, which are not attributable to errors of observation, and they show that when the lime is used in excess the results are more uncertain than when it is used in insufficient proportion to saturate all the CO_2.

Some of the clear filtrate from each experiment in Series 1 was placed in a closed tube, and heated in a water-bath at 170° F. A slight further precipitation took place in each test tube, and it was therefore concluded that the deposit which takes place in the feed pipes of steam boilers using softened water cannot be prevented by altering the proportion of lime used in softening.

In order to investigate more exactly the precipitation of magnesia by lime, it was decided to repeat three of these experiments with larger quantities. Accordingly, three separate litres of the diluted $MgCO_3$ solution were placed in flasks, and were mixed with the following volumes of lime-water of known strength, viz., 321 cc., 354 cc., and 387 cc.; these volumes representing respectively a deficiency of CaO amounting to 2·1 grains per gallon, the theoretical proportion of CaO, and an excess of CaO amounting to 2 grains per gallon. The flasks were closed with rubber stoppers and shaken at intervals for a short time, then left till next morning. The precipitates having settled, it was then observed that the 321 cc. and the 354 cc. quantities were bright, whereas the 387 cc. quantity was opalescent in appearance.

After the 354 cc. quantity, *i.e.*, the quantity containing the theoretical equivalent of CaO, had stood altogether for 22 hours, about half the clear water was transferred to a silver bottle, tightly closed with a rubber stopper, and heated for two hours in a water-bath at 170° F. 500 cc. of the remainder of the clear water were used for estimation of CaO and MgO. At the end of the two hours the silver bottle was placed in cold water, and, when cold, the contents were filtered, and 500 cc. of the filtrate were used for estimation of CaO and MgO. The 321 cc. quantity was treated in precisely the same manner, except that it was allowed to stand for 30 hours before being proceeded with. The 387 cc. quantity, *i.e.*, the quantity containing an excess of lime was, as already stated, opalescent. When an attempt was made to filter it, it was observed that the solution at first passed through opalescent, but after a short time it began to come through bright, and at the same time the filtration became extremely slow, and it could be plainly seen that this was caused by a separation of what looked like magnesia from the water before it passed through the paper. The experiment was subsequently started afresh and the same opalescent fluid was again obtained. On this occasion the flask was allowed to stand for 116 hours, and still the opalescence persisted. The contents were therefore treated as follows: About half the opalescent liquid (which was quite free from visible particles) was carefully siphoned off and was heated in a closed silver bottle for three hours at 170° F. with occasional agitation. The bottle and its contents were then cooled, and the contents were poured into a flask and corked up. The liquid still retained its opalescent appearance, but a very small precipitate was now visible in it, and this was allowed to settle, which took a long time. Altogether, this solution, which had been heated and cooled, stood for four days in the closed flask and still the opalescence persisted, and only the traces of precipitate separated by heat had settled to the bottom. 500 cc. of the opalescent fluid were siphoned off without disturbing the precipitate, and the CaO and MgO were determined. 500 cc. of the original opalescent liquid, which had not been heated, were also treated to separate the CaO and MgO. Unfortunately the MgO estimation in this quantity was lost. The results of the three experiments were as follow:

Magnesium Bicarbonate Solution precipitated by Lime-Water.

Volume of $MgCO_3$ Solution.	1,000 cc.	1,000 cc.	1,000 cc.
Volume of Lime Water.	321 cc.	354 cc.	405 cc.*
The Mixed Solutions contain	2·1 grs. per gall of CaO less than the quantity equivalent to the CO_2	The theoretical equivalents of CO_2 and CaO.	2 grs. per gall. of CaO more than the quantity equivalent to the CO_2
Analysis after precipitation in the cold ..CaO	Grains. 1·04	Grains. 2·62	Grains. 1·46
MgO	1·40	0·58	?
Hardness	5·34	3·50	?
Analysis after heating to 170° F. CaO	Grains. 0·55	Grains. 0·24	Grains. 2·16
MgO	1·13	0·11	7·23
Hardness	3·79	2·74	21·81

* A different solution of lime was used.

The result of this third experiment is remarkable. The MgO originally present, calculated on the total volume of solution (1,405 cc.) amounted to 7·31 grains per gallon, and of this 7·23 grains, *i.e.*, practically the whole of it, failed to precipitate, being held up, not as carbonate but as hydroxide, and forming with the CO_2 free water the peculiar opalescent liquid. We appear to have in these experiments a complete

explanation of the discrepant statements which have appeared as to the possibility of softening magnesia-hard waters by Clark's process. So long as the lime-water is used with care, avoiding the least excess, keeping the quantity rather less than that necessary to combine with all the CO_2, the $Mg(OH)_2$ falls at first as a flocculent precipitate with the $CaCO_3$, and then they crystallise together, forming a coarsely crystalline precipitate which settles well, and a bright softened water which filters easily. But if the lime be used in excess, sometimes when the exact equivalent quantity is used, there is a tendency for a part or a whole of the $Mg(OH)_2$ to remain in a peculiar colloid condition, whilst the $CaCO_3$ assumes the form of a very fine crystalline precipitate which sometimes settles very slowly. When an attempt is made to filter the water in this condition, it at first passes through the filters, but soon the magnesia begins to separate upon the filters in a form which rapidly clogs them and makes them useless. We do not doubt that the softening of magnesia-hard waters by means of lime, or sodium carbonate and lime, can be satisfactorily and economically carried out in the form of plant designed by us, and the hardness brought down to 4 or 5 degrees.

It seemed desirable to ascertain to what extent the solubility of magnesia or magnesium carbonate in water is influenced by the presence of such sodium salts as occur in softened water. Five equal volumes of the dilute $MgCO_3$ solution were therefore placed in separate flasks, and each was precipitated by the addition of the same calculated volume of lime-water. In one experiment the $MgCO_3$ solution was used pure; in a second, sodium sulphate was dissolved in the $MgCO_3$ solution in such quantity that after the lime-water was added there would be 100 grains per gallon of Na_2SO_4; in the third experiment NaCl, and in the fourth $NaNO_3$ were used in the same proportion; whilst in the fifth experiment all three sodium salts were added. After allowing the mixed solutions to stand for 24 hours, 70 cc. of each clear softened water was titrated. The results obtained were as follows:—

Sodium Salts in the Softened Water.	Alkalinity of the Softened Water (Calculated to $CaCO_3$).
	Grains per Gallon.
1. None	4·0
2. Na_2SO_4, 100 grains per gallon	4·85
3. NaCl, 100 grains per gallon	4·0
4. $NaNO_3$, 100 grains per gallon	4·0
5. Na_2SO_4, 100 NaCl, 100 $NaNO_3$, 10 } grains per gallon	5·2

From these results it appears that the influence of sodium salts is inappreciable, except in the case of the sulphate, and even in this case the solubility is only increased to the extent of about 1 degree of alkalinity.

Finally, to test the conclusions arrived at, an artificial magnesia hard water was prepared, containing in 1 litre:—

350 cc. of the strong $MgCO_3$ solution.
0·903 grm. of gypsum.
1·62 grm. of $Na_2SO_4.10\,H_2O$.
0·714 grm. of NaCl.
0·143 grm. of $NaNO_3$

The analysis of this water stated in the usual manner would be about as follows:—

	Grains per Gallon.
$CaCO_3$	25·5
$CaSO_4$	15·3
$MgSO_4$	30·7
Na_2SO_4	50·0
NaCl	50·0
$NaNO_3$	10·0
	181·5

The water was first of all analysed by determining the alkalinity, the CaO, and the MgO. Some of the water was then boiled very rapidly for one hour in a silver beaker, the volume being maintained by additions of distilled water kept boiling in a silver bottle. After filtering, cooling, and making the boiled water up to the original volume, the alkalinity, the CaO, and the MgO were again determined. Some of the water was then softened by adding to it.

(1.) As much Na_2CO_3 dissolved in a little water, as was equivalent to the total CaO + MgO, deducting as much as was equivalent to the total alkalinity of the original water.

(2.) As much lime water as was necessary to give a pale straw colouration with silver nitrate, increased by as much as was equivalent to the total MgO.

Altogether, 500 cc. of the hard water were taken, and there was added 0·29 grm. of pure Na_2CO_3 dissolved in a little water, and then 192 cc. of lime-water (1 cc. = 0·001167 grm. CaO). The precipitate was at first very voluminous, but it quickly became coarsely crystalline and settled nicely. The clear softened water after standing over night was analysed for alkalinity, CaO, and MgO. All the results obtained are arranged in the following table:—

Experiments with Magnesia-Hard Artificial Water.

	Original Water.	After Boiling.	After Softening.
CaO	29·86	8·49	1·57
MgO	11·08	9·87	0·49
Alkalinity (= grains per gallon $CaCO_3$).	26·65	1·70	5·90
Calculated hardness (= grains per gallon $CaCO_3$).	..	..	4·01

Discussion.

Mr. C. G. Cresswell was much interested by the fact that although the authors had added their chemicals both separately and in combination, very little difference was shown in the results produced. It was to be noted, however, that the authors were not dealing with a sewage, but with water, and therefore the results should not differ materially. He would be glad to know whether the organic constituents of the water had been determined after treatment by the reagents together and separately, and if so, whether they differed as much as might be expected. People were in the habit of ridiculing Maignen's statements that water was purified and softened by the simultaneous use of soda, lime, and alumina; but the results brought forward by Messrs. Archbutt and Deeley showed that as regarded softening, the effects were not very different from those claimed by Maignen, and that the object of employing alumina was not to make a lake of organic bodies, but to bring down the inorganic constituents.

Mr. A. H. Allen wished to know what the authors understood by the term "calculated hardness." He hoped that they meant the amount of lime and magnesia calculated into their chemical equivalents of carbonate of calcium, and not according to any fancied hardening power possessed by magnesia as distinguished from lime. The term seemed to him to be obscure; because "hardness" varied in an erratic manner, and one could not predict what the hardness of a sample of water would be merely from the amount of lime and magnesia it contained. Secondly, he was not sure whether he had rightly understood Mr. Archbutt as to the method employed in preparing bicarbonate of magnesium by passing carbon dioxide through water containing magnesia in suspension.

Mr. Archbutt: The current of gas was continued until a good deal of the magnesia was dissolved, but not quite all.

Mr. Allen, continuing, said that under those circumstances the authors would no doubt expect to obtain no excess of carbonic acid, and he would like to know whether that warrantable expectation had been fulfilled. He had made some experiments on the similar question of the solubility of carbonate of calcium in carbonic acid water with a view to ascertain if there was any foundation for the statement that a bicarbonate of calcium exists. For his part, he doubted the existence of any such thing. That calcium carbonate dissolved in carbonic acid water was correct; but that the additional amount of carbonic acid required for its solution was equal to the carbonic acid combined with the lime was, he thought, very questionable. At any rate, his own experiments had failed to convince him of any such relationship. If any excess of carbonic acid was in the authors' magnesia solution, notwithstanding their caution in leaving some magnesia undissolved, it might throw their subsequent calculations wrong. He hoped that the authors had foreseen that danger and provided against it. The paper had thrown new light on a somewhat obscure subject, and it was very satisfactory to find that the authors had attained so much success by a proper and scientific use of their reagents.

Mr. W. Thorp was surprised to hear the authors state that the lime method of purification was not adapted for the treatment of river waters. The authors had quoted Homersham to that effect; but he fancied that they must have quoted him without the accompanying qualifications; for, although there could be no doubt that clear spring waters were most suitable, still he was under the impression that river waters had been successfully treated by that method. He had had no experience of the particular water referred to, but looking at the figures before them he hardly thought it deserved the title of "a filthy water." The hardness did not seem to be considerable, and there were no figures indicating a large amount of pollution for a river water. He had not quite caught the names of all the chemicals employed, and would like to know if there were any chlorides among them, for the quantity of sodium chloride in the samples was greater after treatment than before, and unless this was due to treatment by a chloride, he did not see where it could come from. The mechanical arrangements were very ingenious, and there were only two questions which he wished to put respecting them. First, was the "well" really necessary? He thought that the water would find its way to the inlet of the trajector without the use of the guiding walls of the well itself. In fact, it seemed to him that the walls of the well rather represented the first ideas of the design, and might be discarded. Secondly, had the authors considered and ascertained the expense of the blower? Probably they had, but many people thought that the blowing of air through water was a very simple matter, forgetting that the work to be done was precisely that of pumping an equal quantity of water to a height corresponding to the depth to which the air had to be blown in. If the air had to be blown in, say, 10 ft., the work was equivalent to lifting an equal volume of water 10 ft. It was obvious that that might run away with a great deal of power.

Mr. E. H. Harland agreed with the previous speakers in congratulating the authors, and wished to observe that the difficulties they had spoken of were always found in softening waters containing magnesium salts. After the addition of lime water in even less than the proper proportion, a further precipitation occurred, but not until from 12 to 24 hours after the water had passed through the filter. Then a distinct crystalline sediment was found at the bottom of the vessel, consisting of a magnesium salt, and the water was softer by one or two degrees. It seemed to him that the whole question must be looked at from a different point of view. It was all very well to have tanks holding 20,000 gallons, and all the other arrangements described by the authors. But generally speaking, steam users put their boilers in confined spaces, where there was no room either for tanks or softening apparatus. Unless users of steam therefore departed from their present plans, the solution of this question would have to be arrived at (if it ever was arrived at) in a totally different way. The water would have to be treated inside the boilers, with arrangements devised by the engineer in conjunction with the chemist. An apparatus on those lines called the Carroll boiler water purifier had recently been tried in London, and he would like to know whether Mr. Archbutt had had any experience of it. The inlet of the feed water was so arranged that it passed along the steam space of the boiler from front to back. Part of the inlet pipe was cut away so as to form a channel. The water in its passage became heated to the temperature of the steam. If the working pressure was between 50 and 60 lb. to the square inch, the heat was sufficient to deposit the whole of the calcium sulphate and carbonate, and magnesium carbonate in the front portion of the tube to be removed by blowing off, and the water then flowed into the boiler minus those salts. The apparatus answered well, and the only drawback was the possibility with very hard water, that when pumping, a little of the sediment might be carried forward and deposited in the tubes, but this would not be sufficient to cause a hard scale, and could be swept out. If this trifling defect could be remedied, the apparatus would, he thought, be almost perfect for softening water for boiler purposes.

Mr. B. E. R. Newlands had heard many papers on the present subject, but none so logically worked out as this one. Mr. Thorp was quite right in saying that Clark's process, or modifications of it, had been extensively applied to the purification of river water. Along the Thames many manufacturers had their effluent purified by one or other of the forms of apparatus used in connexion with that process. The difficulty was that the water varied from hour to hour, and so necessitated constant appeals to the laboratory to ascertain the right quantity of reagents to be used. Quite recently, two samples of water before and after purification were sent to him from the neighbourhood of Hammersmith, and his opinion was asked on the merits of the purification effected. The first step he took was to determine the chlorine in each sample, and the result was that he found considerably more in the sample "after purification" than in the other. These samples were taken in good faith, and were honestly intended to represent the effect of the process; but as a matter of fact they represented two different states of the tide, or different conditions of the water. With regard to the precipitation of magnesia, he had found in the early experiments in connexion with the Porter-Clark process that it was impossible to purify water containing much magnesia to the full extent by the addition of the calculated quantity of lime, because the precipitate took a long time to come down, and the water was quite unfilterable. But by reducing the hardness to about 8 degrees only instead of a possible 4, a crystalline precipitate was produced containing a considerable quantity of magnesia, results which the present authors had confirmed by their experiments. He supposed that the authors would not recommend the use of aluminium sulphate except for waters containing flocculent impurities. Its use in other cases appeared to him to be a waste of chemicals, as it required a large quantity of soda or lime and produced a precipitate which added to the bulk to be dealt with. He would like to know the time required to deposit the precipitate in the apparatus under notice as compared with the Stanhope filter. From his own experience he would expect that the rate of precipitation in such a tank as that before them would be about two feet an hour.

Mr. Archbutt: It was 98 per cent. in 30 minutes in one case.

Mr. Newlands, continuing, said that showed that the stirring up of the materials had a very advantageous effect. His own experience was that with tanks of 24 ft. cube, using lime alone, about 12 hours was required for settling out, and a somewhat shorter time if soda was used in addition. If the authors had got the same results in 30 minutes, that was a great advance, and seemed to him to completely answer Mr. Harland's criticism as to the amount of room required. He did not at all agree with the idea of purifying water inside the boiler. Many such plans had been tried, but they always failed. It was from all points of view better to clean the water before it entered the boiler.

He had seen Mr. Archbutt's apparatus at work during the Society's recent visit to Nottingham, and was very pleased with it. The inventors could hardly claim that it introduced any startling novelty; but they had brought together a number of appliances which, combined with chemical skill, bid fair to make the process take the place of many of those at present in use.

Mr. W. Lawrence inquired as to what temperature the water was raised to by the treatment. It was obvious, he thought, that the precipitation was caused either by the agitation or the steam, and he would like to know which.

Mr. Archbutt: The water is raised 3° F. in temperature by the process.

Mr. L. Archbutt, in reply, said: Mr. Cresswell has asked about the organic composition of the water when the chemicals are added together and separately. I have not gone into that question. An organic analysis was made because it was thought that it might interest some of the members. But I have no reason to suppose that the composition would be very different whichever way the chemicals were used. I do not know why chemists should suppose that the chemicals mixed together soften the water less than when they are added separately. The only difference is that you produce so much caustic soda instead of so much lime and sodium carbonate; but the final results are just the same. Maignen says that the reagents do not interfere with one another; but I think that if he made an analysis he would alter his opinion. I think that why we get better results with mixed chemicals, when we do not stir the mud, is because we then put into the water large particles of calcium carbonate, which has somewhat the same result as stirring up the mud from the bottom. I am glad Mr. Allen asked about the "calculated hardness." The results were got by calculating the $CaCO_3$ equivalent to the total CaO and the total MgO and adding the figures together; that plan does away with the uncertainty of that wretched soap test which I have long since abandoned, and think it is quite time every other chemist did the same. The strong magnesium bicarbonate solution, as I should have explained, was analysed for magnesia and carbonic acid, the CO_2 being determined by absorption, and it came out almost the exact equivalent for the formation of the bicarbonate. If we add only enough lime to the solution to combine with the CO_2 existing as bicarbonate, a large quantity of magnesia does not come down. I am going into that question more fully later, but I think that magnesium carbonate is more soluble in water free from carbonic acid than is generally supposed. I was glad to find from Mr. Thorp's remarks that he approves of the process to a limited extent. I think we are justified in describing the water as we have done, not as containing much scale-forming matter, but owing to the large proportion of free and albuminoid ammonia and the high oxygen absorption, and I know that the water receives the sewage of Derby a few hundred yards above where we pump it out. With regard to the sodium chloride, the increase is not very great, and is probably accounted for by the fact that we used soda from the ammonia-soda process, which, I suppose, contains a little undecomposed chloride. As to the well, it is quite true that this was an experimental plant, made before we knew what results we were going to get, and possibly that well may be to some extent modified, but it could not be dispensed with altogether, as there would then be nothing to guide the chemicals into the stream of water produced by the trajector. With regard to the expense of the blower, I would point out that the steam used by the trajector as well as the blower raises the temperature of the water only 3° F. It takes a long time for it to cool down those three degrees, so that the water goes into the boiler warmer than before, and therefore we must not charge the whole of the cost to the softening process. But if we did, it would only amount to one-fifth of a penny per 1,000 gallons; and we certainly do not expect to utilise energy without paying for it. I have had no experience of the apparatus mentioned by Mr. Harland; but I would point out that in the case of locomotive boilers the space is limited for putting in such a tube. And further, you would be practically introducing a condenser into the steam space, and although the fuel consumption may not be increased, ebullition would be more violent, and the steam produced be more loaded with water particles. There are many other openings for softened water besides steam boilers. People who use large quantities of soap find it very expensive to do so with hard water. I am much obliged to Mr. Newlands for his remarks, and am interested to hear that his experience with the Porter-Clark process confirms what I have found in my experiments. I have seen it stated that the best results were got by using excess of lime, which I could not understand. It is true that the chemicals used in our process are the same as those employed by Maignen, or rather that those used by Maignen are the same as have been proposed years before: for some of the earlier patents mention almost every possible chemical, a great number being included in a single patent, thus: "barytes or its soluble salts," "strontia or its soluble salts," and so on. For my own part, I think that the credit of showing that magnesia waters can be softened without the use of caustic soda, if due to any one in particular, is really due to Mr. Wanklyn. With regard to the Stanhope apparatus, no doubt it is very ingenious, but if we can do the same work with a cheaper plant taking up no more space, it is for users to decide which apparatus they will pay for.

SUPPLEMENTARY NOTES ON THE CHEMISTRY OF WHISKY.

BY ALFRED H. ALLEN.

In my recent paper on "The Chemistry of Whisky and Allied Products," I pointed out that the estimation of the ethers from the results of their saponification was liable to be affected by the presence of bodies like aldehyde and furfurol, which neutralised more or less alkali and underwent a species of saponification. The amount of alkali which reacts with aldehyde does not appear to have been determined, if indeed it is at all constant. Furfurol, on the other hand, has been proved in my laboratory by Dr. A Colefax to react with caustic alkali in spirituous solution in a proportion corresponding with the formula—

$$\underset{\text{Furfurol.}}{2\,C_5H_4O_2} + KHO = \underset{\text{K-Pyromucate.}}{KC_5H_3O_3} + \underset{\text{Furfuryl Alcohol.}}{C_5H_6O_2}$$

As furfurol is always present in pot-still spirit, its presence is liable to materially affect, in some cases, the determination of the ethers by the saponification process.

It has, however, been recently pointed out by E. Mohler (Compt. Rend. **112**, 53) that treatment with a solution of aniline in syrupy phosphoric acid renders the aldehyde, furfurol, and bodies of similar constitution non-volatile, without affecting the true ethers (ethereal salts). A careful examination of Mohler's process enables me to confirm his statement, provided the spirit be boiled with the phosphoric aniline solution for at least two hours under a reflux condenser. 100 cc. of the spirit is boiled with 1 cc. of aniline and 1 cc. of phosphoric acid of 45° B. (= 1·442 sp. gr.). If then distilled, the ethers pass over unchanged with the alcohol, while the aldehydic bodies remain in the retort. Where furfurol is the only aldehydic body present, its amount can actually be estimated from the difference in the volume of standard alkali required for saponification before and after treatment of the spirit with the phosphoric aniline reagent. According to the formula already given, each cubic centimetre of difference in the volume of decinormal alkali required for saponification before and after the aniline treatment represents 0·0192 grm. of furfurol.

In my last paper I expressed doubts as to the suitability of an acid solution of potassium permanganate for the oxidation of alcohols to the corresponding acids, especially for the estimation of amylic alcohol by oxidation to valeric acid. The doubts I then expressed have since been fully confirmed, as I have proved the reagent in question to be

very unsuitable for its intended purpose. Commercial potassium permanganate is liable to, and does, contain notable traces of potassium perchlorate, and no care in recrystallising the salt will remove this isomorphous impurity. Commercial permanganate formerly contained much more perchlorate than it does at present, but that the impurity is still to be found is evident from the following experiments. A specimen of well-crystallised potassium permanganate was dissolved in water, pure dilute sulphuric acid added, and then sufficient oxalic acid to decolourise the liquid. Addition of silver nitrate produced a *barely perceptible* turbidity, proving the absence of appreciable quantities of chlorides. Some of the same permanganate was then distilled with water and some of the same sulphuric acid previously used, the latter being added in quantity insufficient to complete the reaction—

$$KMnO_4 + H_2SO_4 = KHSO_4 + HMnO_4.$$

With considerable difficulty, and by taking special precautions to avoid spitting, a colourless distillate was obtained. This had a marked odour, resembling that of one of the oxides of chlorine, rather than chlorine itself. It contained no sulphates, but immediately decolourised phenolphthalein, rendering titration with this indicator impossible. These effects were obtained more strongly on adding a small quantity of pure potassium perchlorate to the contents of the retort, so that there can be no doubt the characters of the distillate were due to the presence of traces of perchloric acid or the products of its decomposition. Its presence could scarcely fail to be detected if the distillate from the oxidation process were titrated with baryta water and phenolphthalein, in the manner devised and described by me; but if the distillate were at once boiled with barium carbonate, and the amount of valeric or other volatile organic acid deduced from the weight of the barium salt obtained, the results would be very fallacious. Curiously enough, perchloric acid has a combining weight of 100·5, which is very close to that of valeric acid, 102.

When chloroform is treated with acid permanganate and the product of the reaction distilled, the distillate contains notable traces of chlorine compounds. I do not say that it may not be possible to obtain or prepare chloroform which will not yield these products, but a chloroform so pure that it gave no sensible quantity of volatile acid when treated under pressure with chromic acid mixture, developed a notable quantity of volatile chlorine products when similarly treated with an acid solution of permanganate.

In the course of the numerous experiments recently conducted in my laboratory on the determination of amylic alcohol in spirits, we were struck with the tendency of the corks employed to absorb valeric acid. India-rubber stoppers not being suitable for use with chloroform, we have adopted the plan of covering all connecting corks with thin tinfoil, to prevent direct contact with the vapours. This device has answered well.

Another curious instance of selective absorption by cork, first observed in my laboratory by Mr. William Chattaway, was in the case of a two-gallon stone bottle of new whisky, which was kept on its side. The cork which closed the bottle was found to have acquired a strong smell of amylic alcohol, and on distilling the portion of the cork which had been in contact with the spirit with water, a distillate was obtained from which amylic alcohol was recovered equal to that in 150 cc. of the whisky, although the cork did not occupy a greater volume than 5 cc.

This experience appeared to point to a remarkable selective absorptive action exerted by cork, and to test the matter further, we added 0·75 per cent. of fusel oil from grain spirit to a pure proof spirit, and kept the fuselated spirit so prepared in contact with cork parings in one case and clean oak shavings in another. After standing for six or seven weeks in contact with the shavings, the spirit was poured off, the shavings dried by pressure between folds of filter paper, packed in a suitable tube, and a current of open steam passed over them. The aqueous liquid thus obtained smelt strongly of fusel oil, and on analysis an amount of amylic alcohol was found equal to 6 per cent. of the weight of the oak shavings and 11 per cent. of the weight of the spirit absorbed by them, as against $\frac{3}{4}$ per cent. in the spirit employed. The cork shavings gave a similar but somewhat less striking result.

It is apparent from these results that vegetable tissue, such as oak and cork shavings, has a curious affinity for the constituents of fusel oil, and they go far to explain the well-known change for the better in the flavour of whisky which occurs by storing the spirit in oaken casks. Animal charcoal is well known to have a similar effect.

Fortunately the means existed for verifying the foregoing conclusions in a very satisfactory manner, by the analysis of some samples of "grog," which is the technical name for the spirit recovered by steaming old whisky casks. A sample of this grog, which had been obtained by steaming a cask which had contained one of the finest brands of pot-still whisky for 18 years, was analysed in my laboratory, as well as the first and last fractions obtained by distilling a similar product. The results are shown in the following table, and for comparison the figures obtained by the analysis of samples of ordinary commercial Irish and Scotch pot-still whisky are also given.

Results of Analyses of Samples of Whisky and "Grog" (the Spirituous Liquid obtained by Steaming Old Whisky Casks).

	"Grog" from a Cask in which the finest Pot-still Whiskey had been kept 18 Years.		First Fraction obtained on distilling a Sample of "Grog."		Last Fraction obtained on distilling a Sample of "Grog."		Commercial Scotch Whisky.		Commercial Irish Whisky.	
Specific gravity	0·9735		0·8260		0·9040		0·8416		0·9408	
Proof spirit (by measure)	39·68		161·85		112·11		81·17		81·64	
Absolute alcohol (by weight)	18·46		88·76		56·32		39·65		39·30	
	Parts by Weight, per 100 Measures.	Grains per Proof Gallon.	Parts by Weight per 100 Measures.	Grains per Proof Gallon.	Parts by Weight per 100 Measures.	Grains per Proof Gallon.	Parts by Weight per 100 Measures.	Grains per Proof Gallon.	Parts by Weight per 100 Measures.	Grains per Proof Gallon.
Secondary constituents—										
Free acid in terms of acetic acid	0·012	21·2	0·004	0·5	0·012	7·5	0·012	10·2	0·008	6·8
Ethers in terms of acetic ethers	0·029	46·5	1·200	519·0	0·123	76·7	0·054	46·5	0·027	23·1
Higher alcohols in terms of amylic alcohol	0·165	264·0	..	..	1·200	807·4	0·104	89·6	0·092	78·8
Aldehyde	Strong trace.	..	Marked amount.	..	None	..	Distinct trace.	..	Trace	..
Furfurol	Strong trace.	..	None.	..	Very marked amount.	..	Trace	..	Distinct trace.	..

From these results it appears that the "grog" was far richer in amylic alcohol than ordinary whisky. It has been suggested, however, that this result is largely, if not entirely, due to the concentration of the amylic alcohol in the pores of the cask through the evaporation of the more volatile constituents. This argument might have some weight in the absence of the shavings experiments; but in the light of these, where no evaporation was possible, there appears to be no other explanation than that the wood exercises a special selective absorption for the higher alcohols of spirit.

The first fraction obtained on distilling grog is of much interest on account of the large proportion of acetic ether contained in it. The smell of the specimen at once indicates the presence of a notable quantity of this constituent, although the odour is somewhat modified by the presence of aldehyde. I may say that the ethers were determined after treatment of the spirit with Mohler's aniline phosphate reagent, so that the influence of aldehyde was eliminated. The presence of so large a proportion as 1·2 per cent. of acetic ether in the first fraction of the grog shows that the action of the wood is not merely physical, as in the absorption of amylic alcohol, but that a chemical change occurs, resulting in the formation of aldehyde and further oxidation of this to acetic acid, which apparently is very rapidly and completely etherified, for the proportion of free acid is extremely small.

The last fraction obtained by the distillation of the grog is equally interesting. It contains a very large amount of amylic alcohol, evident even to the smell, and is also rich in furfurol. From the difference in the volumes of alkali required before and after treatment with the aniline phosphate reagent, I estimate the proportion of furfurol at 0·076 grms. per 100 cc. or 47·7 grains per proof gallon. For the above sample of grog and fractions obtained by its distillation I am indebted to the kindness of a distiller. I have to acknowledge the zealous collaboration of Mr. William Chattaway in the researches of which these notes give an outline.

Discussion.

Mr. G. T. Holloway inquired whether the author had used animal charcoal instead of cork or wood shavings, it being being well known that that material was largely used in Germany. Referring to the author's remarks on permanganate, he might mention a curious experience of his own. He had noticed an evolution of gas of distinctly chlorous odour, on removing the stopper from a bottle in which a dilute solution of permanganate, slightly acidulated with sulphuric acid, had been kept for a few days. He had had the permanganate by him for 10 years, and therefore it probably was more impure than that which was now supplied.

Mr. Otto Hehner would like further evidence of the oxidation of ethereal bodies in the pores of the wood. It seemed to him that if the fusel oil had concentrated in the wood by absorption the ether might have done the same. Yet he understood Mr. Allen to attribute increase in the one case to absorption, and in the other case, the formation of ethers, to oxidation. Comparative figures showing the absorption of higher alcohols by wood and by animal charcoal respectively, would be highly important and interesting.

Mr. Allen, in reply, said that probably the ethers were absorbed by the wood as Mr. Hehner had suggested, but there was evidence of their formation also. Aldehyde was formed, and he assumed that it was a product of the oxidation of the alcohol, and that it had subsequently been further oxidised to acetic acid and then become etherified to acetic ether. The proportion of ethers in the spirit was only 40 or 50 grains to start with; the quantity found in the first fraction of the grog was upwards of 500 grains per gallon, and therefore he thought it was an oxidation process. But the matter was not so simple as the figures on the board appeared to make it; for the ethers that came from the cask were not all acetic ether. There was a certain amount which when saponified yielded acids which were not volatile. It was plain therefore that there was still a good deal to learn about the chemistry of the subject, and the results which he had brought forward would serve to suggest further inquiries in the future.

Mr. W. Foster inquired whether there was any evidence as to the amount of aldehyde and furfurol in ordinary fresh spirits.

Mr. Allen replied that there was no known process for accurately estimating aldehyde, and it would be seen from last week's "Chemical News" that doubt was thrown on the process upon which they had hitherto relied for detecting and roughly estimating it. That doubt was undeserved, and the best test for aldehyde was Gayon's reagent, a solution of rosaniline reduced by a large excess of sodium sulphite. This reagent detected small quantities of aldehyde by forming a crimson coloration. Furfurol existed in some cases in sensible quantities, and might be present to the extent of 30 to 40 grains per proof gallon. It was characteristic of pot-still spirit, and did not exist in steam-distilled spirit; but he could not endorse the statement of Dr. James Bell that the proportion was so constant in pot-still spirit that the presence and proportion of patent still-spirit could be inferred from the deficiency.

Nottingham Section.

University College, Nottingham.

Chairman: Sir John Turney.
Vice-Chairman: L. Archbutt.
Committee:

Jno. R. Ashwell.	*J. M. C. Paton.*
F. Clowes.	S. J. Pentecost
J. B. Coleman.	*C. Spackman.*
W. A. Curry.	H. J. Staples.
H. Forth.	J. T. Wood.
E. Francis.	

Treasurer: S. V. Holgate.
Hon. Local Secretary:
R. L. Whiteley, University College, Nottingham.

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

The names in italics are those of members of Committee who retire at the end of the current Session. The following have been selected to fill the vacancies, and will take office in July next:—

Chairman: L. Archbutt. *Vice-Chairman:* Jno. R. Ashwell. *Treasurer:* J. M. C. Paton. *Committee:* C. H. Field, E. W. Small, C. Taylor, and Sir John Turney.

Meeting held on Thursday, May 7th, 1891.

MR. L. ARCHBUTT IN THE CHAIR.

AN IMPROVED OIL-BATH FOR DYEING LABORATORIES.

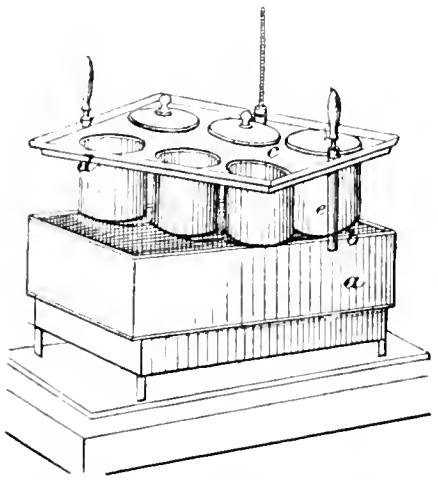
BY R. LLOYD WHITELEY, F.I.C., F.C.S.,
Lecturer and Instructor in Dyeing.

In fitting up the new dyeing laboratory at University College, Nottingham, I was compelled to devise an oil-bath which eliminated the risk of fire attendant on the use of the old form. I think that I have succeeded in this, although I cannot, unfortunately, do away with the smell produced by the use of oil or glycerin.

In the old form, the pots used for dyeing operations were placed directly in the oil in the bath, and it was easy, by faulty manipulation or by the cracking of the pots when put

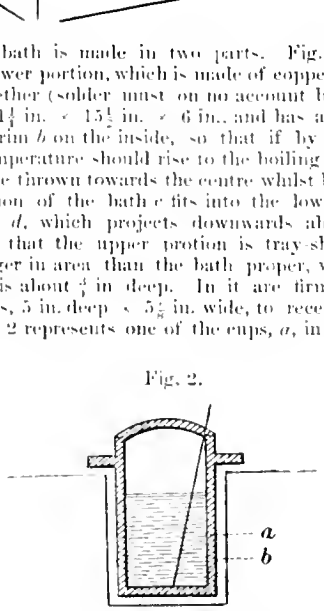
cold into hot oil, to introduce water into the oil, and thus have it boiling over out of the bath; and as a large flame is necessary to produce the required heat, there is thus considerable risk of fire.

Fig. 1.



The new bath is made in two parts. Fig. 1 (*a*) represents the lower portion, which is made of copper welded and brazed together (solder must on no account be used). It measures 21¼ in. × 15½ in. × 6 in., and has an internally-projecting rim *b* on the inside, so that if by any carelessness the temperature should rise to the boiling point of the oil, it will be thrown towards the centre whilst boiling. The upper portion of the bath *c* fits into the lower by means of the rim *d*, which projects downwards about ⅜ in. It will be seen that the upper protion is tray-shaped. It is slightly larger in area than the bath proper, viz., 17 in. × 22 in., and is about ¾ in. deep. In it are firmly fixed six copper cups, 5 in. deep × 5⅛ in. wide, to receive the dye-pots. Fig. 2 represents one of the cups, *a*, in section, with

Fig. 2.



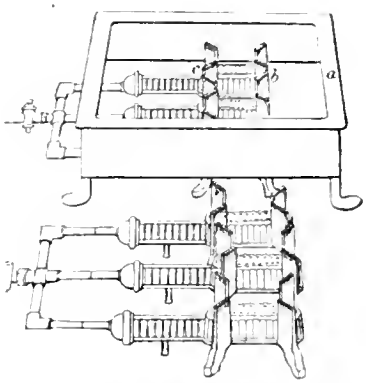
a dye-pot in it, the annular space *b* containing glycerin. The tray is also provided with an aperture for the introduction of a thermometer, and at either end projects a handle, by means of which the flaps *c* can be moved, and the oil thus be stirred, so as to equalise its temperature.

Cotton-seed oil is used in the baths, at a temperature of 160°—170° C., and glycerin is put in the cups which hold the dye-pots. With an arrangement of burners as shown in Fig. 3, I can boil a litre of water in each of the six pots in 35—40 minutes, starting with everything cold.

Fig. 3 represents the arrangement of burners which was adopted after a number of trials with different burners. The stand *a* is of the ordinary type, 5 in. high, provided with a shield of sheet iron 3½ in. deep on three sides. The consequence of such an arrangement is that a rush of flame takes place towards the *back* of the bath and the pots at the back, under the ordinary setting, always boil before the others; this fault is intensified when the whole bath is heated by a central longitudinal burner or by one central round one. I overcame this in part by the introduction of stirrers to keep the oil mixed, but then tried other arrangements of burners.

Fletchers sent me two of their jet burners fitted together so that there was a burner under each row of pots, but I found that in consequence of the gas entering at the centre of the burner the central pots in each row boiled some time before the others.

Fig. 3.



I finally adopted the present arrangement, not only because I obtained the most regular heating, but also from the standpoint of economy in gas. The burners are arranged 6½ in. apart under the bath, but whilst the distance from *b* to the front of the bath is 4 in., the distance from *c* to the back is 7 in., so that the whole of the bath is equally heated. Several different burners were tried either alone or in pairs, and it may interest some members to have their relative value as shown by the amount of gas burnt (for which I have to thank the kindness of Mr. Johnson, of the Corporation Show Rooms) and work done.

	Gas consumed at $\frac{10''}{10}$ pressure.	
1. Two of Fletchers' Longitudinal jet burners coupled consumed..	60	cub. ft. per hour.
2. Two of Fletchers' round slit burners	27	„ „
3. Three of Wright's 310 burners (as adopted)	63½	„ „
4. Two of Wright's 312 burners.....	54	„ „
5. Two of Wright's 322 burners.....	72	„ „

Of these, No. 2 performed the work required far too slowly, No. 5 was the quickest, No. 4 the slowest, No. 1 and No. 3 were about equal; but the expenditure in gas was much less with No. 3 than No. 1, and the heating more regular. The work required was to heat the oil in the bath to 170° C., and 1 litre of water in each pot to 100° C.

Briefly, the advantages of the oil-bath and its setting may be summed up thus: (1.) Regular heating of the dye-pots; (2.) Almost complete immunity from fire risks.

Its disadvantage is the smell from the heated glycerin. This is owing mainly to the fact that the dye-pots are not all one size, and if there is enough glycerin in the cups for one set there may be too much for another, and the glycerin consequently overflows on to the tray, and getting burnt, gives off its disagreeable odour.

A NOTE ON LÖWENTHAL'S METHOD OF TANNIN ANALYSIS.

BY R. L. WHITELEY, F.I.C. AND J. T. WOOD.

A short time since one of us analysed by Löwenthal's method some samples of spent larch bark and obtained much too high results, viz.:—

	Per Cent.
No. 1	7·54
No. 2	6·40
No. 3	8·12

of tannin, stated in terms of oxalic acid on the dry bark. Since no defect in the working or leaching of the bark could be detected which would account for these results, several more samples were taken, dried, and ground, and the results obtained were—

	Per Cent.
No. 4	0·73
No. 5	1·24
No. 6	2·80

As these results were in accordance with expectation, sample 3 was once more analysed and showed 3·71 per cent.

On comparing notes we found that the great discrepancy in our results was apparently due to the different strengths of extracts used by us. In the first three cases about 5 grms. of bark per litre only had been used, whilst in the last three cases from 21 to 28 grms. per litre. These experiments showed that Lowenthal's method was evidently very defective in estimating small quantities of tannin matters.

To further test this we analysed two samples of larch bark under different degrees of dilution and also a sample of sumac.

The percentages of the larch-bark tannin and also of the non-tannin are expressed in terms of oxalic acid, whilst that of sumac tannin is expressed in Neubauer's equivalent.

—	Larch No. 1.	Larch No. 2.		Sumac.	
	Tannin.	Tannin.	Non-Tannin.	Tannin.	Non-Tannin.
	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
Original solution.....	13·81	12·77	3·83	17·97	9·99
Original solution diluted to 20 per cent.	17·05	..	..	..	..
Original solution diluted to 10 per cent.	..	15·43	0·55	..	..
Original solution diluted to 5 per cent.	..	*11·97	1·05	..	..
Original solution diluted to 50 per cent.	..	..	..	19·68	12·48
Original solution diluted to 12½ per cent.	..	..	..	26·89	13·98

	Grms.	Cc.
No. 1 larch contained.....	11·3365 in	1,000
No. 2 larch contained.....	8·4713 in	450
Sumac contained	8·0000 in	1,000

These results thus quite confirm the previous ones; they show that dilution to too great an extent affects the results very deleteriously, making them much too high. It is true that the result marked * would seem to oppose this statement, but it must be borne in mind that in such a weak solution an error in titration of 0·1 cc. would affect the result by 2 per cent., *i.e.*, 11·97 might easily be 13·97. In works on analysis, operators are cautioned against too strong solutions, it having been stated that the total permanganate used should not exceed 1½ times that required for the indigo solution alone, but our experience shows that even where 1¾ times that amount is used, the error is very small, whilst dilution much below a strength of from 1·8—2·0 grms. of tannic acid produces a large error.

Meeting held on Tuesday, March 24th, 1891.

MR. L. ARCHBUTT IN THE CHAIR.

SOME RECENT ADVANCES IN PHOTOGRAPHY.

BY C. H. BOTHAMLEY, F.I.C.,

Assist. Lecturer on Chemistry in the Yorkshire College.

ABSTRACT.

The recent addition to photographic processes that can be regarded as real advances from the practical point of view are limited to three printing processes, two of which belong to the same class and represent an entirely new type of photographic process, whilst the third is a development of an improvement of an older process which previously had no practical value. The discovery of the reversing action of thiocarbamides by Waterhouse is so recent that it is not possible to express any definite opinion as to its actual utility.

The two processes belonging to a new type are both based on the effect of light on diazo-compounds, and hence are fitly termed diazotype; the one is generally distinguished as *Feer-type* and the other as the *Primuline process*.

Feer-type, which derives its name from the inventor, Dr. A. Feer, is based on the fact that diazosulphonic compounds form no colouring matters with phenols and amines, but on exposure to light the sulphonic compound is decomposed with liberation of the diazo-compound, which is then able to exert its power of forming azo-colouring matters with phenols and amines. The diazo-compounds originally recommended (Ger. Pat. 53,455, December 5, 1889) were sodium toluenediazosulphonate and sodium ditolyl-tetrazosulphonate. A 2·5 or 3·0 per cent. solution of one of these salts is mixed with an equivalent quantity of an amine or of a phenol (such as resorcinol or β-naphthol) and caustic soda. Paper or fabrics are immersed in the solution and dried. When exposed to light the diazo-compound is liberated in quantity proportional to the quantity of light-action and being intimately mixed with the phenol or amine at once forms an azo-colouring matter. If the paper or fabric is exposed behind a semi-transparent body like an ordinary photographic negative, it is obvious that the greatest quantity of colouring matter will be found where the semi-transparent body allows most light to pass, and hence a positive image is obtained from a negative, and *vice versâ*. The time of exposure required is stated to be 10 to 15 minutes in direct sunlight. After exposure the print is washed in water, or if an amine has been used, first in dilute hydrochloric acid, and afterwards in water.

My own experiments are as yet few in number, in consequence of some delay in obtaining the necessary material, and are of interest only as confirming in a general way the statements of the inventor. They were made with sodium diazo-pseudo-cumidine-sulphonate, which has been recommended by Feer in place of the toluene or di-tolyl derivative. When it is dissolved in water with equivalent quantities of β-naphthol and sodium hydroxide and paper is immersed in the solution and dried, it yields surfaces which are very sensitive to light. Exposure for only 10 seconds to March sunlight on a not very bright day gave a deep pink colour, and exposure for one minute gave a deep red, which was only very slightly increased in intensity by doubling the exposure. Some "nature prints" made with fern leaves were very satisfactory and showed a considerable amount of detail and structure.

I observed that the rate of change became very much slower as exposure was continued, doubtless because the colouring matter formed in the surface acts as a protective screen to the unchanged material behind. I also found that a print could readily be obtained by means of magnesium ribbon, and that even exposure for 20 minutes at a distance of 6 in. from an ordinary No. 5 gas burner produced a readily recognisable quantity of colouring matter. So far, however, I have made no experiments with the spectrum.

The primuline process has already been described by its inventors before another Section of the Society (this Journal, 9, 1001—1002), and it is therefore only necessary to say that, as a rule, the results of my own experiments confirm their statements.

Phenol, which is recommended for the production of a yellow colour with the unaltered diazo primuline, behaves in a somewhat peculiar way. When the fabric containing the diazo primuline is immersed in the alkaline solution of phenol, it acquires a deep orange-red colour, but on washing with water this slowly changes to yellow. Prolonged washing is required to complete this change, but if the washing is stopped at an intermediate stage the distribution of the colouring matter on the fabric is usually very irregular.

Quinol (hydroquinone) gives only a pale yellow colouring matter, and is practically useless as a developer.

The inventors recommend solutions of the developers containing about 0·25 per cent. of the active constituent; the British Journal of Photography (**37**, 658) recommends solutions containing 0·7 to 1·4 per cent. (3 to 6 grains per ounce). I have not been able to recognise any advantage in the use of the stronger solutions.

The same journal (*loc. cit.*) recommends eikonogen (sodium amido-β-naphthol-β-sulphonate) as a developer for a black colour, and pyrogallol as a developer for a brown colour. The inventors in their later paper state that eikonogen as a developer gives a blue colour.

My own experiments, made with various samples of eikonogen, and with solutions of various degrees of concentration, confirm the statement of the inventors that this developer gives a blue colour. It may be useful to emphasise (1) the importance in this case of making the final washing with water slightly acidified with tartaric acid, and (2) the fact that prints produced with this developer must not be soaped.

Pyrogallol must be used in alkaline solution and the surface of the liquid absorbs oxygen from the air with great rapidity and becomes very dark in colour. Unless, therefore, the fabric is kept entirely at the bottom of the vessel and out of contact with the discoloured layer of liquid it is certain to become stained. Moreover, in the character of the colour produced, pyrogallol is decidedly inferior to meta-phenylene-diamine.

According to my experience the developers giving the most satisfactory results are β-naphthol, resorcinol phenol, α-naphthylamine, metaphenylenediamine, and eikonogen.

The great objection to the use of naphthylamine and some other amines is that they cling most tenaciously to the fingers, and have a very disagreeable smell. It may be useful, therefore, to point out that in this and all similar cases the smell can be immediately and entirely removed by immersing the fingers, &c. in a very dilute acidified solution of sodium or potassium nitrite.

When it is desired to apply the primuline process to paper, I recommend that the paper should first be sized with a hot solution containing 2 per cent. of gelatin and a small quantity of chrome alum, and dried. It is then *floated* on a hot solution of primuline, care being taken that none of the dye gets on the back of the paper, and again dried. When required for use it is diazotised and developed in the same manner as a fabric.

In order to apply the process for the production of transparencies on glass, the following mixture may be used: Gelatin, 5 parts; primuline, 2 parts; water, 100 parts; chrome alum, 0·025 to 0·1 part. The solution is heated to a few degrees above its melting point and poured on carefully cleaned and levelled glass plates, the thickness of the layer depending on the depth of colour required. As soon as it has thoroughly set it is diazotised by immersion for several minutes (according to the thickness of the film) in an acidified solution of sodium nitrite, washed with water, and dried. The quantity of chrome alum that can be added without precipitating the gelatin from the solution varies with the quality of the gelatin; it is desirable to use as much as possible, since the film is subjected to treatment with acids and alkalis in the subsequent stages, and unless it has been properly alumned it is very liable to leave the glass.

With respect to the permanence of the prints obtained by the primuline process and Feer's process, it may be pointed out that in both cases the image consists of an azo-colouring matter, and most of these, as is well known, fade when exposed to very bright light for any length of time, whilst, on the other hand, they are very stable when exposed only to the diffused light of ordinary rooms.

It does not seem at all likely that either of these processes will displace the ordinary photographic printing processes for general purposes. At the same time the variety of colour that can be obtained, and the ease with which they can be applied to fabrics, makes them of considerable value for decorative purposes, and it is in this direction that their utility will probably be found to lie.

The third process, which the inventor, Dr. W. W. J. Nicol, calls *Kallitype*, is of an entirely different character, and is based upon the old observations of Herschel and of Hunt that ferric salts when exposed to light are reduced to ferrous salts, and the latter precipitate metallic silver from solutions of silver nitrate. Neither in the hands of Herschel nor Hunt did the method acquire any practical value, and Nicol's improvement consists in the careful working out of the details of the process. Paper is coated with ferric oxalate, citrate, or tartrate, or a mixture of these, and after exposure is treated with an ammoniacal solution of silver nitrate mixed with a large proportion of an alkaline salt of an organic acid, the function of the latter being to prevent the precipitation of the iron. The print is afterwards washed with an ammoniacal solution of sodium citrate in order to remove both the iron and the silver salts (see this Journal, **9**, 113—414).

Specially prepared paper coated with ferric salts is now on the market, and the developing solution recommended contains silver nitrate, 50 grains, sodium citrate, 1 oz., potassium dichromate, 1 grain, water, 10 oz., ammonia solution ·880, 30 minims. The quantity of ammonia here stated leaves a large proportion of the silver citrate undissolved. My experience is that better results are obtained with a solution containing silver nitrate, 1 part, sodium citrate, 10 parts, water up to 100 parts, ammonia, *quant. suff.* The silver nitrate is dissolved in five or six parts of water and carefully mixed with ammonia until the precipitate is just redissolved, and the solution is poured into a solution of the sodium citrate in about 80 parts of water and the mixture is diluted to 100 parts. A slight precipitate of silver citrate will form and is filtered off. The developing solution and the solutions used for washing the print should be kept in the dark as much as possible. With the present commercial paper the use of developing solutions containing potassium oxalate or borax in place of sodium citrate produces no noteworthy difference in the colour of the image. It is stated that the addition of a small quantity of potassium dichromate to the developer gives greater contrasts in the resulting print, but I was not able to observe any such result.

The image formed consists of metallic silver, or at any rate behaves exactly like metallic silver with various reagents. It is bleached by solutions of mercuric chloride or cupric bromide, but can be redeveloped by treatment with any ordinary developing solution after the excess of the mercuric or cupric salt has been washed out. The image bleached with mercuric chloride or bromide can be intensified by treatment with a solution of potassium silver cyanide and probably by other methods also.

The image is not appreciably affected by exposure for 48 hours to the products of the combustion of sulphur in air, nor by immersion for the same length of time in a solution of sulphurous acid. A solution of hydrogen sulphide produces a slight change in the colour of the image, but has no other effect. Ammonium sulphide in dilute solution changes the colour from black to brown without any loss of detail, and with only a slight loss of intensity. The brown colour is not unpleasant, and is very suitable for certain subjects. There is no reason to doubt the permanence of the images when exposed to ordinary atmospheric influences.

The colour of the image with the commercial paper is not a pure black, but has a tendency towards a slightly bluish tinge. This, however, will probably be remedied when further experience has been gained with the process, and though at present kallitype cannot be regarded as equal to the much older platinotype, it is considerably cheaper, and is capable of giving very fine results with good negatives of suitable subjects.

Glasgow and Scottish Section.

Chairman: E. C. C. Stanford.
Vice-Chairman: A. Crum Brown.
Committee:

G. Beilby.	J. Falconer King.
Wm. Boyd.	G. McRoberts.
J. Christie.	T. P. Miller.
W. J. A. Donald.	*E. J. Mills.*
D. B. Dott.	*T. L. Patterson.*
C. A. Fawsitt.	J. Pattison.
Wm. Foulis.	E. Smith.
J. Gibson.	R. R. Tatlock.

Hon. Treasurer: W. J. Chrystal.
Hon. Local Secretary:
Dr. G. G. Henderson, Chemical Laboratory, University of Glasgow.

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

The names in italics are those of members of Committee who retire at the end of the current Session. The following have been elected to fill the vacancies, and will take office in July next:—*Committee:* C. J. Ellis, R. A. Inglis, R. Irvine, and J. B. Readman.

Meeting held at the Societies' Rooms, 207, Bath Street, Glasgow, on Monday, June 1st, 1891.

MR. E. C. A. FAWSITT IN THE CHAIR.

ON DESTRUCTIVE DISTILLATION.

BY EDMUND J. MILLS, D.SC., F.R.S., AND T. O. McMILLAN.

Part II.

It has been shown in a previous Part (this Journal, 1885, 325) that the destructive distillation of various organic substances is an act of very definite character; and that in various instances, including coal, for example, the distribution of the original material is based on a C_3 unit. The investigation was, however, incomplete, because the above results were only established for gas and tar taken together. The main object of the present research is to prove that they are true for the gas and tar separately.

The coal employed was a Scottish bituminous coal (Balquhatstone), much in request for household purposes in the West of Scotland. It was very carefully sampled for analysis. Total sulphur was determined by Nakamura's process (J. Chem. Soc. 1879, 787). Pit water was determined at 100° in a current of purified dry coal gas. There was practically no additional loss up to 130°. The organic analysis was carried out in a mixture of plumbic chromate and cuprie oxide, oxygen being used at the last. The percentage composition was as follows:—

Carbon	82·54
Hydrogen	4·88
Oxygen	5·58
"Pit water"	2·52
Nitrogen	1·75
Sulphur	0·77
Ash	1·96
	100·00

The sample contained sulphate corresponding to 0·05 per cent. of sulphur.

The carbon, hydrogen, and oxygen have the relation $C_{18}H_{12}O$:—

	Found.	Calculated.
Carbon	88·75	88·53
Hydrogen	5·25	4·91
Oxygen	6·00	6·56
	100·00	100·00

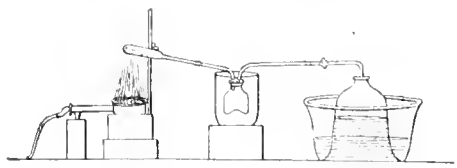
It may be of interest to compare this composition with others similarly worked out:—

Yorkshire and Durham	$C_{24}H_{14}O$
Balquhatstone	$C_{18}H_{12}O$
Boghead	$C_{12}H_{8}O$
Average cannel	$C_{12}H_{12}O$
Heywood gas cannel	$C_{9}H_{12}O$
Good average Scotch shale	$C_{7}H_{10}O$

[Mills's Destructive Distillation, pp. 39, 40, 56.]

Low Temperature Distillation.

The coal was crushed until it would pass fairly through a sieve having six holes to the inch. The portion of this unable to traverse a sieve having eight holes to the inch was employed for the destructive distillations. The fragments distilled had an average diameter of 3½ millimetres. The nature of the apparatus employed will be sufficiently understood by reference to the following sketch:—



The retort was a piece of hard glass, and contained 10 grms. of coal.

The source of heat was a Fletcher burner, gradually raised. The uncorrected results were as follows:—

	Per Cent.
Coke (free from ash), 3 experiments	73·32
Crude gas (1,560 cc. sp. gr. ·1891)	..
Water (including 2·52 pit water), 3 experiments	6·20
Tar	8·34

The gas was measured over water saturated with gas from a previous operation. Its specific gravity was determined with the effusiometer. The following is the composition of the gas, including air in the apparatus:—

		Vols.
"Pure" gas.	Methane	41·03
	Hydrogen	19·90
	$C_{13\cdot29}H_{16\cdot076}$	1·54
	Carbonic oxide	6·56
	Nitrogen	27·51
	Oxygen	5·99
	Carbonic dioxide	0·83
	Hydric sulphide	0·42
		103·78

The calculated specific gravity of the "pure" gas is 0·537.

If the "pure" gas only be considered, and the above volumes be converted into weights, the composition will be found to be:—

	Found.	$C_{30}H_{105}O_3$
Carbon	70·98	70·14
Hydrogen	19·91	20·51
Oxygen	9·11	9·35
	100·00	100·00

Thus the gas may be considered, as is probably usual for low temperature gas, to be mainly redistributed methyl and water [$C_{30}H_{105}O_3 = 30\ CH_4 . 3\ H_2O . H_2$].

100 grms. of the pure organic matter of the coal give 6·927 grms. pure gas (= 3,580 cubic feet per ton).

The tar was analysed by combustion in a platinum boat, in front of which was a mixture of cuprie oxide and

plumbic chromate. Oxygen was used when the tar began to burn with difficulty. The percentage composition was as follows:—

Carbon	59·92	Mean of 6 determinations.
Hydrogen	12·81	
Oxygen	24·60	
Nitrogen	1·19	
Sulphur	1·48	
	100·00	

On the usual assumption that the tar contains 0·5 per cent. of water, and neglecting nitrogen and sulphur, we have:—

—	Found.	$C_{30}H_{50}O_2$
Carbon	61·88	62·05
Hydrogen	13·17	13·13
Nitrogen	24·95	24·82
	100·00	100·00

The tar may be regarded mainly as redistributed methylene and water [$C_{30}H_{50}O_2 - 30\,CH_2 + 9\,H_2O - H_2$].

Water was determined by removal with a pipette from the total weighed distillate, and then weighing the remainder.

The coke was set aside for analysis, but was found on analysis to have taken up so much water and oxygen from the air as to render the results unavailable.

The equality connecting the composition of the pure organic matter of Balquhatstone coal with its products of destructive distillation at a low temperature may be written thus:—

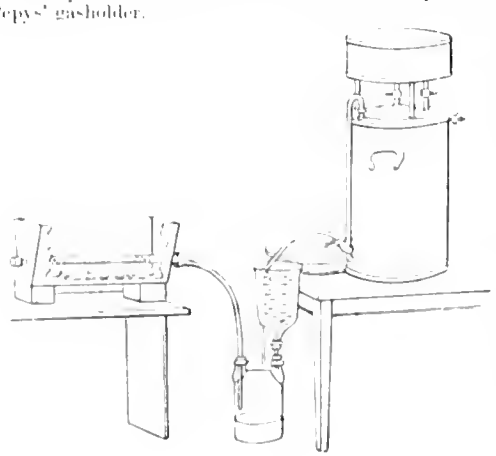
$$28\,C_{18}H_{12}O = \underset{\text{Coke.}}{C_{111}H_{128}} + \underset{\text{Tar.}}{C_{30}H_{50}O_2} + \underset{\text{Gas.}}{C_{30}H_{104}O_4} + \underset{\text{Water.}}{16\,H_2O}$$

	Found.	Calculated.
Coke	78·84	79·79
Tar (= 0·012 water)	8·51	8·49
Gas	7·45	7·51
Water (+ 0·012 in tar)	4·01	4·21
	98·81	100·00

We have thus reached a very simple result. About nine-tenths of the carbon of the organic matter has been converted into coke; the rest has been divided equally between the tar and the gas.

High Temperature Distillation.

The apparatus employed is illustrated in the following sketch. It consisted of a tube and furnace of malleable iron, followed by a Wolff's bottle, a coil surrounded by ice, and a Pepys' gasholder.



The tube having been heated by charcoal to a point considerably above redness, the plug at its open end was momentarily removed, and an iron spoon inserted containing 30 grms. of coal, in pieces of the same size as employed for the low temperature distillation. The spoon was about 18 in. long, $\frac{9}{16}$ in. in diameter, and $\frac{1}{32}$ in. thick. Immediately after its insertion the plug was luted and replaced: gas came off directly afterwards. This apparatus is very convenient for determining the gas given off by coal at a high temperature. We are not, however, acquainted with any laboratory method of determining directly the tar or water; but it may be assumed, in accordance with well-known facts, that the latter is practically the same in amount both at low and high temperatures. Hence the tar may approximately be determined by difference. The coke was determined in a platinum crucible,—a method which gives the same result as in working on a large scale. The uncorrected results were:—

Coke (free from ash)	67·15 per cent.
Gas	28,333 cc. (sp. gr. ·457)

The following is the composition of the gas:

		Vols.
"Pure" gas.	Methane	37·31
	Hydrogen	44·58
	$C_{2\cdot96}H_{5\cdot67}$	2·59
	Carbonic oxide	9·82
	Nitrogen	5·82
	Oxygen	0·76
	Carbonic dioxide	0·78
	Hydric sulphide	1·04
		102·20

The calculated specific gravity of the "pure" gas is 0·403.

If the pure gas only be regarded, and the above volumes be converted into weights, the composition will be found to be:—

—	Found.	$C_{30}H_{130}O_8$
Carbon	63·01	63·16
Hydrogen	22·78	22·81
Oxygen	14·21	14·03
	100·00	100·00

Thus the gas may be considered, as is probably usual for high temperature gas, to be mainly redistributed marsh-gas and water [$C_{30}H_{130}O_8 - 30\,CH_4 + 5\,H_2O$].

100 grms. of the pure organic matter of the coal, give 14·65 grms. pure gas under "high" temperature conditions (= 10,089 cubic feet per ton).

On account of some tar being carried off into the gas holder during the generation of gas, we could not directly determine it. We, however, obtained the following results in analysing the tar:—

Carbon	75·75	5 experiments.
Hydrogen	8·20	
Oxygen	13·13	
Nitrogen	1·06	
Sulphur	1·17	
	100·00	

On the assumption that the tar contains 0·5 per cent. of water, and neglecting nitrogen and sulphur, we have:—

—	Found.	$C_{30}H_{46}O_4$
Carbon	77·86	77·59
Hydrogen	8·53	8·62
Oxygen	13·51	13·79
	100·00	100·00

The composition, similarly calculated, of a sample of London tar, and given in Part I., was $C_{21}H_{32}O_3$, which differs little from what has been above recorded. Our tar may be regarded as mainly redistributed methinyl and water [$C_{30}H_{40}O_4 = 30\,CH + 4\,H_2O + H_2$].

The observations we had already made in connexion with low temperature coke having convinced us that the whole subject of the composition of coke requires fresh investigation, we did not analyse our high temperature product.

The equality connecting the composition of the pure organic matter of our coal with its destructive distillation at a high temperature may be written thus:—

$$30\,C_{18}H_{12}O = \underset{\text{Coke.}}{C_{450}H_{28}} + \underset{\text{Tar.}}{C_{30}H_{40}O_4} + 2\,\underset{\text{Gas.}}{C_{30}H_{130}O_4} + 16\,\underset{\text{Water.}}{H_2O}$$

	Found.	Calculated.
Coke	72·20	74·15
[Tar	6·38]	6·34
Gas	14·65	15·58
[Water.....	4·01]	3·93
	97·24	100·00

Under the column "Found" we have placed, as previously indicated, the water of the low temperature distillation. The tar is calculated by assuming also the losses of the low temperature analysis.

We have thus arrived at a very simple result. About five-sixths of the carbon of the organic matter has been converted into coke; the rest has been divided in the proportion of 1:2 between the tar and gas.

Considering comparatively the low and high temperature distillations of the same organic matter, it is evident that the high temperature volatilises in gas twice as much carbon as the low temperature does.

These results are so simple and so distinct that we are disposed to regard them as probably normal conditions in the low and high temperature industries respectively.

Among minor inferences from our work, we desire to call attention to the fact that low temperature tar is much more oxidised than high temperature tar, the contrary being necessarily true for the gas.

Our best thanks are due to Messrs. Hamilton, Buchanan, and Baird for valuable assistance in this investigation.

THE SCRUBBING OF GASES.

Professor Mills then made a verbal communication "On the Scrubbing of Gases."

In order to determine the amount of matter that can be removed from a gas, *e.g.*, coal gas, by scrubbing, the dry gas is passed through a succession of U-tubes of exactly the same pattern, and each about half filled with the same weight of pumice of uniform grain, saturated with heavy lubricating oil. It is convenient to cool the gas and U-tubes with ice. After a suitable time has elapsed, tube I. (nearest the supply) will be found to have absorbed a certain weight a of hydrocarbon; tube II. will contain less, say, $r\,a$; tube III. will contain less, say, $r\,(r\,a) = r^2\,a$; &c., &c. Three tubes will usually be found sufficient. The total amount of hydrocarbon that would have been absorbed, from the volume of gas under experiment, by an infinite number of such tubes, is $\frac{a}{1-r}$.

It is obvious that tube I. should not be allowed to become saturated, and that the gas to be scrubbed should not be saturated with the various matters to be removed.

Obituary.

EDWARD WILLIAM PARNELL.

A MEMBER OF THE SOCIETY OF CHEMICAL INDUSTRY.

Edward William Parnell was born in 1848, in St. Helen's, Lancashire, where his father, Edward Andrew Parnell, was then carrying on chemical manufactures in partnership with William Henry Balmain. After receiving a general education at various schools, including the Wigan and Bristol Grammar Schools, he applied himself to the study of chemistry as a profession, under the superintendence of his father, who then resided in Swansea. In 1867 he went to Wiesbaden, and became a laboratory pupil of the renowned analyst, Professor Fresenius. At the completion of his course, Professor Fresenius invited him to become his assistant; but Mr. Parnell, intending to devote himself to technical chemistry, returned to England, and soon became engaged in the laboratory of the chemical works of the Runcorn Soap and Alkali Company. He afterwards became managing director of the Desoto Alkali Company, having works at Widnes for the manufacture chiefly of caustic soda. For a few years prior to his decease, he applied himself with great energy to carrying out the process of his invention known as the "Parnell and Simpson Alkali Process," the object of which is to conjoin and carry on unitedly the old Leblanc process with the ammonia-soda process; with production of soda-ash, caustic soda, bleaching powder, and sulphur. A paper, by Mr. Parnell, describing his process, which he read before the Liverpool Section of the Society of Chemical Industry, will be found in the Journal of the Society, Jan. 31, 1889 (No. 1, Vol. viii). Unfortunately, he did not live to see all the practical difficulties in some of the details of this ingenious and promising process surmounted.

An important improvement in the manufacture of caustic soda, introduced by Mr. E. W. Parnell, consisted in causticising under high pressure. A much stronger liquor is obtainable thereby than at ordinary pressure.

His uprightness, amiability, and unselfishness, brought him the esteem of all who knew him; and those who knew him best esteemed him most. He died in London on April 3rd, within a few days of the forty-third anniversary of his birth-day.

Journal and Patent* Literature.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

The Treatment of Hard Water. L. Archbutt and R. M. Deeley.

See pages 511—517.

PATENTS.

Improvements in and relating to Evaporating and Distilling Apparatus. J. Foster, Sunderland. Eng. Pat. 4309, March 19, 1890. 11*d.*

These improvements refer to the construction, arrangement, and combination of evaporating vessels by fitting them each with one or more divisions or compartments within the same outer shell, each compartment forming a separate evaporator and capable of working in combination with the other compartments either as single, double, or multiple effect. Several of these vessels may be arranged to work together and thus afford ready means for the installation of various-sized evaporating plant capable of convenient and quick adjustment for the work in hand. The system is applicable to both vertical and horizontal evaporators or distillers, several arrangements of which are indicated in the two sheets of drawings attached to the specification.—B.

An Improved Furnace or Heating Chamber for Conducting Chemical Operations. G. E. Davis and A. R. Davis, Manchester. Eng. Pat. 6433, April 28, 1890. 8*d.*

In this improved furnace the chemical operations can be performed, either with or without contact with the fuel gases, and the furnace may be fed and discharged automatically, and the speed of working regulated at will.

The furnace consists of an elongated tube, preferably oval in section, either fixed or made to revolve, and containing two or more removable longitudinal shafts, carrying creeper-blades. The shafts are placed at such a distance apart that the extremities of the creeper-blades of one shaft nearly touch the metal of the next, the pitch of the blades being such that those on one shaft nearly touch those of the next at some point in their revolution, by which arrangement they are kept free from deposits and incrustations. By suitable gearing the shafts may be made to revolve in the same or opposite direction, and the speed of revolution varied to suit the chemical substances under treatment. In certain processes two or more of these furnaces may be arranged at different levels, so that the lower one may be charged from that above. The furnace may be conveniently heated by a fire-place underneath. External air is excluded when necessary by sealing the openings, or by other means.—E. S.

Improvements in Appliances for Cooling or Heating and Filtering Oil and like Liquids. F. N. Mackay, London. Eng. Pat. 7696, May 17, 1890. 8*d.*

A jacketed cylinder is fitted internally with rotating scrapers and oil circulators, and is supplied with means by which liquid ammonia or like substance is injected into the jacket and allowed to evaporate therein, the gas evolved being led to a purifier; the main object being to cool the oil or liquid by direct application of a heat-absorbing liquid combined with direct application of the pressure necessary for filtration. Better results are said to be obtained and with greater economy. To effect this, six improvements in the apparatus are described, for details of which the specification must be consulted.—E. S.

Improvements in Means or Apparatus for Use in Producing or Separating Oxygen and Nitrogen Gases from Atmospheric Air, also applicable for Manufacturing other Gases. W. Cryer, London. Eng. Pat. 8752, June 6, 1890. 8*d.*

Retorts are set in nests and "supported at their ends in a series of holes in plates or supports," and are surrounded by openwork rows of bricks or tiles. By this arrangement it is claimed that the destruction or sagging of the retorts consequent on local excessive temperature or want of adequate support is avoided, the bricks or tiles constituting moreover a reservoir of heat.

An alternative method of supporting the retorts consists in the use of pipes, through which water circulates and is used for the generation of steam or some similar purpose. Such pipes conveniently serve as runners on which the retorts may be readily drawn.—B. B.

Improvements in Apparatus for Evaporating, Concentrating, and Distilling Liquids. W. R. Watson and R. A. Robertson, Glasgow. Eng. Pat. 8790, June 7, 1890. 6*d.*

The object of this invention is to simplify the construction of the apparatus described in Eng. Pat. 11,485 of 1888 (this Journal, 1889, 530), and so render it more easily packed for transport. This is done by forming the separating chambers into a column detached from the evaporators, with which they are connected by pipes.—E. S.

Improvements in the Manufacture of Tin, Iron, and other Metal Drums for carrying Oils and other Liquids. G. Cox, London. Eng. Pat. 9685, June 23, 1890. 6*d.*

Near one edge, the lid is dished outwards from the inside around the bung-hole, and on to the part thus raised a nozzle to receive the bung is so brazed as to leave no internal projection. This allows free outflow of the liquid, whilst it also adds strength to the bung-hole.—E. S.

Improvements in Cocks for Mixing Gas and Air. R. Giesbde, Hanover, Prussia. Eng. Pat. 10,698, July 10, 1890. 8*d.*

The invention relates to the construction of cocks by which a mixture of gas and air, the latter at ordinary atmospheric pressure or under compression, is produced for feeding burners of heating apparatus, the object being to prevent explosions occurring in the cocks and burners and their connexions, both when the mixture issuing from the burners is lit and when it is turned off. In order to understand the construction of the cock it will be necessary to consult the drawing attached to the specification.—E. S.

An Improved Construction of Kiln for Drying Moist Materials. G. A. Hart, Hull. Eng. Pat. 12,897, August 16, 1890. 6*d.*

The material is placed on a horizontal revolving table beneath which are one or more fire-places, the whole being arranged in a dome-shaped circular building. Scrapers are suitably placed above the table for turning over the material and for delivering it, when required, through an exit.—H. K. T.

* Any of these specifications may be obtained by post, by remitting the cost price, *plus* postage, to Mr. H. Reader Lack, Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C. The amount of postage may be calculated as follows:—

If the price does not exceed 8*d.*	.....		½*d.*
Above 8*d.*, and not exceeding 1*s.* 6*d.*	.....		1*d.*
„ 1*s.* 6*d.*,	„	„ 2*s.* 4*d.*	..... 1½*d.*
„ 2*s.* 4*d.*,	„	„ 3*s.* 4*d.*	..... 2*d.*

Improvements in Centrifugal Apparatus for Treating Molten Material. O. B. Peck, Chicago, U.S.A. Eng. Pat. 15,343, September 27, 1890. By Internat. Conv. March 3, 1890. 8*d*.

See under X., *page* 552.

Improvements relating to Centrifugal Apparatus for Treating Molten Meterial. O. B. Peck, Chicago, U.S.A. Eng. Pat. 15,348, September 27, 1890. By Internat. Conv. March 3, 1890. 8*d*.

See under X., *page* 552.

Improvements relating to Centrifugal Apparatus for Treating Molten Material, and to Means for Removing the said Material from such Apparatus. O. B. Peck, Chicago, U.S.A. Eng. Pat. 15,349, September 27, 1890. By Internat. Conv. March 3, 1890. 6*d*.

See under X., *page* 553.

Improvements in or relating to Gas Compressing Pumps and their Application to Refrigerating Apparatus. C. G. Mayer, New York, U.S.A. Eng. Pat. 85, January 2, 1891. 8*d*.

This patent deals principally with improvements in the details of pumps used with refrigerating apparatus, in which a gas is alternately condensed by compression and volatilised, the heat required for vaporisation being taken up from the circulating liquid. Three sheets of drawings show a general arrangement of the apparatus and details of the compressing gas pump, and there are 22 claims, of which the more important seem to be one for temporarily equalising the pressure on both sides of the piston to facilitate the work at starting, and one for cooling the oil used for lubricating the piston-rod gland.—B.

Apparatus for Distilling and Rectifying. A. G. Burkhardt, Stuttgart, and G. Schule, Hohenheim, Germany. Eng. Pat. 1214, January 23, 1891. 6*d*.

The apparatus is formed of two concentric cylinders, the walls of which are spirally corrugated. A pipe passes up the centre of the apparatus, the space between it and the inner cylinder forming a steam jacket. In practice two of these appliances are superimposed. The liquid to be distilled is passed up the central tube of the lower portion of the apparatus, and overflowing, spreads over the outside of the inner cylinder, which is heated by means of steam, as described above. The volatile portion of the liquor finds its way into the space between the outer and inner cylinders of the upper portion of the combined apparatus, where it undergoes rectification. For details and drawings of the apparatus, the original specification must be consulted.

—H. T. P.

Improvements in Filtering Apparatus. H. H. Lake, London. From E. M. Knight, San Francisco, U.S.A. Eng. Pat. 1509, January 27, 1891. 8*d*.

The filter consists of two separate chambers, one above the other, the upper one standing on the rim of the lower one. This latter forms the storage and delivery chamber. The bottom of the upper chamber is fitted with two wire screens, having asbestos cloth between them. On the upper screen, a paste made of finely-powdered charcoal and water is placed, the whole being properly secured in its place. Resting on this a second and similar screen, but without the paste, is placed, which can be lifted off and on by a handle. The object of this second screen is to prevent the water when poured on from washing away the paste on the lower screen, whilst it also serves to receive any coarse sediment which may be in the water, and prevent its passing readily through upon the filtering medium below.

—E. S.

Improvements in Filtering Apparatus. H. H. Lake, London. From E. M. Knight, San Francisco, U.S.A. Eng. Pat. 1521, January 27, 1891. 11*d*.

A series of tanks, which can be used independently or together, is supported and secured in a battery of exterior bracing frames. In the interior of each tank is a filter frame, the sides of which are formed of finely-perforated wire-cloth, upon which is spread asbestos, to support the filter bed, which is formed of a coating of finely-powdered charcoal, made into a paste with water, and brushed into the interstices of the wire-cloth, until a sufficient thickness has been applied.

For further details of construction and mode of working the specification, and three sheets of drawings attached, must be consulted. There are 11 claims.—E. S.

Improvements in the Method of and Apparatus for Forcing Semi-Fluids into Filter Presses. S. H. Johnson and C. C. Hutchinson, Stratford. Eng. Pat. 3004, February 19, 1891. 8*d*.

In filter presses of the usual construction, the amount of sludge which can pass through the press gradually diminishes as the pressure increases during each operation, and, in order to prevent overstraining, the pumps employed must either allow part of the sludge to escape through a relief valve, or they must be worked at greatly reduced speed towards the end. In the former case a loss of power results, whilst in the latter the valves and passages are stopped up with the fibrous material, and the proper action of the pumps is impeded.

The patentees avoid these inconveniences by causing the pumps to work intermittently, but always at their full speed, and to stop automatically every time the full pressure has been reached. When the pressure has fallen again by a predetermined amount, a regulator comes into action automatically, to open the steam-valve of the pumps, and this is repeated until the press is quite filled. Details of the regulator, and a complete arrangement of the plant, are shown in the drawings. There are two claims.—B.

A New or Improved Method of and Apparatus or Machinery for Continuous Mechanical Distilling. S. Barber, London. Eng. Pat. 3140, February 20, 1891. 8*d*.

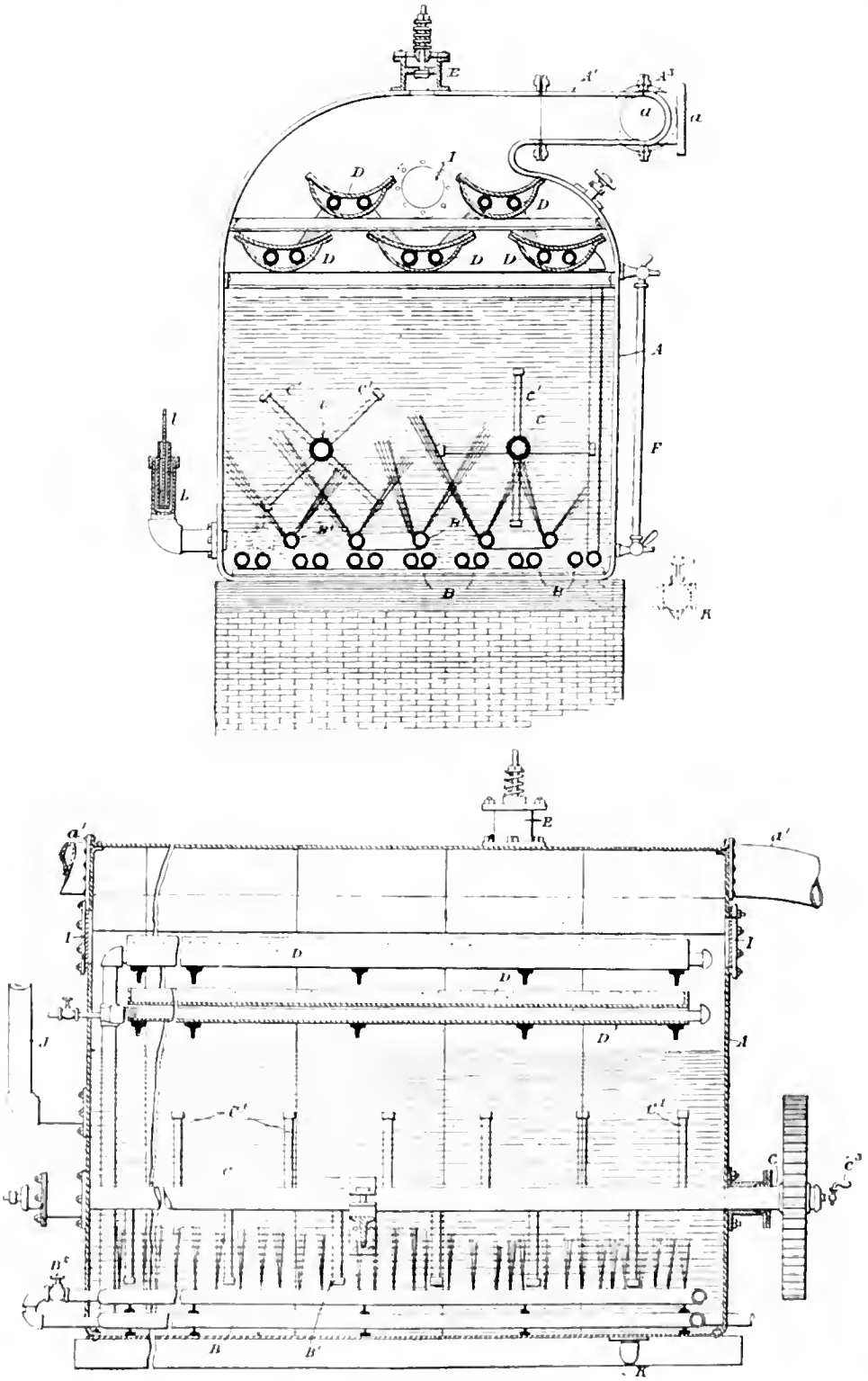
The apparatus consists of a combination of horizontal mixers and horizontal closed cylinders or stills with central revolving shafts and stirrers, for the purpose of mixing and automatically delivering certain solid substances, such as coal or coke, stones, shells, sand, cork, pulps, &c., whilst undergoing the process of distillation. Tars, oils, or acids may be injected into the mixer for distribution amongst the solid matter, whilst air, steam, or gases are admitted to the stills through nozzles entering from below, and the resulting gases or vapours drawn off from above. The mixer and stills deliver from one to the other automatically, and the solid materials are discharged at the end of the last still, ready for any further treatment, such as pressing into blocks, &c. The drawings accompanying the specification give a general idea of the arrangements of the apparatus, and are supported by five claims.—B.

Improvements in Apparatus for Automatically Changing the Direction of Flow of Currents of Fluids through Pipes or Passages. "The Brins Oxygen Company, Limited," and K. S. Murray, London. Eng. Pat. 4292, March 10, 1891. 8*d*.

The improvements apply to part of apparatus previously described in Eng. Pat. 4955 of 1889, and consist in devices for the automatic reversal of valves with a view to the reversal of the flow of air or gases through pipes. The presence of the fluid in the pipes is made use of for producing the desired change, and for details, the specification and two sheets of drawings must be consulted.—B.

Improvements in Evaporators. R. Haddan, London. From I. W. Evans, Cleveland, U.S.A. Eng. Pat. 5555, March 31, 1891. 8*d*.

In the naphtha process of extracting oil from seeds, the seeds, after having been ground, are placed in percolators filled with naphtha, which extracts the oil, and is afterwards separated therefrom by evaporation and condensation. Quantities of, say 1,000 bushels, of meal, and perhaps 150 barrels of naphtha, may be treated in one percolation at a time, and several of these may be working in conjunction,



Improvements in Evaporators.

and the evaporator must, therefore, be of ample size and efficiency to enable its work to be done with despatch.

The invention refers to the construction of an improved evaporator with that point kept in view, the naphtha being evaporated at comparatively low heat. The accompanying illustrations show the apparatus in longitudinal and cross sections, and will be clear from the following references, viz.:—

A is a rectangular box or container, preferably made of sheet iron with circular top, having an opening at one side extending the full length of the vessel. To the flanges of this opening are secured the lengthening piece A^1 and cover plate A^2 with outlets a and a^1 for the naphtha vapours. The interior is heated by the steam coil B and the perforated steam pipes B^1, from the latter of which the steam can be cut off by the valve B^2 without affecting the remainder. Above the steam pipes are fitted agitators, consisting of hollow shafts C with hollow prongs C^1, into which steam can be admitted through the tap C^3, for the purpose of keeping them at the proper temperature. In the upper part of the vessel the hollow troughs D heated by steam still further aid evaporation, whilst their shape facilitates the collection of any naphtha condensed overhead. E is a vacuum valve, for protection against a collapse of the vessel on cooling; F, glass gauge; I, glass lights; J, inlet pipe for the compound; and K, outlet for the purified oil; L, well for ascertaining the temperature, and there are man-holes and other usual mountings. The specification covers six claims.

—B.

II.—FUEL, GAS, AND LIGHT.

The Scrubbing of Gases. E. J. Mills.

See page 527.

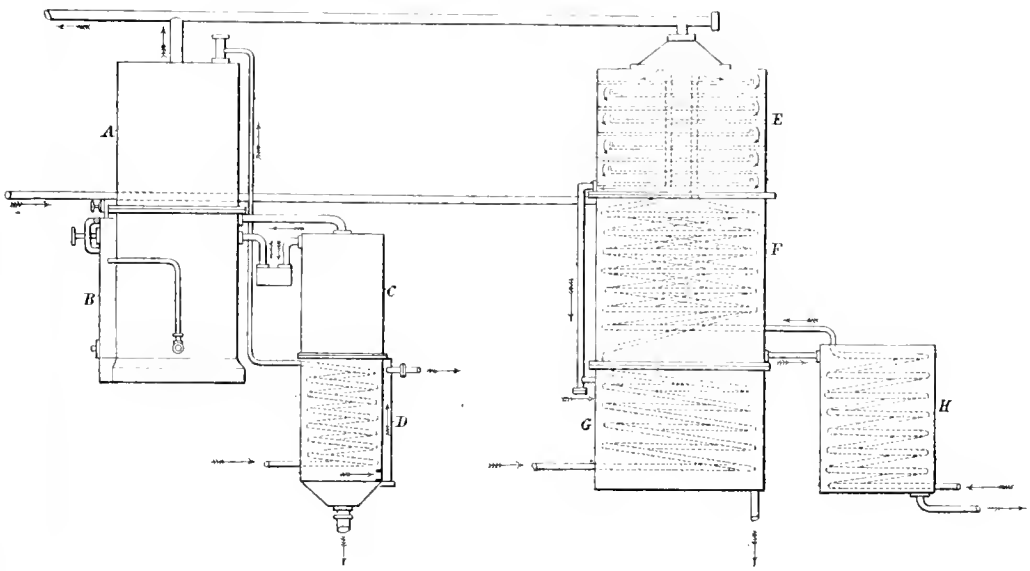
PATENTS.

Improvements in the Method of and Apparatus employed in the Manufacture of Coal-Gas and of Compounds of Ammonia. T. Holgate, Halifax. Eng. Pat. 3684, March 8, 1890. 8*d*.

The improved apparatus is a suitable arrangement of various stills of any approved form, whereby the waste heat generated in the preparation of ammonia from ammoniacal liquor and in the purification of crude ammoniacal liquor (and in the manufacture of coal-gas) can be utilised. The apparatus consists of two parts, one for the preparation of ammonia for making sulphate, the other for the partial purification of crude ammoniacal liquor (for use in purifying coal-gas), the two parts and processes being worked in conjunction with one another.

The apparatus for preparing ammonia consists of a still A, in which the crude liquor, previously warmed in D, is heated to drive off the free ammonia, &c.; the gases pass into an ordinary saturator, the liquor being conveyed to a second vessel B, placed below A, and there agitated with lime; the mixture is then passed into another still C, and heated to drive off the rest of the ammonia. The spent liquor from C is passed into a still D, and its heat is utilised for warming the cool ammoniacal liquor before it passes into A.

The other part of the apparatus consists of a vessel E, in which ammoniacal liquor previously warmed by passing through the vessels G, F, or H, F, is being heated to expel sulphuretted hydrogen and carbon dioxide; these gases



Apparatus for Treating Ammoniacal Liquor.

pass to the saturator, and the purified liquor runs into a cooler G placed below where its waste heat is utilised for raising the temperature of crude ammoniacal liquor before it passes through F into E. Situated between E and G is a vessel F, which receives hot waste gases from the saturator and in which ammoniacal liquor, already warmed in G, or in H, is still further heated. The waste gases from F are conducted through a still H, where crude ammoniacal liquor is heated before it passes into F and E, and then to a "Claus kiln," sulphuric acid plant, or oxide of iron purifier.

—F. S. K.

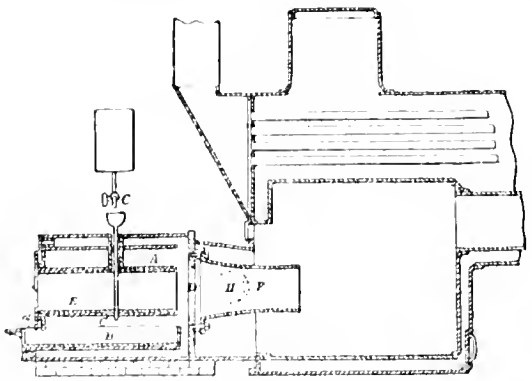
Improvements in Coke Ovens, and in the Method of Using the Same. E. Edwards, London. From F. Strochmer, Dresden, Germany. Eng. Pat. 4457, March 21, 1890. 8*d*.

In this invention it is proposed to use trucks for coking in. The coal is carefully laid and rammed down in the trucks, four of which are used. The trucks are introduced into a vaulted fire-brick coking oven, suitably arranged, and to which air has free access from the bottom. After coking, a fresh truck is pushed in at one end and so pushes out the one furthest away and most coked. The doors are closed and coking resumed.

It is claimed that this furnace and mode of operation will be useful for glass or smelting furnaces, pottery kilns, and such like.—D. A. S.

Improvements in Apparatus for Burning Hydrocarbon Oil as Fuel. H. H. Lake, London. From J. P. Swift, Woods Holl, U.S.A. Eng. Pat. 6502, April 28, 1890. 8*d*.

This is an apparatus in which petroleum or other liquid hydrocarbons are used for heating steam boilers or for similar purposes. The hydrocarbon is fed through C into a trough B, which may be lined with asbestos or similar material. The hydrocarbon is partially burnt and volatilised by a current of air entering through *a*. The flame so produced passes through D, and is urged onwards and burnt by a current of air passing through E. The tube F serves to keep together and thoroughly mingle the air and hydrocarbon flame. In order to prevent the



Apparatus for Burning Hydrocarbons.

deposition of carbon on D and in the tube F, air is admitted through tubes surrounding the combustion chamber A, and through a side-tube H into F. The various air apertures are fitted with dampers.—H. K. T.

An Improved Process for the Manufacture of Illuminating Gas, and Apparatus therefor. R. C. Lindsay, Hampstead. Eng. Pat. 7252, May 9, 1890. 1*s*. 1*d*.

Coal, cannel, or other gas-making material is carbonised in retorts in the usual manner, and the gas, after being passed through condensers and washers, is led into an exhauster. Before drawing the charge, steam is admitted, when carbonic oxide and hydrogen are produced at first, but later on, as the retort cools, carbonic acid and hydrogen are formed. The object of introducing steam is to prevent the coke from bursting into flame when the charge is being transferred to the water-gas retorts, this being a better method than damping with water, and also serving to keep the retorts free from carbon. The coke is then drawn, while still hot, and placed in a second series of retorts, where it is treated with steam, previously superheated in small fireclay pipes. These retorts are arranged in batteries of two; in the first two the steam is decomposed, forming principally carbonic acid and hydrogen; this mixture is then superheated in small fireclay pipes and passed into the second series of retorts, where the carbonic acid is converted into carbonic oxide. The water-gas produced in this way is now mixed with hydrogen, this gas being generated by passing superheated steam through vertical retorts, in which are fitted iron trays filled with spongy iron; the addition of hydrogen to the water-gas is necessary to keep down the percentage of carbonic oxide in the illuminating gas subsequently produced.

The purified gas obtained from the coal is forced back to the retort bench, and there divided into six or more jets, each of which passes into the end of a carburetter, drawing with it the water-gas from the water-gas retorts, and also a supply of heavy petroleum oil; the gaseous mixture obtained in this way is then forced by another jet of coal-gas into a second carburetter, and so on, until the desired luminosity is obtained, and finally led away to coolers, scrubbers, &c., and stored in the usual manner.

All the retorts, of which there are four for carbonising, four for the production of water-gas, and two for the production of hydrogen, together with the superheating pipes and carburetters, are arranged in an oblong gas furnace fitted with regenerators; the gas employed for heating is a waste gas, taken hot from the hydrogen producers, which are worked alternately; this waste gas is generated by passing fixed water-gas through one of the hydrogen producers, the other being used in the meantime for making hydrogen; in this way the oxide of iron is reduced to metal and the producer is ready for use again.

There are six claims and five sheets of drawings.—F. S. K.

Apparatus for Automatically Delivering any Proportionate Quantity of Oxygen, Air, or other Gaseous Body or Bodies into Gas Purifiers or other Vessels, Pipes or Conduits, irrespective of any Pressure there may be in such Gas Purifiers or other Vessels. C. B. Newton, Shrewsbury. Eng. Pat. 7714, May 17, 1890. 1*s*. 1*d*.

The air, oxygen, or other reagent is contained in, or pumped from an ordinary holder into a gas-holder, of which the side sheets are carried above the junction of the crown so as to form a tank on the top of the holder; this tank is filled with water, so as to give a greater pressure than in the purifier or other pipes, and is fitted with an adjustable overflow, so that by raising or lowering the water level the pressure can be regulated at will. An electric contact maker, so constructed as to prevent any danger arising from sparking, is placed in connexion with the station meter index and with an electro-magnet, the arrangement being such that when a certain quantity of gas has passed through the meter the circuit is momentarily closed; the electro-magnet then attracts an armature, and certain valves, through which the air or other reagent is supplied, are thereby opened. The air, or oxygen, on its way to the purifier passes through a meter, which, by means of a suitable mechanical arrangement, shuts the valves again when the desired quantity has been admitted; the gas then passes through one or more regulating valves, worked by hand, by means of which the time occupied in passing can be lengthened or shortened as required, and then through a governor, which is so constructed as to maintain a constant difference of pressure between the inlet and outlet of the meter or regulating valves.

The same object may be accomplished by connecting the drum spindle of the station meter with that of the reagent meter. Sufficient pressure is then put on the reagent meter to drive it faster than the station meter, but, by means of a pawl and a projecting pin, the former is prevented from moving faster than the latter, and so the required percentage of gas passes into the purifiers or pipes; the reagent meter is not geared directly to the station meter, nor is it bound to revolve by the action of the latter, but rather follows it by reason of the pressure of the gas.—F. S. K.

Improvements in Apparatus for the Conversion of Solid into Gaseous Fuel and its Purification. B. C. Sykes and G. Blamires, Cleckheaton. Eng. Pat. 7830, May 20, 1890. 8*d*.

The apparatus patented is a gas producer with an internal chamber for the partial combustion of the fuel, surrounded by an annular space filled with water, and surmounted by a steam space. The gases generated are caused to pass down vertical tubes placed in the annular water space, and to escape through the water, depositing tar and ammoniacal salts and converting the water into steam in so doing. The mixed gases and steam are "used to actuate a non-condensing engine," and then passed through a condenser where water is the cooling medium, and thence into one which is cooled by air, and finally pumped by compressors into the burning chamber. It is claimed that the process of condensation is "truly regenerative," that "any amount of temperature may be obtained," and that "the whole of the

nitrogen in the fuel, and possibly from the high temperature developed, and the high pressure employed, some of the nitrogen of the air will be converted into ammonia or cyanogen."—B. B.

A Process and Apparatus for the Manufacture of Illuminating Gas. S. Pitt, Sutton. From E. J. Jerzmanowski, New York, U.S.A. Eng. Pat. 8535, June 2, 1890. 8*d*.

Two fireclay retorts, each of which consists of a horizontal portion and three vertical portions, are filled with limestone, containing preferably some clay, and heated by a furnace until the limestone is converted into lime. Steam and oil are then forced into the horizontal portion of the retort, through a long perforated pipe, and there converted into illuminating gas; this gas, which contains also a small percentage of carbonic oxide and carbonic acid, passes through the vertical portions of the retort, where the illuminant is fixed, and is then led off to the hydraulic main. The gas is tested at frequent intervals and the admission of oil regulated accordingly.—F. S. K.

An Oil Flame Furnace. The Lucigen Light Company, Limited, and T. M. Jarmain, Westminster. Eng. Pat. 9181, June 13, 1890. 6*d*.

The furnace may be portable, in which case it is placed on a wheeled truck, or stationary, but the essential parts are the same. They consist of a firebrick body with flue and chimney constituting the furnace proper, and a burner which is placed upon the top of the furnace and is directed downwards into it. The burner consists of an annular trough containing oil which is supplied from an adjacent tank, the flow being regulated by a float valve and capable of being cut off altogether when required, and of a nozzle for supplying superheated steam to drive the flame of the burning oil downwards into the furnace. This nozzle or jet is supplied from an annular boiler surrounding the mouth of the burner where it enters the furnace connected with a coil of pipe in the upper part of the burner serving as a superheater. Water for the boiler and superheater is supplied from a closed-in reservoir provided with a hand pump for compressing the air above the water, and thereby expelling it in a steady stream. On starting the furnace the oil is lighted in the trough and burns with its flame directed upwards until the water in the coil is converted into steam and begins to supply the jet. Upon this happening the boiler comes into play and continues the supply of steam to the coil which now acts as a superheater. A cap covering the burner is put on and the running continues automatically, air being drawn in through holes in the cap.—B. B.

Improvements in the Treatment of Liquid Hydrocarbons. J. H. W. Stringfellow, Walthamstow. Eng. Pat. 14,832, September 19, 1890. 6*d*.

See under III., *page* 534.

Improvements in Gas Producers or Generators. A. Dauber, Bochum, Germany. Eng. Pat. 20,002, December 8, 1890. 6*d*.

This is a furnace for the production of heating gas by the partial combustion of bituminous slate, turf, and other inferior solid fuels either alone or in conjunction with paraffin, tar, residues from oil works, or coal dust. The solid fuel is placed in a shaft having the shape of an inverted cone, and is burnt by a downward current of air, the gaseous products being drawn off through gratings at the lower extremities. Blast blowpipes conveying hot air or superheated steam and hydrocarbons or coal dust are inserted in the sides of the shaft and also in its central axis in order to assist the combustion. The clinker falls into a sump at the bottom of the shaft.—H. K. T.

Improved Method of and Apparatus for Treating the Smoke of Factory and other Chimneys for the Purpose of Rendering the same Innocuous. E. R. Sawley, Bristol. Eng. Pat. 489, January 10, 1891. 8*d*.

A jet of steam is directed across a chimney at any convenient height up the stack, the outlet from which it issues being either a continuous slot in a metal box or trough, or a perforated pipe extending half round the periphery of the chimney. The steam passes into a receiver which may be jacketed with cold water, and in this the impurities from the smoke are caught and allowed to fall into any suitable receptacle, the pipe leading down to which may be water-sealed. An alternative plan consists in the use of a jet not blowing across the chimney, but exhausting the smoke out of the chimney, the collecting arrangements being, however, the same. In this case a damper above the point of aspiration may be provided as an additional means of control. The apparatus may be fitted to the funnels of locomotive and stationary engines.
—B. B.

Improvements in Methods of Generating Heating and Lighting Gases from Liquid and Solid Hydrocarbons, and in Apparatus therefor. B. H. Thwaite, Liverpool. Eng. Pat. 971, January 20, 1891. 1*s*. 1*d*.

This invention relates partly to improvements in former inventions (compare this Journal, 1890, 169, and 1891, 242) and has for its object the improvements in the methods and apparatus for the production of oil-gas and water-gas simultaneously.

Two vessels or chambers are connected together above by a refractory lined conduit, and each is provided at the upper part with an annular cavity, filled with open brickwork, so as to provide a large heating surface. Each vessel is provided further with an air inlet arrangement for supplying air requisite for the combustion of part of the gas produced; this combustion takes place immediately above the fuel, thus heating the open brickwork of a temperature necessary for the volatilisation and fixation of the liquid hydrocarbon, which is injected with steam. Each of the air inlets has a gas ignition flame, which is always kept burning in such a way that the flame covers the opening; this arrangement serves to ignite the combustible gas at intervals, as required, without explosion.

There are eleven claims and four sheets of drawings.
—F. S. K.

Improvements in Apparatus for use in the Manufacture of Gas. J. Price, Coleshill. Eng. Pat. 1560, January 28, 1891. 8*d*.

Instead of putting the hydraulic main over the retort benches it is placed in a convenient position in the front of them, and the ascension pipe enters the main vertically from underneath, the end projecting just above the water line; the advantages of this arrangement are, firstly, there is considerable saving in the length of pipe required; secondly, the use of arch-pipes is obviated; and thirdly, the direct action of heat from the retort benches on the tar, &c., in the main is avoided.

A cover or inverted thimble of block-tin or iron is placed over the open end of the ascension pipe and dipping into the liquor in the main; this cover is perforated and moveable vertically, so that when gas is escaping from the ascension pipe the cover is lifted to the water level, and in this way the back pressure is taken off the retorts. Instead of allowing the cover to lift automatically it may be raised if desired, or lowered into the liquor with a lever, or fixed by a screw; in the latter case it then acts as a washer.

The tar is drawn off from the bottom of the hydraulic main; a tank containing ammonia-water is placed above the level of the main so that it may be kept cool by a flow of liquor.—F. S. K.

Improvements in Apparatus for Carburetting Air. G. Hargreaves, J. P. Scranton, and E. W. Porter, Detroit, U.S.A. Eng. Pat. 2145, February 5, 1891. *8d.*

The object of the patent is to secure an automatic regulation of the oil and air used in making carburetted air for lighting purposes, so that the supply is always controlled by the demand.

This end is secured by the use of an air pump driven by a motor consisting of a drum, round which is wrapped a cord attached by tackle to a falling weight, the pump being of the same type as the wet gas meters used for locally increasing the pressure of the gas supply for manufacturing purposes. The motor is only in action when carburetted air is being burnt, and the rotation of the pump proceeds at the rate determined by the consumption. At the same time the reservoir containing the oil used for carburetting is put under pressure, and the flow of oil from it to the carburettor is controlled by a plunger pump and needle valves actuated by a shaft connected by gearing with the driving drum.

The carburettor consists of a series of conical discs with their apices alternately turned up and down, and provided with perforations disposed alternately at the centres and edges of the cones; the oil is allowed to trickle from top to bottom.

It is claimed that the reservoir of oil being maintained at a fixed pressure, its separation into lighter and heavier fractions is avoided.—B. B.

Improvements in Apparatus for Measuring or Delivering Air or other Gases, and for Mixing Air with other Gases in Definite Uniform Proportions, and Delivering the Mixture under a Definite Uniform Pressure. W. P. Thompson, Liverpool. From J. Tayler, New York, U.S.A. Eng. Pat. 2427, February 10, 1891. *8d.*

The inventor uses two drums, constructed very much like those employed in liquid gas meters, which are immersed in water or some other suitable liquid to some distance above the middle of their height. The drums are built each in two compartments longitudinally, one part receiving the gas from the outside through an elbow pipe, the mouth of which reaches above the water level. The other part of the drum is sub-divided, by diaphragms, into a number of longitudinal spiral partitions with radial openings at each end which, on the rotation of the drum, dip alternately under the water, and allow a measured quantity of gas to pass from the first compartment into the vessel within which the two drums are enclosed. The said elbow pipes pass through one end of this vessel, whilst the drum shafts protrude at the other end, and have motion imparted to them in any desired way, their relative speeds being controlled by differential gearing. Any predetermined mixture of gases can be brought about by speeding the drums accordingly; and the apparatus has been more particularly designed for mixing air and hydrocarbon gas in fixed proportions for illuminating or heating purposes. An additional mixing chamber is also provided for the more complete mixing of the gases before they leave the vessel. There are three sheets of drawings and three claims.—B.

Improvements in Apparatus for the Manufacture of Gas from Petroleum Oil. W. P. Thompson, Liverpool. From G. S. Sanford, Mount Clemens, U.S.A. Eng. Pat. 2889, February 17, 1891. *6d.*

The apparatus is for producing gas, either for illuminating or for heating purposes, from petroleum oil. It consists essentially of (1) a retort in which a mixture of steam, air, and petroleum oil is raised to a high temperature and thus converted into a fixed gas; (2) a mixer, in which the oil is thoroughly mixed with steam and air, and which is provided with suitable valves for regulating the proportions of the three ingredients, (3) an oil burner, of the same construction as the mixer, for heating the retort; and (4) apparatus for washing, purifying, and storing the gas produced.—F. S. K.

Improvements in the Manufacture of Coal Briquets. H. H. Lake, London. From G. A. Purbeck, New York, U.S.A. Eng. Pat. 2900, February 17, 1891. *4d.*

Coal-dust, saw-dust, or other organic waste is mixed with a solution containing about 1 per cent. of dry bi- or tri-silicate of potash or soda, or a mixture of both, the specific gravity ranging from 30 to 65 B., and is then pressed into blocks and dried. Nitrates or permanganates may be added to assist combustion.—H. K. T.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

On Destructive Distillation. E. J. Mills and T. O. McMillan.

See pages 525—527.

Purity of Benzene. C. Liebermann and A. Seyewetz. Ber. **24**, 788—790.

See under XXIII., *page* 578.

PATENTS.

Improvements in the Destructive Distillation of Mineral Oils, and in Apparatus therefor. J. Laing, Edinburgh. Eng. Pat. 1120, March 17, 1890. Second Edition. *8d.*

Mineral oils are cracked by distillation in a long cylindrical boiler divided into compartments by divisions reaching nearly to the bottom, and provided with exit tubes, condensers, and return tubes, so that the product of distillation from the compartment at the furnace end of the boiler may be condensed and drop into the next compartment, and so on, while the product of distillation from the compartment at the end of the boiler remote from the furnace passes off finally, and is condensed and collected in the ordinary manner. The temperature of the boiler is regulated by the opening or closing of dampers in flues running beneath it from end to end, the furnace gases being also capable of diversion without traversing the whole system.

The last compartment may be cooled, as to its outer side, by a water jacket; and is, moreover, provided with a draw-off tube for the pitchy residue left by the distillation of the oil in this manner, and with a pyrometer. The use of the latter is to allow of a temperature being attained and maintained, which has previously proved to yield the best results for the particular oil under treatment.

By this apparatus the production of lighter from heavier mineral oils is said to be successfully effected.—B. B.

Improvements in the Treatment of Liquid Hydrocarbons. J. H. W. Stringfellow, Walthamstow. Eng. Pat. 14,832, September 19, 1890. *6d.*

With a view principally to obviate the disadvantages attending the carriage and storage of liquid hydrocarbons, finely ground *quillaia saponaria* bark or similar saponifier is mixed with the liquid hydrocarbon under treatment. When water is added and an intimate mechanical mixture is ensured, solidification is set up by the water acting chemically upon the distributed particles of the saponifier and the whole mass quickly gelatinises. The solidified product does not "flow" when being burned; it may be re-liquefied by treatment with a small quantity of acid.

—K. E. M.

IV.—COLOURING MATTERS AND DYES.

Stability of Diazo-Compounds in Aqueous Solution. R. Hirsch. Ber. **24**, 324—326.

The author has made experiments on the comparative stability of the diazo-compounds obtained from 9·3 grms. aniline, 10·7 grms. *o*-toluidine, 10·7 grms. *p*-toluidine, 12·1 grms. *m*-xylidine, and 17·3 grms. sulphanilic acid. The amido-compounds were each dissolved in about 700 cc. water with the addition of 30 cc. hydrochloric acid, and diazotised with 7·2 grms. of sodium nitrate dissolved in sufficient water so that each product measured 1 litre. These solutions were then allowed to stand and from time to time the amount of diazo-product in each solution was determined by means of a standard solution of sodium naphtholsulphonate (Schäffer's salt) equal in strength to the freshly-prepared diazo-solutions. In each case 25 cc. of the standard naphthol-solution were taken and the amount of diazo-solution required to react with the naphthol-sulphonate contained therein was determined. The following table gives the number of cubic centimetres required, and it is evident that these must be in direct ratio to the decomposition :—

Hours.	Aniline.	*o*-Toluidine.	*p*-Toluidine.	*m*-Xylidine.	Sulphanilic Acid.
1	26	32	25·5	27·5	25·5
2	26·5	49	25·6	30	25·5
3	29	50	25·5	33	25·5
4	30·5	77	26	37·5	25·5
5	31	94	27	43	26
6	34	112	27·5	46	26·5
24	50	265	27·8	70	27
240	..	..	50	..	..

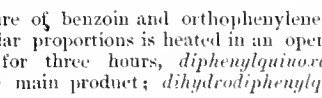
It would appear from these results that a methyl-group in the para-position to the diazo-group imparts to the latter a remarkable degree of stability, whilst the reverse is the case with an orthomethyl-group.

Experiments are also tabulated showing the comparative stability of solutions of diazobenzene under different conditions of temperature, and also in the presence of sodium acetate, an excess of caustic soda, and of hydrochloric acid. The results show that the diazo-compound is rendered most stable by cold, that the addition of acid has a slight preservative effect, whilst the effect of sodium acetate or alkali is insignificant.—A. K. M.

A New Class of Fluorescent Dyes of the Quinoxaline Group. O. Fischer. Ber. **24**, 719—723.

The author has discovered a ready means of obtaining dihydroquinoxalines from orthodiamines and α-ketone alcohols.

When a mixture of benzoin and orthophenylenediamine in equal molecular proportions is heated in an open vessel at 160°—170° for three hours, *diphenylquinoxaline* is obtained as the main product; *dihydrodiphenylquinoxaline*—

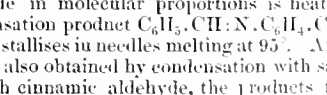


is also formed in small quantity. On repeating the experiment in a sealed tube in order to avoid atmospheric oxidation, the latter substance formed the chief product, 60 per cent. of the theoretical yield being obtained, whilst but little diphenylquinoxaline was produced. Dihydrodiphenylquinoxaline forms dark yellow crystals, melts at 148°—149°, dissolves readily in benzene and in hot alcohol, more sparingly in ether and very sparingly in light petroleum; it is insoluble in water; the solutions in ether and benzene show a beautiful yellowish-green fluorescence. It is a weak base, the salts which it forms with mineral acids and with acetic acid being decomposed by water.

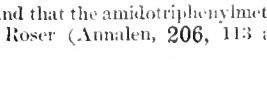
Diphenyltolyl-toluquinoxaline—

is similarly obtained from benzoin and orthamidoditolylamine. Its ethereal and benzene solutions also exhibit yellowish-green fluorescence.

In the same way benzoin and diphenyltriamidobenzene [$NH_2:NHC_6H_5:NHC_6H_5 = 1:2:4$] yield—



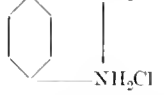
whilst from benzoin and β-phenyl-*o*-naphthylenediamine the compound—



is produced. The former crystallises in greenish-yellow lustrous plates melting at 223°, and exhibits in its solutions (especially in alcohol and in benzene) a magnificent deep green fluorescence. The latter forms glistening plates or needles of an intense yellow colour and melting at 163°—164°, and its solutions in benzene, alcohol, and ether, exhibit a greenish-yellow fluorescence.—A. K. M.

Paramidocarbinols. O. and G. Fischer. Ber. **24**, 723—729.

It has long been known that in the formation of the triphenylmethane colours by the action of an acid on the amidocarbinol, a molecule of water is split off between the OH group and a paramido group. In order to determine whether this reaction holds good for other amidocarbinols, the authors have prepared and experimented with paramidobenzylalcohol $NH_2.C_6H_4.CH_2.OH$. This is obtained when paranitrobenzylacetate (Annalen, **147**, 343) is reduced by means of stannous chloride and hydrochloric acid, the acetyl-group becoming displaced during the process. The resulting amidocarbinol crystallises in colourless plates of a silver lustre; it melts at 95°. Its *hydrochloride* is colourless and crystallises in long slender needles; when heated at 100°—120° it becomes yellow and the product in alcoholic solution will then dye silk. When the yellow salt is dissolved in water, the solution rapidly becomes colourless and the original colourless salt can be recovered. The authors consider that the production of the yellow colour is due to water being split off, thus giving rise to the formation of the compound—



They failed however to effect a quantitative conversion.

The hydrobromide behaves similarly to the above. The oxalate C_7H_9NO, $2C_2H_2O_4$, acetyl derivative—

$$NH(C_2H_3O)C_6H_4.CH_2OC_2H_3O$$

and the benzoyl-derivative—

$$C_6H_5CONH.C_6H_4.CH_2OH$$

are described.

When a mixture of *p*-amidobenzylalcohol and benzaldehyde in molecular proportions is heated at 100°, the condensation product $C_6H_5.CH:N.C_6H_4.CH_2OH$ is formed; it crystallises in needles melting at 95°. Analogous compounds are also obtained by condensation with salicylic aldehyde and with cinnamic aldehyde, the products melting respectively at 163° and 155°.

The authors find that the amidotriphenylmethane prepared by Fischer and Roser (Annalen, **206**, 113 and 155) from

benzhydrol and aniline, and which Fischer and Frankel (Annalen, **241**, 362) afterwards stated to be orthamidotriphenylmethane is really a paramido-compound as was first assumed.—A. K. M.

Oxidation of Hydropyridine Bases. C. Schotten. Ber. **24**, 772—775.

The author has previously shown that the benzoyl-derivatives of hydropyridine bases, namely, piperidine and conine, are readily oxidised by potassium permanganate with formation of amido-acids of the fatty series (Ber. **21**, 2235), and he now proposes to make use of this reaction for determining the constitution of pyridine bases.

Conversion of Tetrahydroquinoline into Isatine.—Quinoline was converted into its tetrahydro-derivative by reduction with tin and hydrochloric acid (Ber. **16**, 728), and the product agitated with caustic soda and benzoylchloride. The benzoyltetrahydroquinoline obtained was then boiled with a solution of two and a half times its weight of potassium permanganate. The chief product is *benzoylisatinic acid*—

$$C_6H_4\begin{matrix}CO.COOH\\NHC_7H_5O\end{matrix}$$

This is almost insoluble in water and readily soluble in alcohol; it melts at 188°. A product identical with this is obtained when isatine is boiled with dilute caustic soda and the cooled alkaline solution agitated with benzoylchloride.

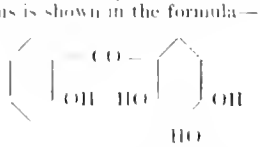
When benzoylisatinic acid is heated above its melting point, it loses water and is converted into *benzoylisatin*. This crystallises from glacial acetic acid in yellow needles, and melts at about 206°.—A. K. M.

Hydroxyketone Colouring Matters. A New Dihydroxyxanthone. C. Graebe and A. Eichengrün. Ber. **24**, 967—970.

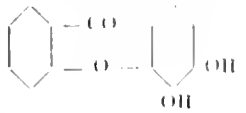
The authors are investigating some of the colouring matters belonging to the hydroxyketone group patented by the Badische Anilin und Soda Fabrik (this Journal, 1890, 497 and 609). Those examined are—(1) trihydroxybenzophenone prepared from benzoic acid and pyrogallol, and known as alizarin yellow; (2), tetrahydroxybenzophenone, from salicylic acid and pyrogallol; and (3) tetrahydroxyphenylnaphthylketone from gallic acid and naphthol (Alizarin W). From the first of these a mono- and a dimethyl-derivative have been obtained, but the third hydroxylic hydrogen atom could not be displaced by methyl or ethyl. The acetyl derivative—

$$C_6H_2.CO.C_6H_2(OCH_3)_2.(OC_2H_3O)$$

has, however, been obtained, and confirms the presence of three hydroxyl-groups. Heated with concentrated sulphuric acid at 100°, or with slightly diluted acid at 130—140°, trihydroxybenzophenone is decomposed, yielding benzoic acid and pyrogallolsulphonic acid. Tetrahydroxybenzophenone suffers decomposition in the same way. In the latter compound the relative position of the CO group in the pyrogallol nucleus is shown in the formula—



This is proved to be the case by the fact that when tetrahydroxybenzophenone is heated with water at 180—220° water is split off and dihydroxyxanthone—



is formed.—A. K. M.

Action of Dihydroxyquinone on Orthodiamines. R. Nietzki and G. Hasterlik. Ber. **24**, 1337—1340.

Nietzki and Kehrmann (Ber. **20**, 3150) showed that tetrahydroxyquinone reacts with orthodiamines like an *ortho*-diketone, but the question as to whether the product was a phenazine derivative, or whether it contained a quinoneimido group, was not settled. The authors now find that dihydroxyquinone reacts with orthophenylenediamine, yielding dihydroxyphenazine, and similarly with other orthodiamines. With orthotolylenediamine it gives an azine of the formula $C_{13}H_{10}N_2O_2 + 2\,H_2O$, melting at 265° and crystallising from dilute alcohol in red needles, and from strong alcohol in yellowish-brown plates. The azine obtained from 1 : 2 naphthylenediamine crystallises in reddish-brown needles melting at about 300°.

The authors are still unable to decide the question of the constitution of these substances (compare Kehrmann, this Journal, 1890, 931).—A. K. M.

Alizarin sulphonic Acids and the Conversion of Anthraquinone α- and β-Disulphonic Acids into Flavopurpurin and Anthrapurpurin. R. E. Schmidt. J. Prakt. Chem. **43**, 232—237.

An examination of the intermediate products obtained on fusion of anthraquinone-α- and β-disulphonic acids with caustic soda for conversion into flavopurpurin and anthrapurpurin respectively has shown that they are isomeric alizarin monosulphonic acids of the formula—

$$HSO_3.C_6H_2:C_2O_2:C_6H_2(OH)_2$$

Their general character, and especially their conversion into alizarin-blue sulphonic acids, were greatly in accord with this view, which is now confirmed by the formation of these acids from alizarin. When alizarin is treated with fuming sulphuric acid a mixture of two disulphonic acids is obtained, and on heating these with sulphuric acid of 60° B. at 180°, hydrolysis of one of the sulpho-groups occurs, and a mixture of two isomeric alizarin monosulphonic acids is produced; these are identical with the products mentioned above. When the mixed acids are fused with potash, flavopurpurin and anthrapurpurin are obtained in about equal quantities.

—A. K. M.

New Colouring Matters of the Anthraquinone Series. R. E. Schmidt. J. Prakt. Chem. **43**, 237—246.

When alizarin is heated at 130—140° with an excess of fuming sulphuric acid containing 70 per cent. of anhydride, and the product subsequently hydrolysed, a colouring matter is obtained which is different from alizarin. The same product is formed without sulphonation taking place when alizarin is treated at a temperature of 25—50° with a large excess of sulphuric anhydride (75—85 per cent. fuming acid). On pouring the product on to ice an insoluble orange-yellow intermediate substance is obtained; this appears to be the sulphate of *Alizarin-bordeaux*, for when it is dissolved in alkali, the solution acidulated and boiled, the new dye is precipitated. Other Bordeaux have been prepared from purpurin, anthragallol, flavopurpurin, and anthrapurpurin.

With alumina mordants Alizarin-bordeaux gives Bordeaux shades, and a black-blue with chrome mordants; it will dye wool an intense blue similar in shade to Alizarin-blue. The colours are extremely fast. It is characteristic of all the "Bordeaux" that they give solutions with concentrated sulphuric acid, which are considerably bluer than those obtained from the mother-substances.

Other anthraquinones, namely, quinizarin, xanthopurpurin, anthrarufin, hydroxyflavopurpurin, hydroxyanthrapurpurin, and rufigallic acid, have also been treated with sulphuric anhydride and converted into dyes of the same class. Alizarin-bordeaux has been submitted to a second treatment with sulphuric anhydride and converted into another new product. Full details of the methods employed and descriptions of the products are given in the German patents.

Alizarin-bordeaux yields a mononitro-derivative which is the analogue of Alizarin-orange, and with mordants yields shades similar to those given by flavopurpurin. The amido-derivative behaves like β-amidoalizarin. Alizarin-bordeaux also yields a *blue* corresponding to Alizarin-blue, but identical with the *Alizarin indigo blue* of the Badische Anilin und Soda Fabrik. When Alizarin-bordeaux is treated with sulphuric acid and manganese dioxide or arsenic acid, it does not yield a Purpurin-bordeaux, as was expected, but is converted into a new and valuable colouring matter, "*Alizarin-cyanine R*," which dyes an intense blue with chrome-mordants and a violet with alum-mordants; wool is dyed greenish-blue. The same product is obtained on the oxidation of Purpurin-bordeaux, whilst the Bordeaux from flavopurpurin and anthrapurpurin give other but similar *Cyanines*. Alizarin-bordeaux can be oxidised to another dye by sulphuric acid alone, the product in some respects resembling alizarin-cyanine.

Colouring-matters are also obtained by the action of sulphuric anhydride on anthraquinone, dibromanthracene and dichloranthracene.

When Alizarin-bordeaux sulphate mentioned above is treated with ammonia and the solution acidulated a dye is obtained bluer in shade than Alizarin-bordeaux

If the oxidation of Alizarin-bordeaux be conducted at not too high a temperature, the product poured into iced water and the precipitate filtered off in the cold, an intermediate product is obtained which is readily converted into Alizarin-cyanine R. by boiling with water or dilute acids. By the action of ammonia on this intermediate product another important colouring matter, *Alizarin-cyanine G.*, is obtained which gives considerably bluer shades than Alizarin-cyanine R. Similar dyes can be obtained also from the intermediate products which are formed during the preparation of the *Cyanines* from Flavopurpurin-bordeaux and Anthrapurpurin-bordeaux.—A. K. M.

Naphthol-Sulphonic Acids and Naphthol-Sultones. R. Nietzki. Chem. Zeit. **15**, 296—297.

The author has examined a compound which is produced along with β-naphthol-trisulphonic acid in the manufacture of the latter, and which possesses the characteristic properties of a sultone (this Journal, 1890, 491 and 1121). β-naphthol-trisulphonic acid is prepared by mixing 1 part of β-naphthol with 5½ parts of anhydro-sulphuric acid containing 40 per cent. of anhydride, at a temperature not exceeding 90°, and then heating to 120° for six hours. After cooling, the mass is poured on to 3 parts of ice. The compound in question separates from the cold solution in the form of a sandy, crystalline powder, which is filtered-off and pressed. For the purpose of investigation, the cakes so obtained were mixed with water, almost neutralised with soda, and the sodium salt of the sultone derivative isolated by repeated precipitation with common salt from a hot solution, until the yellow-green fluorescence of sodium β-naphthol-trisulphonate no longer appeared on the addition of alkali to the mother-liquor. The sodium salt of β-naphthol-sultone-disulphonic acid differs from that of β-naphthol-trisulphonic acid in the following respects:—

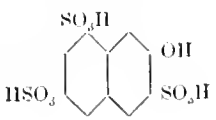
1. Its solution is yellow, but without fluorescence.
2. Diazo-naphthalene-sulphonic acid and other diazo-compounds do not combine with it.
3. It is not coloured violet by ferric chloride.

It is converted into the trisulphonic acid by boiling for a short time with caustic soda.

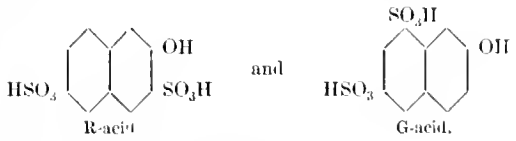
Analyses of the sodium salt gave numbers corresponding with the formula—

$$C_{10}H_4S_3O_9Na_2 = C_{10}H_4(SO_3Na)_2\begin{cases}SO_2\\|\\O\end{cases}$$

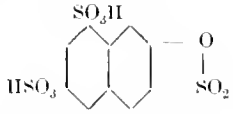
As the constitutional formula of β-naphthol-trisulphonic acid is—



those of the isomeric β-naphthol-disulphonic acids, from both of which it is obtained by further sulphonation, being respectively—



the formula of the sultone must be—

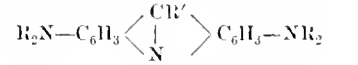


The author has not as yet succeeded in preparing this ortho-sultone by the diazo reaction from the corresponding β-naphthylamine-trisulphonic acid, but has had to suspend his experiments through lack of material. He is pursuing the subject further.—E. B.

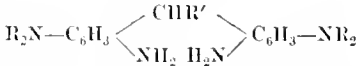
PATENTS.

Improvements in the Manufacture of Colouring Matters. W. R. Lake, London. From A. Leonhardt & Co., Mühlheim-on-the-Maine, Germany. Eng. Pat. 8243, May 27, 1890. 6*d*.

These products are derivatives of the acridine series and are orange dyestuffs, having the general formula—



They are produced from tetramido compounds of the formula—



by the elimination of ammonia and subsequent oxidation. The compounds are obtained by condensing aldehydes such as formaldehyde or benzaldehyde with aromatic substituted *m*-diamines such as *m*-amidodimethylaniline, or, the aldehydes may be condensed with tertiary aromatic amines, such as dimethylaniline, two other amido groups being subsequently introduced by nitration and reduction. Ammonia is eliminated by heating the tetramido bodies with a mineral acid, and the oxidation is carried out preferably by the use of ferric chloride. Instead of first forming the leuco compounds from formaldehyde the colouring matters can be obtained directly by heating a mixture of formic acid or oxalic acid and glycerol with aromatic diamines in presence of a condensing agent. The dyestuffs obtained by the use of this invention dye mordanted cotton orange, silk dyed with the colouring matter shows a brilliant green fluorescence.—T. A. L.

The Manufacture of New Derivatives of Alizarin and its Analogues. B. Willcox, London. From the "Farbenfabriken vormals F. Bayer & Co.," Elberfeld, Germany. Eng. Pat. 8725, June 5, 1890. 6*d*.

A disulphonic acid of alizarin is produced when 20 kilos. of dry powdered alizarin or its mono-sulphonic acid or salts, and 253 kilos. of fuming sulphuric acid containing 24 per cent. of anhydride are heated from 135°—140° C. for about six hours. Samples are taken out from time to time, poured into water, boiled and made strongly alkaline with caustic soda. The sulphonation is complete when the blue colour of this solution does not increase in depth. The melt is then poured into 1,000 litres of water, boiled, and after cooling the disulphonic acid is separated by the addition of potassium chloride. By heating 10 kilos. of this acid with 60 kilos. of sulphuric acid of 60° B. at 180°—190° C. for about six hours, one sulphonic acid group is split off and

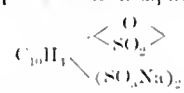
an alizarin mono-sulphonic acid is obtained identical with that described in Ger. Pat. 50,161. Another derivative of alizarin described in the present patent is a product insoluble in water which has been termed "Alizarin-bordeaux." This is produced by the action of a large excess of sulphuric acid anhydride on alizarin at a temperature not exceeding 60° C. 10 kilos. of dry ground alizarin are stirred into 100 kilos. of 70 per cent. anhydride at a low temperature and kept at 35°—40° C. for 24—48 hours until a sample poured on to ice and saturated immediately with caustic soda lye gives a yellowish-red solution, when the melt is poured into 200 kilos. of sulphuric acid of 60° B., and this mixture poured into 2,000 litres of water, the whole boiled, filtered, and the precipitate dissolved by boiling with caustic soda in 2,000 litres of water. The boiling solution is then decomposed with hydrochloric acid which precipitates the alizarin-bordeaux. After filtering and washing it may be employed in the form of a paste. Alizarin-bordeaux crystallises from glacial acetic acid or nitrobenzene. Its solution in concentrated sulphuric acid is a bright bluish-violet, and the shades obtained with mordants are much bluer than those from alizarin. It can also be nitrated in an acetic acid solution yielding nitro-alizarin-bordeaux, and this on reduction forms amido-alizarin-bordeaux which can be converted into a quinoline derivative by means of Skraup's synthesis. The product thus obtained differs from alizarin blue (which dissolves in sulphuric acid with a reddish-brown colour) by the blue colour of its solution in sulphuric acid. Similar bodies to the Alizarin-bordeaux may also be obtained from purpurin, flavopurpurin, anthrapurpurin and anthragallol.—T. A. L.

Manufacture of Phenol Ether and Oxydiphenyl, their Homologues and Analogues. J. Dawson and R. Hirsch, Huddersfield. Eng. Pat. 9080, June 12, 1890. 6*d*.

When aqueous solutions of diazobenzene, diazotoluene, diazonaphthalene, or of other aromatic diazo-compounds are mixed with phenol the diazo salt appears to dissolve in the phenol, forming a compound $C_6H_5.N = N.O.C_6H_5$. The solution is tolerably stable at low temperatures, but on heating gives off nitrogen and forms phenol ether, $C_6H_5.O.C_6H_5$, *o* and *p*-hydroxydiphenyl, and small quantities of the mixed ether $C_6H_5.O.C_6H_4.C_6H_5$. The following method is employed in working the process:—10 kilos. of aniline, 10 litres of water, and 30 kilos. of hydrochloric acid are diazotised with 7·5 kilos. of sodium nitrite in 15 litres of water. The solution thus obtained is shaken with 30 kilos. of phenol, which is then drawn off, and the treatment repeated three times with 10 kilos. of phenol. The solutions, after mixing, are decomposed by heating in a vessel provided with a condenser. The water formed in the reaction is drawn off, the phenol solution distilled, and the distillate collected, that which comes over at 200°—350° weighing about 14 kilos. This is mixed with 30 kilos. of toluene, and the warm toluene solution shaken with a 5 per cent caustic soda solution until nothing more is extracted. The toluene solution is then distilled, and the phenol ether collected which comes over at 243°—290° weighing 2·5 kilos. After rectification it boils at 255°—258°. The caustic soda solution is precipitated with hydrochloric acid and yields about 12 kilos. of *o*- and *p*-hydroxydiphenyl, which may be separated by crystallisation from glacial acetic acid or by fractional distillation. Several ethers and hydroxy derivatives have been obtained by this method, and the melting and boiling points of some of them are given in the specification.—T. A. L.

Improvements in the Production of Naphtholtrisulphonic Acid, Naphtholtrisulphonic Monamide, Dioxynaphthalin-disulphonic Acid, and the Colouring Matters derived therefrom. O. Imray, London. From H. Koch, Marburg, Germany. Eng. Pat. 9258, June 14, 1890. 8*d*.

Sodium naphthalene trisulphonate is dissolved in four times its weight of sulphuric acid, the requisite amount of concentrated nitric acid added to form a mononitro derivative, and the reaction completed on the water-bath. The melt is then diluted with water, reduced with iron, limed, filtered, and converted into the sodium salt. A new naphthylaminetrisulphonic acid is thus produced which differs from the two known isomers by forming a colourless diazo compound, and by being non-fluorescent in an alkaline solution. On boiling the aqueous diazo solution of this acid it is converted into a naphtholtrisulphonic acid. If a concentrated solution of the sodium salt of this acid be made acid and allowed to stand, it deposits needles of the sodium salt of naphthsultone-disulphonic acid—



which on treatment with ammonia yields the sulphamide $C_{10}H_4(OH)(SO_2NH_2)(SO_3Na)_2$. On fusing with caustic soda, the naphtholtrisulphonic acid or its anhydride (the naphthsultone disulphonic acid) form dihydroxynaphthalene di-sulphonic acid. All these hydroxynaphthalene compounds are capable of combining with diazo compounds to form colouring matters, and can be employed in the well-known manner.—T. A. L.

Improvements in the Production of Blue-Green Colouring Matters of the Malachite Green Series. O. Imray, London. From the "Farbwerke vormals Meister, Lucius, und Brüning," Hoechst-on-the-Maine, Germany. Eng. Pat. 9530, June 19, 1890. 6*d*.

An extension of Eng. Pat. 12,796 of 1888 (this Journal, 1889, 701) and of Eng. Pat. 14,822 of 1888 (this Journal, 1889, 980). It has been found that the sulphonic acids of the *m*-chloro-tetralkyl-diamido-triphenyl carbinols are also fast blue-green acid colouring matters. The *m*-chloro-tetralkyl diamido-triphenyl methanes are obtained from the *m*-diazo-tetralkyl diamido-triphenyl methanes by decomposing them with molecular copper in presence of hydrochloric acid, according to Gatterman's method (Ber. 23, 1218; this Journal, 1890, 823). The subsequent treatment of the products so obtained is similar to that employed for the production of colouring matters from the corresponding hydroxy derivatives.—T. A. L.

Improvements in and relating to the Manufacture of Substantive Dyestuffs and of New Materials therefor. J. Y. Johnson, London. From the "Badische Anilin und Soda Fabrik," Ludwigshafen, Germany. Eng. Pat. 9537, June 19, 1890. 6*d*.

A new α-naphthol-monosulphonic acid can be obtained from β-naphthylamine disulphonic acid G. in two ways. Either the amido-group is first removed by means of the hydrazine method and the (1·3) naphthalene disulphonic acid thus obtained fused with caustic soda so as to replace one SO_3H group by OH, or β-naphthylamine disulphonic acid G. ($NH_2:SO_3H:SO_3H$ 2:1′:3′) on fusion with caustic soda yields amidonaphthol sulphonic acid G.—

($NH_2:OH:SO_3H$ 2:1′:3′)

(Eng. Pat. 15,176 of 1889; this Journal, 1890, 855), and on removing the NH_2 group gives the same α-naphthol-sulphonic acid as above. A valuable blue colouring matter is obtained from this product by combining it with the diazo-compound from *o*-dianisidine, the shade obtained being superior to that given by Benzazurine.—T. A. L.

Improvements in and relating to the Manufacture of Substantive Dyestuffs, and of Materials therefor. J. Y. Johnson, London. From the "Badische Anilin und Soda Fabrik," Ludwigshafen, Germany. Eng. Pat. 9676, June 21, 1890. 6*d*.

This specification describes the preparation of derivatives obtained from (1·1′) naphthylamine sulphonic acid which yields the following products:—1. On fusion with caustic soda it gives a new (1·1′) amido-naphthol. 2. This amido-

naphthol can be sulphonated and combines then with tetrazo-compounds yielding dull substantive colouring matters. 3. Bright dyestuffs are produced by replacing hydrogen in the amido-group by an acid radicle of the fatty or aromatic series such as acetyl or benzoyl previous to combination with the tetrazo-compounds. These substances dye unmordanted cotton from a bath containing caustic alkali. 4. By choosing combinations such that the total number of sulphonic or carboxylic acid groups is increased in the finished dyestuff, more soluble colouring matters are obtained which dye unmordanted cotton from a neutral, alkaline, or soap bath. A colouring matter of this class is obtained by diazotising diamidodiphenyldicarboxylic acid ($NH_2 : CO_2H = 1 : 2$) and combining it with (1·1′) benzoylamidonaphtholsulphonic acid. The colouring matter is soluble in hot water and can be precipitated by adding salt.—T. A. L.

A Process for the Production of a New α-β-Naphthylenediamine-mono-sulpho Acid. J. Dawson and R. Hirsch, Huddersfield. Eng. Pat. 9768, June 24, 1890. 6*d*.

By slowly adding β-naphthylamine nitrate to sulphuric acid monohydrate and afterwards adding fuming sulphuric acid containing 20 per cent. of SO_3, a mixture of two nitronaphthylamines is obtained which melt respectively at 143° and 105°, the acetyl compounds of both melting at 197°. The nitronaphthylamine of melting point 143° yields a naphthylene-diamine on reduction which is oily, but gives an acetyl-compound of melting point 260°. The naphthylene-diamine on sulphonation with fuming sulphuric acid gives a monosulphonic acid almost insoluble in cold water, crystallising in small needles which contain water, and on boiling with an insufficient quantity of water change into short heavy prisms.—T. A. L.

Improvements in the Manufacture of Trioxybenzophenone, a Colouring Matter of the Oxyketone Group. J. Y. Johnson, London. From the "Badische Anilin und Soda Fabrik," Ludwigshafen, Germany. Eng. Pat. 10,095, June 30, 1890. 4*d*.

An extension of Eng. Pat. 8373 of 1889, and of Eng. Pat. 9428 of 1889 (this Journal, 1890, 497), describing a new process for the production of trihydroxybenzophenone consisting in boiling together pyrogallol in alcohol containing 10 per cent. of water and adding benzotrichloride slowly. After the reaction is complete the whole is poured into a large quantity of boiling water and filtered, when the trihydroxybenzophenone crystallises out on cooling and may be filter-pressed, washed, and dried, or preferably used as a paste.—T. A. L.

Improvements relating to the Manufacture of Colouring Matters. H. H. Lake, London. From K. Oehler, Offenbach-on-the-Maine, Germany. Eng. Pat. 10,599, July 8, 1890. 6*d*.

These colouring matters belong to the hydrazone series, and are produced by combining nitro-xylylhydrazine sulphonic acid with dihydroxytartaric acid. The nitroxylylhydrazine sulphonic acid may be produced from diazotised nitroxylidine sulphonic acid by sodium bisulphite or by means of stannous chloride. The condensation with the dihydroxytartaric acid takes place slowly and is completed by heating the mixture to 80° C., when the dyestuff forms a yellow crystalline powder which dyes a greenish yellow and is said to be faster to milling than tartrazine.—T. A. L.

Manufacture of Colouring Matters derived from Pyrogallic Acid, and their Application to Dyeing and Printing. J. C. L. Durand, D. E. Huguenin, and A. J. J. d'Andiran-Koechlin ("La Société L. Durand, Huguenin et Cie.") Bâle, Switzerland. Eng. Pat. 3263, February 23, 1891. 4*d*.

Yellow to brown colouring matters are produced by combining the diazo-compounds from aniline, *p*- and *m*-nitraniline amido-azobenzene and its monosulphonic acid or the tetrazo-compounds from thio-aniline and thio-*p*-toluidine with pyrogallol. The colouring matters will dye unmordanted wool and silk from an acid bath, but are principally to be used in conjunction with a mordant when very deep shades can be obtained and the goods will stand the most severe fulling.—T. A. L.

V.—TEXTILES: COTTON, WOOL, SILK, Etc.

On the Composition of Woody Matter and the Influence of Alkalis and Calcium Bisulphite on Wood. A. Ihl. Chem. Zeit. **15**, 201—202.

See under XIX., *page* 563.

PATENTS.

Improvements in the Manufacture of Artificial Horsehair from Vegetable Fibre. H. H. Lake, London. From K. Müller, J. Schwarz, and M. Scheid, Freiburg, Germany. Eng. Pat. 3725, March 8, 1890. 4*d*.

The incrusting substances of Mexican grass or similar fibres may be dissolved by boiling for about two hours in an alkaline liquor of 1 or 2 per cent. strength with or without pressure according to the thickness of the fibres. These are then washed and placed for 15 to 20 minutes either in a mixture of 2 to 3 parts of sulphuric acid and 1 part of water, or in a solution of zinc chloride. The fibres are hereby parchmentised, and after being washed and combed they assume a hair-like character, and possess greater elasticity than real horsehair.—H. S.

Improved Processes for the Nitration and Denitration of Cellulose and for Regaining the Acids Employed and Apparatus Employed in Connexion therewith. H. de Chardonnet, Paris, France. Eng. Pat. 5376, April 8, 1890. 8*d*.

See under XIX., *page* 566.

Improvements in the Retting and Scouring of Textile and other Fibres. C. Vicomte de la Roche, Paris, France. Eng. Pat. 8180, May 24, 1890. 6*d*.

The patentee has found that the pectic, resinous, or gummy substances of vegetable textile fibres, such as flax, hemp, china-grass, jute, and the like, as well as of peat, &c. may be dissolved by fatty acids. To effect this, the raw fibres are boiled for about three or four hours in soapy water, until thoroughly impregnated with it. Then ammonium chloride solution is added (1 part NH_4Cl to 3 parts of soap) which decomposes the liquid and sets free the neutral insoluble fatty acids. These dissolve the resinous substances of the fibres, so that after two or three hours treatment the fibres are freed from all gums or resins, but impregnated with fatty acids. These are then saponified by a further treatment for about two hours with a slightly caustic lye. After this, the fibres are washed and dried, and then found to be disintegrated. China-grass and other foreign fibres which contain more refractory pectic matter

must be treated with borated water after the fibres have been washed as above described. The fibres produced by this process are said to be uniform and stronger than the best fibres obtained by the ordinary retting process. When the material is to be used for paper pulp, the process may be assisted by a kneading or agitating apparatus to facilitate the removal of the gummy matters.—H. S.

Improvements in Machines for Preparing Flax, Hemp, Jute, Wool, and other Fibres. A. T. Lawson, F. W. Lawson, and S. Dear, Leeds. Eng. Pat. 8475, May 31, 1890. 8*d*.

This patent deals with machines in which chains are used to carry the fallers or gill bars. The links in which the gill bars are held, are in this invention made with U-like openings at the top, into which the necks of the gill bars are introduced. It is possible by this arrangement to take out any bar at the top of the chain. To keep the bars in their places, guides are put around the chain, covering the necks of the bars. Sometimes the guides may be dispensed with, by providing the links with loose caps, screwed on the top. These caps can be removed, and any bar taken out.—H. S.

Improvements in Machines for Decorticating Ramie and other Textile Plants in a Dry or a Green State. P. A. Favier, Paris, France. Eng. Pat. 8520, June 2, 1890. 8*d*.

The object of this invention is to obtain ramie and other textile fibres freed from all ligneous parts which are removed immediately after the crushing, bruising, and breaking operations. The machine consists of a series of horizontal rollers and scrapers arranged in pairs (one roller or scraper above the other), between which the stalks of the material are crushed, broken, and the woody parts disengaged and separated from the fibres.

At the front end of the machine is a table for the distribution and division of the stalks, and at the other end of it is an endless cloth intended to receive the fibres as they issue from the machine. Between the rollers—the majority of which are fluted—and the scrapers, large spaces are left in which the stalks are submitted to the action of beaters, which facilitate the fall of the ligneous parts as well as the passage of the strips of material. Other spaces are left between the lower row of friction rollers at the end of the machine, permitting the pellicles and the few splinters, which might have passed notwithstanding the action of the beaters, to fall more easily from the textile material to which they adhered. The scrapers work at great speed, and in the same pair of scrapers their blades or projections pass between each other without touching or meeting, and the end of each blade in travelling approaches the circular bottom of the corresponding scraper, leaving exactly the space necessary for the scraping of the material which is thus scraped without injury to the fibres. The rollers and beaters at the front end of the machine may be in two parts, separated by a middle partition, whilst farther down they extend the entire breadth of the machine.—H. S.

A Method or Process of Treating Silk or Mixed Silk Fabrics to give them the Appearance of China Crape. D. Gantillon, Lyons, France. Eng. Pat. 14,246, September 10, 1890. 4*d*.

The fabric, in the state in which it comes from the dyer or weaver, is wound on a steaming column without stretching it lengthwise or breadthwise, an intermediate cotton or linen cloth being employed, to which sufficient tension is given while winding it on the column. Then the fabric is submitted to the steaming operation from 5 to 15 minutes under a pressure of 4 or 5 atmospheres, and after that it is unwound and folded ready for market. The effects produced can be varied according to the texture of the intermediate cloth.—H. S.

Improved Means for Imparting a Silky Appearance to Fabrics, Threads, and Fibres. C. Brodbeck, Paris, France. Eng. Pat. 18,119, November 11, 1890. 6*d*.

This invention consists in applying a solution of fibroine of silk to fabrics, threads, or fibres which have been scoured, lixiviated, and bleached, and the tissues calendered by friction and beetled. They are then hydrated and physically modified by passing them through a solution of caustic potash or soda of 1·35—1·40 sp. gr., or of sulphuric acid of 1·53—1·56 sp. gr. In both cases a low temperature of 4—8° C. is required. If animal fibres are present, no caustic alkalis can be used. Cellulose is by this treatment freed from most of the impurities which it contains when imperfectly bleached, which renders the fixing of the silk easier and more perfect. After careful washing and drying the fabrics or fibres are treated with concentrated solutions of silk, the fibroine being dissolved either in hydrochloric, phosphoric, or sulphuric acid, or in pure cuprammonium, &c. If the solution of silk is effected in more or less hydrated sulphuric acid, the temperature must be about 0° C. to avoid decomposition. Silk in any form may be dissolved; hence scraps, cocoon silk, waste silk, and other material which was hitherto practically useless may thus be utilised. Previous to silkifying cellulose fabrics they should be subjected to the action of a metallic or tannic mordant, the selection of which depends on the colour which the fabric is to receive. This is of advantage in combining the silk more intimately with the cellulose. The impregnation with the silk solution is effected by passing the material through a tightly-closed impregnating apparatus with only two openings, one for the inlet and the other for the outlet of the material. It then passes through a hot-air drying apparatus, and subsequently through a second vessel containing liquids with which the solvents employed combine, the silk being hereby precipitated upon and fixed in the pores of the fibres. The material is then washed and dried. Should it be desired to increase the amount of silk, the silkifying process may be repeated as often as desirable. Materials rendered silky in this way may be bleached by the same means as those employed for real silk. All fabrics which have been treated by this process must be subjected to a mechanical finishing, beetling, calendering, rubbing, brushing, polishing, and pressing according to the purpose for which they are destined, in order to impart to them a glossy appearance and silky feel.—H. S.

Improvements in Machines for Cleaning Vegetable Fibre. W. C. McBride, Brooklyn, U.S.A. Eng. Pat. 20,353, December 13, 1890. 8*d*.

From fibrous vegetable substances which have been subjected to a crushing process, extraneous matters may be removed by a machine which consists of two shafts revolving in opposite directions, and bearing scrapers which are so arranged that they interlock or overlap each other in a slight degree. Below the scrapers are two tension rollers, between which the fibres may be gripped, revolving in the same directions as the shafts above them. The top of the machine is covered, except in the middle part of it above the scrapers, where an opening is left, and provided with two rack-bars forming rails on which two holders travel (one on each side of the machine), which are used alternately to convey the fibrous stock to the scrapers. In the middle of these holders is a fluted roller which can be made to revolve by means of a crank. Each holder is provided with a jaw which may be opened by raising it. This jaw has two elastic rollers, which are so arranged as to rest saddlewise on the fluted roller. On both sides of the fluted roller the jaw has a number of dabbing brushes, which are of sufficient length to reach nearly to the cover of the machine. The jaw, when closed, is held down firmly to the holder by means of springs and a rope. The material to be treated is placed in the holder across the fluted roller, and the jaw shut down. The elastic rollers and the brushes bear upon the fibres, the whole mass of which is subjected to the action of the scrapers by causing the holder to travel backwards and forwards, and by a proper manipulation of the fluted roller as well as of the tension rollers, hereby cleaning the fibres.—H. S.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

An Improved Oil-Bath for Dyeing Laboratories. R. L. Whiteley.

See pages 521—522.

Fastness of Aniline Black Dyes. W. Evans. Chem. Zeit. **15**, 43 and 75.

The author states that certain methods of dyeing with aniline black by means of the dry oxidation process will give fast dyes provided that the oxidation can be properly effected. Koechlin gives the following recipe:—

10 parts of potassium chlorate.
10 parts of ammonium chloride.
10 parts of copper chloride.
20 parts of aniline oil.
20 parts of hydrochloric acid.
200—300 parts of water.

Cotton and silk fabrics impregnated with this solution have to be suspended for 24 hours in oxidation chambers at a low temperature and then washed. No potassium bichromate is used. The chief difficulty of this method is to effect the solution of the different substances in 200 or 300 parts of water, as above described. If 300 parts of water are used, a deep black cannot be obtained; but in using 200 parts it frequently happens that aniline black is formed in the impregnating liquid, in which case the dye will never be fast, as a mechanical precipitation of dye particles upon the fibres is unavoidable. But if this forming of aniline black in the liquid can be prevented, the dye obtained by the subsequent oxidation will be found to be perfectly fast. To effect this the liquid should be mixed and kept at low temperatures, should not contain much acid and should be filtered before being used a second time as afterwards described. The following modification of Koechlin's recipe has been found by the author to give very good results:—

10 parts of sodium chlorate.
10 parts of ammonium chloride.
10 parts of copper sulphate.
35 parts of aniline salt.
x parts of aniline oil.
200 parts of water.

Copper sulphate and sodium chlorate are substituted on account of their much greater solubility in water, 55 parts of water being necessary for 10 parts of copper sulphate, and 65 parts of water for 10 parts of sodium chlorate and 10 parts of ammonium chloride together; the 35 parts of aniline salt required have to be dissolved in a small quantity of hot water, and then neutralised by aniline oil. All these substances are dissolved separately and have to be carefully mixed when perfectly cold, by first adding the aniline salt solution to the sodium chlorate and ammonium chloride, and then adding the copper sulphate solution. The mixture is diluted with water to 9·5° T. This solution has always to be kept at a low temperature, especially in hot weather. The fabrics to be dyed have to be cleaned and dried before being impregnated with the liquid, which must be renewed after having been used for 10 pieces of material. When properly filtered the liquid may be re-used for the necessary dilution of fresh mixture. A fast dye can be obtained by other methods as well, if the forming of aniline black in the liquid can be avoided. To add starch, dextrin, &c. as has been recommended, is useless. In ordinary oxidation chambers, very good results were obtained with a temperature of 30° C. and 25° moisture, the oxidation being completed within 14 hours. The black was developed by treating the fabrics at 80° C. with a solution containing 1 per cent. of potassium bichromate, 0·5 per cent. of soda, and 0·5 per cent. of sodium chloride. If by accident some unfast pieces are obtained, it is impossible to improve the colour, except by repeating the dyeing, which, however, is not to the advantage of the fabrics. The author did not obtain satisfactory results with Prudhomme's or with the vanadium and cerium method.

—H. S.

PATENTS.

An Improved Process of Bleaching Textile Fibres. W. Hitchcock-Spencer, Hitchin. Eng. Pat. 7198, May 8, 1890. 6*d*.

The improvement relates to the bleaching of textile fibres, whether vegetable or animal, and particularly rhea-grass, without steeping. It consists in treating the slightly moistened fibre, contained in a suitable chamber, with chlorine gas.—W. E. K.

Improvements in Black Dyeing "Piece Goods" or Fabrics. A. North, Bradford. Eng. Pat. 8799, June 7, 1890. 4*d*.

This improvement consists in "topping" with Methylene blue after the cloth has been dyed black by well-known methods.—W. E. K.

An Improved Ink. T. W. Just, R. Weiler, and O. Heidepriem, Melbourne, Australia. Eng. Pat. 16,757, October 21, 1890.

This invention is for an ink which is permanent and unaffected by the application of acids, alkalis, &c., and which renders forgeries and erasures, additions, or alterations easy of detection and difficult to accomplish. To carbon black (preferably prepared by the action of concentrated sulphuric or other acid on sugar) are added a solution of gum arabic or other mucilage, caustic soda, oxalic acid, and Indian ink. Vanadium in any form, Aleppo galls, nut galls and a small quantity of an aniline dye are then added along with sufficient water to make the ink flow readily. The following proportions yield good results:—Nut galls, 20 per cent.: Aleppo galls, 5 per cent.; carbon black, 10 per cent.; "vanadium, 1 per cent."; Indian ink, 10 per cent.; oxalic acid, 3 per cent.; aniline dye, 1 per cent.; rain water, 50 per cent. "The whole is boiled, filtered, and strained."—B. H.

VII.—ACIDS, ALKALIS, AND SALTS.

Recent Determinations of the Specific Gravities of Hydrochloric Acids of different Strengths. G. Lunge and L. Marchlewski. Zeits. f. angew. Chem. 1891, 133—135.

Reasons similar to those which caused Lunge and Isler (this Journal, 1890, 501) to redetermine the specific gravities of sulphuric acids, prompted also the extension of this work to hydrochloric acid and nitric acid. The analytical method used was similar to that followed in the sulphuric acid determinations. The acid was weighed in a Winkler pipette, and stronger acids in glass bulbs. The pyknometer was provided with a ground-in thermometer, previously compared with two normal thermometers and corrected accordingly. The water value of the apparatus had been repeatedly determined at the beginning, middle and end of each experimental series. All determinations were made at 13°, 15°, and 17° C. and at least once repeated, and with a different pyknometer. The authors are thus enabled to guarantee the specific gravities to ± 0·0001. The specific gravities were reduced to 4°, and vacuo by means of Kohlrausch's formula.

The acids were analysed with a caustic soda solution, which was titrated with a one-fifth normal hydrochloric acid, and this was standardised with sodium carbonate and checked gravimetrically with silver nitrate. The same acid, independently made and agreeing to about 0·02 per cent. with the previous one, served also for Lunge and Rey's determinations of the specific gravities of nitric acids (see following abstract).

SPECIFIC GRAVITIES OF HYDROCHLORIC ACIDS OF DIFFERENT CONCENTRATION.

Specific Gravity at 15° C. (in Vacuo).	Degrees B.	Degrees Tw.	100 Parts by Weight of Pure Acid correspond to: Per Cent. HCl.	Per Cent. Acid of 18° B.	Per Cent. Acid of 19° B.	Per Cent. Acid of 20° B.	Per Cent. Acid of 21° B.	Per Cent. Acid of 22° B.	1 Litre contains Kilogrammes: HCl.	Acid of 18° B.	Acid of 19° B.	Acid of 20° B.	Acid of 21° B.	Acid of 22° B.
1·000	0·0	0·0	0·16	0·57	0·53	0·49	0·47	0·45	0·0016	0·0057	0·0053	0·0049	0·0047	0·0045
1·005	0·7	1	1·15	4·08	3·84	3·58	3·42	3·25	0·012	0·041	0·039	0·036	0·034	0·033
1·010	1·4	2	2·14	7·60	7·14	6·66	6·36	6·04	0·022	0·077	0·072	0·067	0·064	0·061
1·015	2·1	3	3·12	11·08	10·41	9·71	9·27	8·81	0·032	0·113	0·106	0·099	0·094	0·089
1·020	2·7	4	4·13	14·67	13·79	12·86	12·27	11·67	0·042	0·150	0·141	0·131	0·125	0·119
1·025	3·4	5	5·15	18·30	17·19	16·04	15·30	14·55	0·053	0·188	0·176	0·164	0·157	0·149
1·030	4·1	6	6·15	21·85	20·53	19·16	18·27	17·38	0·064	0·225	0·212	0·197	0·188	0·179
1·035	4·7	7	7·15	25·40	23·87	22·27	21·25	20·20	0·074	0·263	0·247	0·231	0·220	0·209
1·040	5·4	8	8·16	28·99	27·24	25·42	24·25	23·06	0·085	0·302	0·283	0·264	0·252	0·240
1·045	6·0	9	9·16	32·55	30·58	28·53	27·22	25·88	0·096	0·340	0·320	0·298	0·284	0·270
1·050	6·7	10	10·17	36·14	33·95	31·68	30·22	28·74	0·107	0·380	0·357	0·333	0·317	0·302
1·055	7·4	11	11·18	39·73	37·33	34·82	33·22	31·59	0·118	0·419	0·394	0·367	0·351	0·333
1·060	8·0	12	12·19	43·32	40·70	37·97	36·23	34·44	0·129	0·459	0·431	0·403	0·384	0·365
1·065	8·7	13	13·19	46·87	44·04	41·09	39·20	37·27	0·141	0·499	0·469	0·438	0·418	0·397
1·070	9·3	14	14·17	50·35	47·31	44·14	42·11	40·04	0·152	0·539	0·506	0·472	0·451	0·428
1·075	10·0	15	15·16	53·87	50·62	47·22	45·05	42·84	0·163	0·579	0·544	0·508	0·484	0·460
1·080	10·6	16	16·15	57·39	53·92	50·31	47·99	45·63	0·174	0·620	0·582	0·543	0·518	0·493
1·085	11·2	17	17·13	60·87	57·19	53·36	50·90	48·40	0·186	0·660	0·621	0·579	0·552	0·525
1·090	11·9	18	18·11	64·35	60·47	56·41	53·82	51·17	0·197	0·701	0·659	0·615	0·587	0·558
1·095	12·4	19	19·06	67·73	63·64	59·37	56·61	53·86	0·209	0·742	0·697	0·650	0·620	0·590
1·100	13·0	20	20·01	71·11	66·81	62·33	59·46	56·54	0·220	0·782	0·735	0·686	0·654	0·622
1·105	13·6	21	20·97	74·52	70·01	65·32	62·32	59·26	0·232	0·823	0·774	0·722	0·689	0·655
1·110	14·2	22	21·92	77·89	73·19	68·28	65·14	61·94	0·243	0·865	0·812	0·758	0·723	0·687
1·115	14·9	23	22·86	81·23	76·32	71·21	67·93	64·60	0·255	0·906	0·851	0·794	0·757	0·719
1·120	15·4	24	23·82	84·61	79·53	74·20	70·79	67·31	0·267	0·948	0·891	0·831	0·793	0·754
1·125	16·0	25	24·78	88·06	82·71	77·19	73·64	70·02	0·278	0·991	0·931	0·868	0·828	0·788
1·130	16·5	26	25·75	91·50	85·97	80·21	76·52	72·76	0·291	1·034	0·972	0·906	0·865	0·822
1·135	17·1	27	26·70	94·88	89·15	83·18	79·34	75·45	0·303	1·077	1·011	0·944	0·901	0·856
1·140	17·7	28	27·66	98·29	92·35	86·17	82·20	78·16	0·315	1·121	1·053	0·982	0·937	0·891
1·145	18·0	..	28·14	100·00	93·93	87·66	83·62	79·51	0·322	1·143	1·073	1·002	0·955	0·908
1·147	18·3	29	28·61	101·67	95·52	89·13	85·02	80·84	0·328	1·164	1·094	1·021	0·973	0·926
1·150	18·8	30	29·57	105·08	98·73	92·11	87·87	83·55	0·340	1·208	1·135	1·059	1·011	0·961
1·152	19·0	..	29·95	106·43	100·00	93·30	89·01	84·63	0·345	1·226	1·152	1·075	1·025	0·975
1·155	19·4	31	30·55	108·58	102·00	95·17	90·79	86·32	0·353	1·254	1·178	1·099	1·049	0·997
1·160	19·8	32	31·52	112·01	105·21	98·19	93·67	89·07	0·366	1·299	1·221	1·139	1·087	1·033
1·164	20·0	..	32·10	114·07	107·17	100·00	95·39	90·70	0·373	1·326	1·246	1·163	1·109	1·054
1·165	20·3	33	32·49	115·46	108·48	101·21	96·55	91·81	0·379	1·345	1·264	1·179	1·125	1·070
1·170	20·9	34	33·46	118·91	111·71	104·24	99·43	94·55	0·392	1·391	1·307	1·220	1·163	1·106
1·171	21·0	..	33·65	119·58	112·35	104·82	100·00	95·09	0·394	1·400	1·316	1·227	1·171	1·113
1·175	21·4	35	34·42	122·32	114·92	107·22	102·28	97·26	0·404	1·437	1·350	1·260	1·202	1·143
1·180	22·0	36	35·39	125·76	118·16	110·24	105·17	100·00	0·418	1·484	1·394	1·301	1·241	1·180
1·185	22·5	37	36·34	129·05	121·23	113·11	107·90	102·60	0·430	1·529	1·437	1·340	1·279	1·216
1·190	23·0	38	37·29	132·30	124·30	115·98	110·63	105·20	0·443	1·574	1·479	1·380	1·317	1·252
1·195	23·5	39	38·16	135·41	127·21	118·87	113·40	107·83	0·456	1·621	1·523	1·421	1·355	1·289
1·200	24·0	40	39·11	138·78	130·28	121·81	116·22	110·51	0·469	1·667	1·567	1·462	1·395	1·326

The diagram constructed from the specific gravities and the corresponding percentages represents an almost perfectly straight line, which for weaker acids agrees fairly well with the one obtained by Kolb. The observations taken between 13°—17° should be reduced to 15° by deducting the following figures for every degree for readings below 15° and adding them above 15°.

Specific gravity 1·000—1·040:	± 0·0002
1·041—1·085:	0·0003
1·086—1·120:	0·0004
1·121—1·155:	0·0005
1·156—1·200:	0·0006

For Table see page 542.

—H. A.

Specific Gravities of Nitric Acids of different Strengths. G. Lunge and H. Rey. Zeits. f. angew. Chem. 1891, 165—170.

For these determinations a pipette of a special form has been used, which prevents any loss of acid vapours in pipetting, weighing, and delivering the requisite quantities of acid.

The low-strength nitric acids were obtained in a pure form by blowing a current of air or carbonic acid through the warm acids. The preparation of the pure high-strength acid succeeded best by adding to the pure 98·7 per cent. acid double its volume of monohydrated sulphuric acid and distilling the mixture in vacuo. The temperature in the retort rose only to 35° and the colourless distillate contained 99·7 per cent. of HNO_3.

The results differ from those obtained by Kolb only for the highly-concentrated acids. In this case Kolb's figures are on a straight line, whilst Lunge and Rey's figures diverge.

The following correction should be applied for observations taken between 13°—17° C.

Specific Gravity.	Correction for ± 1° C.
1·000—1·020	∓ 0·0001
1·021—1·040	0·0002
1·041—1·070	0·0003
1·071—1·100	0·0004
1·101—1·130	0·0005
1·131—1·161	0·0006
1·162—1·200	0·0007
1·201—1·245	0·0008
1·246—1·280	0·0009
1·281—1·310	0·0010
1·311—1·350	0·0011
1·351—1·365	0·0012
1·366—1·400	0·0013
1·401—1·435	0·0014
1·436—1·490	0·0015
1·491—1·500	0·0016
1·501—1·520	0·0017

For Table see pages 544–546.

—H. A.

PATENTS.

Improvements in the Manufacture of Soda and Potash. F. Ellershausen, Hebburn-on-Tyne. Eng. Pat. 1015, January 20, 1890. 6*d*.

A sodium sulphide solution of say 40° Tw. is passed through a filter bed of granulated sodium ferrate (Eng. Pat. 9112 of 1890, see page 547), obtained by roasting sodium carbonate with iron peroxide. Caustic soda is formed and an insoluble double compound of sodium and iron sulphide is left behind. The reaction takes place in two stages: first of all the water of the sodium sulphide solution decomposes the sodium ferrate with formation of caustic soda and iron hydroxide, which latter, on acting upon sodium sulphide, will yield more sodium hydrate and the insoluble sodium-iron sulphide. The degree of concentration of the resulting solution is increased by reason of the fact that sodium ferrate, in its conversion into caustic soda, absorbs water from the solution.

The soda contained in the sodium-iron sulphide is utilised for the production of sodium sulphate, sulphite, or hyposulphite, according to a subsequent patent (Eng. Pat. 16,676 of 1890, not yet published).—H. A.

Improvements in the Means or Apparatus to be Employed in the Production of Solutions containing Sulphurous Acid or its Salts. G. Horsley, West Hartlepool, and A. C. Wilson, Stockton-on-Tees. Eng. Pat. 3992, March 14, 1890. 8*d*.

The apparatus consists of a tower lined with acid-resisting material, and provided with perforated shelves and corresponding apertures for charging and stocking up the basic material, such as lime or magnesia when sulphites are to be produced. In the case of limestone or dolomite the bottom part only of the tower need be provided with shelves. The sulphurous acid is injected by means of a steam jet in an admission chamber in the bottom part of the tower. In its upward course the gas is absorbed by the charge, and the condensation may be completed by means of a spray of cold water or lime solution, which is introduced in the top part of the tower. At the base of the tower is a tank for catching and delivering the sulphite solution which drains down. For the production of a solution of sulphurous acid the shelves are left empty and water is injected at suitable intervals.—H. A.

Improvements in and relating to the Production of Potash from Potassium and Magnesium Carbonate. H. Precht, Löderburg, Germany. Eng. Pat. 4519, March 22, 1890. 4*d*

The double salt, $KHCO_3MgCO_3 + 4\ H_2O$, is decomposed in a covered apparatus by heating with water under a pressure of at least half an atmosphere, and at a temperature above 115° C. A precipitate of magnesium carbonate is formed, and a concentrated solution of potassium carbonate remains. In practice it is best to work at about 140° C. and with a pressure of about 5 atmospheres. The carbonic acid evolved from bicarbonates of potassium and magnesium that were in solution at the beginning of the operation, can be obtained in this way comparatively free from water, as the solution does not boil at this pressure and temperature.

—H. S. P.

Improvements in the Production of Magnesic Oxychloride. F. M. Lyte, London. Eng. Pat. 6333, April 25, 1890. 4*d*.

Magnesium hydrate or magnesite is burnt at the lowest possible temperature, and mixed with 30—40 per cent. of more strongly burnt magnesia, and 15—20 per cent. of organic matter; an admixture of glass, silica, or slag will render the mass more coherent when burnt. The mixture is then formed into bricks, covered with a wet cloth till the mass begins to set, and the setting completed under water. The bricks are then gradually heated to redness and the remaining porous mass saturated with fused magnesium chloride. A magnesium oxychloride is then formed (this Journal, 1890, 622), which can be employed for the manufacture of chlorine (this Journal, 1890, 1128—1129).—H. A.

SPECIFIC GRAVITIES OF NITRIC ACIDS OF DIFFERENT CONCENTRATIONS AT 15° C. (REFERRED TO WATER AT 4°.)

Specific Gravity at $\frac{15}{4}$ (in Vacuo).	Degrees Baumé.	Degrees Twaddell.	100 Parts by Weight contain					1 Litre contains Kilogrammes				
			N_2O_5	HNO_3	Acid of 36° B.	Acid of 40° B.	Acid of 48½° B.	N_2O_5	HNO_3	Acid of 36° B.	Acid of 40° B.	Acid of 48½° B.
1·0040	0	0	0·08	0·10	0·19	0·16	0·20	0·001	0·001	0·002	0·002	0·001
1·0065	0·7	1	0·85	1·00	1·89	1·61	1·03	0·008	0·010	0·019	0·016	0·010
1·0110	1·4	2	1·62	1·99	3·60	3·07	1·95	0·016	0·019	0·036	0·031	0·019
1·0155	2·1	3	2·39	2·80	5·30	4·52	2·87	0·024	0·028	0·053	0·045	0·029
1·0200	2·7	4	3·17	3·70	7·01	5·98	3·79	0·033	0·038	0·072	0·061	0·039
1·0250	3·4	5	3·94	4·69	8·71	7·43	4·72	0·040	0·047	0·089	0·076	0·048
1·0300	4·1	6	4·71	5·50	10·42	8·88	5·64	0·049	0·057	0·108	0·092	0·058
1·0355	4·7	7	5·47	6·38	12·08	10·30	6·54	0·057	0·066	0·125	0·107	0·068
1·0400	5·4	8	6·22	7·26	13·75	11·72	7·45	0·064	0·075	0·142	0·121	0·077
1·0455	6·0	9	6·97	8·13	15·40	13·13	8·34	0·073	0·085	0·161	0·137	0·087
1·0500	6·7	10	7·71	8·99	17·03	14·52	9·22	0·081	0·094	0·178	0·152	0·096
1·0555	7·4	11	8·45	9·84	18·64	15·89	10·09	0·089	0·104	0·197	0·168	0·107
1·0610	8·0	12	9·15	10·68	20·23	17·25	10·95	0·097	0·113	0·214	0·182	0·116
1·0665	8·7	13	9·87	11·51	21·80	18·59	11·81	0·105	0·123	0·233	0·198	0·126
1·0720	9·4	14	10·57	12·33	23·35	19·91	12·65	0·113	0·132	0·250	0·213	0·135
1·0775	10·0	15	11·27	13·15	24·91	21·24	13·49	0·121	0·141	0·267	0·228	0·145
1·0830	10·6	16	11·96	13·95	26·42	22·53	14·31	0·129	0·151	0·286	0·244	0·155
1·0885	11·2	17	12·64	14·74	27·92	23·80	15·12	0·137	0·160	0·303	0·258	0·164
1·0940	11·9	18	13·31	15·53	29·41	25·08	15·93	0·145	0·169	0·320	0·273	0·173
1·0995	12·4	19	13·99	16·32	30·91	26·35	16·74	0·153	0·179	0·339	0·289	0·184
1·1050	13·0	20	14·67	17·11	32·41	27·63	17·55	0·161	0·188	0·356	0·304	0·193
1·1105	13·6	21	15·34	17·89	33·89	28·89	18·35	0·170	0·198	0·375	0·320	0·203
1·1160	14·2	22	16·00	18·67	35·36	30·15	19·15	0·177	0·207	0·392	0·335	0·212
1·1215	14·9	23	16·67	19·45	36·84	31·41	19·95	0·186	0·217	0·411	0·350	0·223
1·1270	15·4	24	17·34	20·23	38·31	32·67	20·75	0·195	0·227	0·430	0·366	0·233
1·1325	16·0	25	18·04	21·00	39·77	33·91	21·54	0·202	0·236	0·447	0·381	0·242
1·1380	16·5	26	18·66	21·77	41·23	35·16	22·33	0·211	0·246	0·466	0·397	0·252
1·1435	17·1	27	19·32	22·54	42·69	36·40	23·12	0·219	0·256	0·485	0·413	0·263
1·1490	17·7	28	19·98	23·31	44·15	37·65	23·91	0·228	0·266	0·504	0·430	0·273
1·1545	18·3	29	20·64	24·08	45·61	38·89	24·70	0·237	0·276	0·523	0·446	0·283
1·1600	18·8	30	21·20	24·84	47·05	40·12	25·48	0·245	0·286	0·542	0·462	0·293
1·1655	19·3	31	21·94	25·60	48·49	41·35	26·26	0·254	0·296	0·561	0·478	0·304
1·1710	19·8	32	22·60	26·36	49·92	42·57	27·04	0·262	0·305	0·580	0·494	0·314
1·1765	20·3	33	23·25	27·12	51·36	43·80	27·82	0·271	0·316	0·598	0·510	0·324
1·1820	20·9	34	23·90	27·88	52·80	45·03	28·59	0·279	0·326	0·617	0·526	0·334
1·1875	21·4	35	24·54	28·63	54·22	46·24	29·36	0·288	0·336	0·636	0·543	0·345
1·1930	22·0	36	25·18	29·38	55·64	47·45	30·13	0·297	0·347	0·657	0·560	0·356
1·1985	22·5	37	25·83	30·13	57·07	48·66	30·90	0·306	0·357	0·676	0·577	0·366
1·2040	23·0	38	26·47	30·88	58·49	49·87	31·67	0·315	0·367	0·695	0·593	0·376
1·2095	23·5	39	27·10	31·62	59·89	51·07	32·43	0·324	0·378	0·715	0·610	0·388
1·2200	24·0	40	27·74	32·36	61·29	52·26	33·19	0·333	0·388	0·735	0·627	0·398
1·2205	24·5	41	28·36	33·09	62·67	53·23	33·94	0·342	0·399	0·755	0·644	0·409
1·2210	25·0	42	28·99	33·82	64·05	54·21	34·69	0·351	0·409	0·775	0·661	0·419
1·2215	25·5	43	29·61	34·55	65·44	55·18	35·44	0·360	0·420	0·795	0·678	0·431
1·2220	26·0	44	30·24	35·28	66·82	56·16	36·18	0·369	0·430	0·815	0·695	0·441
1·2225	26·4	45	30·88	36·04	68·24	57·04	36·95	0·378	0·441	0·835	0·712	0·452

SPECIFIC GRAVITY OF NITRIC ACIDS OF DIFFERENT CONCENTRATIONS AT 15° C. (REFERRED TO WATER AT 4°)—*continued*.

Specific Gravity at 15° 4° (in Vacuo).	Degrees Baumé.	Degrees Twaddell.	100 Parts by Weight contain					1 Litre contains Kilogrammes				
			N_2O_5	HNO_3	Acid of 36° B.	Acid of 40° B.	Acid of 48½° B.	N_2O_5	HNO_3	Acid of 36° B.	Acid of 40° B.	Acid of 48½° B.
1·230	26·9	46	31·53	36·78	69·66	59·13	37·72	0·387	0·452	0·856	0·730	0·466
1·235	27·4	47	32·17	37·53	71·08	60·61	38·49	0·397	0·463	0·877	0·748	0·475
1·240	27·9	48	32·82	38·29	72·52	61·84	39·27	0·407	0·475	0·900	0·767	0·487
1·245	28·4	49	33·47	39·05	73·96	63·07	40·05	0·417	0·486	0·921	0·785	0·498
1·250	28·8	50	34·13	39·82	75·42	64·31	40·84	0·427	0·498	0·943	0·804	0·511
1·255	29·3	51	34·78	40·58	76·86	65·54	41·62	0·437	0·509	0·965	0·822	0·522
1·260	29·7	52	35·44	41·34	78·30	66·76	42·40	0·447	0·521	0·987	0·841	0·534
1·265	30·2	53	36·09	42·1	79·74	67·99	43·18	0·457	0·533	1·009	0·860	0·547
1·270	30·6	54	36·75	42·87	81·2	69·23	43·97	0·467	0·544	1·031	0·879	0·558
1·275	31·1	55	37·41	43·64	82·65	70·48	44·76	0·477	0·556	1·054	0·898	0·570
1·280	31·5	56	38·07	44·41	84·11	71·72	45·55	0·487	0·568	1·077	0·918	0·583
1·285	32·0	57	38·73	45·18	85·57	72·96	46·34	0·498	0·581	1·000	0·938	0·596
1·290	32·4	58	39·39	45·95	87·03	74·21	47·13	0·508	0·593	1·123	0·957	0·608
1·295	32·8	59	40·05	46·72	88·48	75·45	47·92	0·519	0·605	1·146	0·977	0·621
1·300	33·3	60	40·71	47·49	89·94	76·7	48·71	0·529	0·617	1·169	0·997	0·633
1·305	33·7	61	41·37	48·26	91·4	77·94	49·50	0·540	0·630	1·193	1·017	0·646
1·310	34·2	62	42·03	49·07	92·94	79·25	50·33	0·551	0·643	1·218	1·038	0·659
1·315	34·6	63	42·76	49·89	94·49	80·57	51·17	0·562	0·656	1·243	1·059	0·673
1·320	35·0	64	43·47	50·71	96·05	81·9	52·01	0·573	0·669	1·268	1·080	0·686
1·325	35·4	65	44·17	51·53	97·6	83·22	52·85	0·585	0·683	1·294	1·103	0·701
1·330	35·8	66	44·89	52·37	99·19	84·58	53·71	0·597	0·697	1·320	1·126	0·715
1·3325	36·0	66·5	45·26	52·80	100·0	85·27	54·15	0·603	0·704	1·333	1·137	0·722
1·335	36·2	67	45·62	53·22	100·8	85·95	54·58	0·609	0·710	1·346	1·148	0·728
1·340	36·6	68	46·35	54·07	102·41	87·32	55·46	0·621	0·725	1·373	1·171	0·744
1·345	37·0	69	47·08	54·93	104·04	88·71	56·34	0·633	0·739	1·400	1·193	0·758
1·350	37·4	70	47·82	55·79	105·67	90·1	57·22	0·645	0·753	1·427	1·216	0·772
1·355	37·8	71	48·57	56·66	107·31	91·51	58·11	0·658	0·768	1·455	1·240	0·788
1·360	38·2	72	49·35	57·57	109·03	92·97	59·05	0·671	0·783	1·483	1·265	0·803
1·365	38·6	73	50·13	58·48	110·75	94·44	59·98	0·684	0·798	1·513	1·289	0·818
1·370	39·0	74	50·91	59·39	112·48	95·91	60·91	0·698	0·814	1·543	1·314	0·835
1·375	39·4	75	51·69	60·3	114·20	97·38	61·85	0·711	0·829	1·573	1·339	0·850
1·380	39·8	76	52·52	61·27	116·04	98·95	62·84	0·725	0·846	1·603	1·366	0·868
1·3833	40·0	..	53·08	61·92	117·27	100·0	63·51	0·735	0·857	1·623	1·383	0·879
1·385	40·1	77	53·35	62·24	117·88	100·51	63·84	0·739	0·862	1·633	1·392	0·884
1·390	40·5	78	54·20	63·23	119·75	102·12	64·85	0·753	0·879	1·665	1·420	0·902
1·395	40·8	79	55·07	64·25	121·68	103·76	65·90	0·768	0·896	1·697	1·447	0·919
1·400	41·2	80	55·97	65·30	123·67	105·46	66·97	0·783	0·914	1·731	1·476	0·937
1·405	41·6	81	56·92	66·40	125·75	107·24	68·10	0·800	0·933	1·767	1·507	0·957
1·410	42·0	82	57·83	67·50	127·84	109·01	69·23	0·816	0·952	1·803	1·537	0·976
1·415	42·3	83	58·83	68·63	129·98	110·84	70·39	0·832	0·971	1·839	1·568	0·996
1·420	42·7	84	59·83	69·80	132·19	112·73	71·59	0·849	0·991	1·877	1·600	1·016
1·425	43·1	85	60·84	70·98	134·43	114·63	72·8	0·867	1·011	1·915	1·633	1·037
1·430	43·4	86	61·86	72·17	136·68	116·55	74·02	0·885	1·032	1·955	1·667	1·058
1·435	43·8	87	62·91	73·39	138·99	118·52	75·27	0·903	1·053	1·995	1·701	1·080
1·440	44·1	88	64·01	74·68	141·44	120·61	76·59	0·921	1·075	2·037	1·736	1·103
1·445	44·4	89	65·13	75·98	143·90	122·71	77·93	0·941	1·098	2·086	1·773	1·126

SPECIFIC GRAVITIES OF NITRIC ACIDS OF DIFFERENT CONCENTRATIONS AT 15° C. (REFERRED TO WATER AT 4°)—*continued.*

Specific Gravity at $\frac{15}{4}$ (in Vacuo).	Degrees Baumé.	Degrees Twaddell.	100 Parts by Weight contain					1 Litre contains Kilogrammes				
			N_2O_5	HNO_3	Acid of 36° B.	Acid of 40° B.	Acid of 48½° B.	N_2O_5	HNO_3	Acid of 36° B.	Acid of 40° B.	Acid of 48½° B.
1·450	43·8	90	66·24	77·28	144·36	124·81	79·26	0·961	1·121	2·123	1·810	1·150
1·455	45·1	91	67·38	78·60	148·86	126·91	80·62	0·981	1·144	2·167	1·848	1·173
1·460	45·4	92	68·56	79·98	151·47	129·17	82·03	1·001	1·168	2·212	1·886	1·198
1·465	45·8	93	69·79	81·42	154·20	131·49	83·51	1·023	1·193	2·259	1·927	1·224
1·470	46·1	94	71·06	82·90	157·00	133·88	85·03	1·045	1·219	2·309	1·969	1·250
1·475	46·4	95	72·39	84·45	159·94	136·39	86·62	1·068	1·246	2·360	2·012	1·278
1·480	46·8	96	73·76	86·05	162·97	138·97	88·26	1·092	1·274	2·413	2·058	1·307
1·485	47·1	97	75·18	87·70	166·09	141·63	89·95	1·116	1·302	2·466	2·103	1·335
1·490	47·4	98	76·80	89·60	169·69	144·70	91·90	1·144	1·335	2·528	2·156	1·369
1·495	47·8	99	78·52	91·60	173·48	147·93	93·95	1·174	1·369	2·593	2·211	1·404
1·500	48·1	100	80·65	94·09	178·19	151·96	96·50	1·210	1·411	2·672	2·278	1·447
1·501	..	..	81·09	94·60	179·16	152·78	97·03	1·217	1·420	2·689	2·293	1·456
1·502	..	..	81·50	95·08	180·07	153·55	97·52	1·224	1·428	2·704	2·306	1·465
1·503	..	..	81·91	95·55	180·96	154·31	98·00	1·231	1·436	2·720	2·319	1·473
1·504	..	..	82·29	96·00	181·81	155·04	98·46	1·238	1·444	2·735	2·332	1·481
1·505	48·4	101	82·65	96·39	182·55	155·67	98·86	1·244	1·451	2·748	2·343	1·488
1·506	..	..	82·94	96·76	183·25	156·07	99·27	1·249	1·457	2·759	2·353	1·494
1·507	..	..	83·26	97·15	183·95	156·86	99·62	1·255	1·464	2·773	2·364	1·502
1·508	48·5	..	83·58	97·50	184·65	157·47	100·00	1·260	1·470	2·784	2·374	1·508
1·509	..	..	83·87	97·83	185·30	158·01	100·35	1·265	1·476	2·795	2·384	1·514
1·510	48·7	102	84·09	98·10	185·79	158·43	100·62	1·270	1·481	2·805	2·392	1·519
1·511	..	..	84·28	98·32	186·21	158·79	100·84	1·274	1·486	2·814	2·400	1·524
1·512	..	..	84·46	98·53	186·61	159·13	101·06	1·277	1·490	2·822	2·406	1·528
1·513	..	..	84·63	98·73	186·98	159·45	101·26	1·280	1·494	2·829	2·413	1·532
1·514	..	..	84·78	98·90	187·30	159·72	101·44	1·283	1·497	2·835	2·418	1·535
1·515	49·0	103	84·92	99·07	187·63	160·00	101·61	1·287	1·501	2·843	2·424	1·539
1·516	..	..	85·04	99·21	187·89	160·22	101·75	1·289	1·504	2·848	2·429	1·543
1·517	..	..	85·15	99·34	188·14	160·43	101·89	1·292	1·507	2·854	2·434	1·546
1·518	..	..	85·24	99·46	188·37	160·63	102·01	1·294	1·510	2·860	2·439	1·549
1·519	..	..	85·35	99·57	188·58	160·81	102·12	1·296	1·512	2·864	2·442	1·551
1·520	49·4	104	85·44	99·67	188·77	160·97	102·23	1·299	1·515	2·869	2·447	1·554

Improvements in the Manufacture of Chlorine. G. E. Davis and A. R. Davis, Manchester. Eng. Pat. 6698, May 1, 1890. 6*d*.

In the specification for "Improvements in the Preparation of Chlorine," Eng. Pat. 6416 of 1890 (this Journal, 1891, 163), the fact that the water of the reaction flowed away from the first nitric acid tower holding a quantity of hydrochloric acid gas in solution, is mentioned. This water of reaction may absorb as much as 30 per cent. of the hydrochloric acid, and the total water introduced into and formed in the process may at times be capable of dissolving and so removing from the process nearly one-half of the hydrochloric acid produced from the salt. The invention described has for its object such a modification of the process, as will enable the operator to keep the whole of the hydrochloric acid employed within the process until its chlorine is liberated.

To this end the sulphuric acid which has passed down the absorbing tower for the purpose of absorbing nitrous compounds is now caused to enter the first nitric acid tower at a point below where the action of the nitric acid upon the hydrochloric acid is completed, and where an excess of hydrochloric acid exists. The result is that the sulphuric acid at once combines with the water of the aqueous hydrochloric acid and the hydrochloric acid is liberated, a portion of it reacting upon the nitrogen oxides present in the sulphuric acid, forming chloronitrous gas, which passes on with the main body of the gases to be decomposed as already described in Eng. Pat. 6416 *loc. cit.* This improvement necessitates also the production of weak sulphuric acid, which is hereafter concentrated to the proper strength for the decomposition of salt or the absorption of nitrous gases.

Improvements in and Apparatus for or connected with the Liquefying and Storage of Chlorine. T. Y. Johnson, London. From J. Marx and Dr. Weller, Sachsenhausen, Germany. Eng. Pat. 7058, May 6, 1890. 8*d*.

For the purpose of liquefaction, the chlorine is first of all separated in the form of hydrate from its admixture with other gases. This is effected by injecting water or

brine in a receiver, into which the chlorine is simultaneously admitted. The receiver is provided with a false bottom on which the chlorine hydrate collects, whilst the excess water drains through the perforations and is pumped back, after cooling, into the receiver.

After sufficient chlorine hydrate has been formed, the vessel is disconnected and the chlorine is liberated from its combination with water by the aid of heat, preferably water of 25°—30° C., circulating through some piping placed inside the receiver. The evolved gas passes first through a vessel cooled from outside by water, and provided with a perforated bottom. Any water present deposits here in combination with chlorine; the escaping chlorine is collected in a water-jacketed or otherwise cooled storing bottle, in which it is liquefied by its own pressure.

The cast-iron or steel storing bottles are to a certain extent acted upon even by liquid chlorine, which is therefore preferably kept in glass bottles, having an iron jacket cemented to the outer surface. The glass bottles are provided with metal heads which, for the purpose of charging, can be screwed on to the iron bottles. Two drawings accompany the specification.—H. A.

Improvements in and connected with the Obtainment of Cyanides and Ferrocyanides. D. T. Playfair, Glasgow. Eng. Pat. 7764, May 19, 1890. 6*d*.

By heating in a retort an intimate mixture of an alkaline or an alkaline-earthy "sulphocyanate" (thiocyanate or sulphocyanide) with powdered zinc or lead, or with both of these metals, the corresponding cyanide is formed along with zinc or lead sulphide. The charge is heated above the melting point of zinc, and at the completion of the reaction the charge is withdrawn at once to prevent secondary reactions; there is less danger for these to take place when lead has been used instead of zinc. The mass is lixiviated and any undecomposed sulphide may be removed by addition of freshly precipitated cyanide of lead. The solution may either be used directly or else evaporated to dryness in vacuo. The lead or zinc are regenerated from the corresponding sulphides.

When ferrocyanides are required, a mixture of iron and lead or zinc is used; the iron sulphide formed in the process of fusion reacts with the alkaline cyanide with production of an alkaline ferrocyanide, which may be obtained in a crystallised form.

The sulphocyanide is preferably produced by the action of ammonia and carbon bisulphide in the presence of a fixed alkali or of an alkaline earth. The resulting solution is heated for the elimination of any ammonia present, filtered from the sulphur and evaporated to dryness.—H. A.

A Process for the Application of Iron Residues which result from the Reduction of Organic Nitro compounds. T. Peters, Chemnitz, Germany. Eng. Pat. 8922, June 9, 1890. 6*d*.

The iron residues of the aniline works consist chiefly of iron sesquioxide, with an admixture of carbonaceous matter, in suspension in a liquid containing calcium chloride. It is proposed to utilise these residues for the manufacture of liquid or solid iron mordant. 200 parts of the well-settled iron-mud are treated with 100 parts of "moderately dilute" sulphuric acid or preferably waste acid from the nitration of the aromatic hydrocarbons, and 100 parts of water are added. A violent reaction soon sets in, whereby the whole mass liquefies and the bulk of the organic matter is destroyed. The mass is allowed to settle, the clear liquor is drawn off and evaporated to 50° Tw. A product free from iron protoxide may be obtained by adding dilute nitric acid during the process, for which purpose the weak acid from the manufacture of nitric acid may be used.

The remaining iron-mud is washed with water, and the washings used over again in lieu of water.

For the production of iron mordant in the solid state 100 parts of the mud are mixed with the same quantity of "fairly concentrated" sulphuric acid or waste acid. The mixture solidifies to a hard mass which is easily pulverised.—H. A.

Improvements in the Manufacture of Caustic Soda. F. Ellershausen, Hebburn-on-Tyne. Eng. Pat. 9112, June 12, 1890. 4*d*.

Sodium ferrate, preferably in the hot state, as it is drawn out of the furnace, is laid in an open tank in a layer about 4 ft. thick. The sodium sulphide liquor is run on the centre of the filter surface and is causticised as it penetrates through the mass. The sides of the vessel are thus protected from the corrosive action of the sodium sulphide liquor. (See Eng. Pats. 1015 and 1016 of 1890, pages 253 and 543.)—H. A.

Improvements in the Process of and Apparatus for Purifying Double Carbonate of Potassium and Magnesium. H. Precht, Lüderburg, Germany. Eng. Pat. 10,115, June 30, 1890. 8*d*.

The double salt $MgCO_3.KHCO_3.4H_2O$, prepared by Engel's process, viz., by treating a solution of potassium chloride with magnesium carbonate and carbonic acid under pressure, contains a certain amount of impurities in form of magnesium chloride and potassium chloride, which prevent the manufacture of pure potassium carbonate therefrom. The patentee finds that impurities can be reduced to 0·2—0·3 per cent. by washing with a solution of magnesium carbonate in water containing carbonic acid. The wash-waters are then saturated with potassium chloride and return to the process.—H. A.

Improvements in the Manufacture of Chromates, Bichromates, and other Chromium Compounds. H. H. Lake, London. From J. Massignon and E. Watel, Paris, France. Eng. Pat. 2224, February 6, 1891.

The object of this invention is to obtain a complete decomposition of the chrome ore with economy of fuel. The finely ground chrome ore is mixed with a paste prepared by slaking more than a sufficient quantity of lime or limestone, or a mixture of both, to form calcium chromate, in a strong solution of calcium chloride, containing one equivalent of calcium chloride for three equivalents of the lime employed, "which proportion is suitable for composing calcium oxychloride." The kneaded mass is formed into blocks, dried, burnt in a kiln heated by gas, and partially oxidised by a current of air which passes through the kiln. The baked materials are then piled up in aired chambers where the "complete oxidation" of the chromium sesquioxide is "gradually effected" by the atmospheric oxygen.

For manufacturing chromic acid, chromates and bichromates of potash or soda, the calcium chloride contained in the oxidised mass is first extracted with hot water, and the small quantity of calcium chromate contained in this solution is either precipitated with a lead salt for the manufacture of lead chromate or the whole solution concentrated and used for saturating a fresh quantity of chrome ore and lime. After this washing operation, the remaining mass is treated with sulphuric acid, if chromic acid be required, or with potassium or sodium carbonate or sulphate and sulphuric acid for the manufacture of the corresponding bichromates. The dry oxidised material may be treated direct by sulphuric acid or by hydrochloric acid gas for the production of chlorochromic acid.—H. A.

Process for Converting Carbonate of Lead, obtained by Decomposition of Sulphate of Lead or other Compound of Lead with Carbonate of Sodium, into Basic Salt. J. N. Zeitler, Cannstatt, Germany. Eng. Pat. 2812, February 16, 1891. 4*d*.

See under XIII., *page* 557.

Improvements in the Manufacture of Phosphorus in Sticks or Blocks. W. P. Thompson, Liverpool. From "La Société Cosmos & Cie," Lyons, France. Eng. Pat. 2970, February 18, 1891. 4*d*.

The phosphorus is formed in rectangular parallelopipeds which will fit one on the other along their lateral faces. The packages will thus hold more phosphorus, and only about one-fifth of the water will be required for filling up the empty space in the packages, in comparison with the quantity necessary when packing cylindrical or prismatic phosphorus.—H. A.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

PATENTS.

Improvements in Ovens for Firing Pottery. A. J. Wilkinson, Burslem. Eng. Pat. 4356, March 20, 1890. 8*d*.

The object of the patent is the attainment of a more even temperature than can be got in the ordinary pottery kiln.

This is achieved by the use of vertical flues between the "bags," the lower ends of which pass horizontally through the bottom of the oven, while the upper ends are about level with the outside top of the crown of the oven. The flues converging from the bags to the "well hole" may be partially divided longitudinally for the better distribution of the heat. Any suitable number of holes situated in the roof of the oven and provided with means of regulating the draught may be used.—B. B.

Improvements in Coke Ovens, and in the Method of Using the same. J. Edwards, London. From F. Strochmer, Dresden, Germany. Eng. Pat. 4457, March 21, 1890. 8*d*.

See under II., *page* 531.

Improvements in the Manufacture of Ceramic Ware and Apparatus for that Purpose. H. M. Ashley, Ferrybridge. Eng. Pat. 5970, April 19, 1890. 6*d*.

The raw plastic material of which the ware is to be made is forced through a die so as to form a sheet. Both surfaces of the sheet are preferably partially dried by currents of warm air, and are sprinkled with some of the material of which the sheet is composed in the state of powder. The sheet then travels between rolls or over guide rollers to a punch, which cuts out and removes a disc from the sheet. The disc held by the punch is brought over a mould and air or other fluid under pressure is admitted at the back of the former, forcing the disc into the latter and causing it to receive its form. The mould is then inverted and the shaped disc either dropped or forced out by compressed air, on to a travelling apron by which it is finally removed.

The method is applicable to the manufacture of such articles as plates, saucers, and basins.—B. B.

Improvements in Kilns. J. Brook, Huddersfield. Eng. Pat. 6088, April 22, 1890. 8*d*.

It is proposed to provide a bottom supply of gas and air in gas fired down-draught kilns. A gas flue is arranged near the bottom of the kiln with perforations for admitting gas near to the walls and the lower part of the kiln where it meets with air.

The products of combustion after circulating through the kiln pass away through perforations in the floor to a discharge flue.

A number of these kilns adopted to be worked in rotation can be worked regeneratively.—D. A. S.

An Improved Method for Producing Coloured Designs on Glass. O. Billmann, Munich, Germany. Eng. Pat. 9942, June 26, 1890. 6*d*.

The object of the invention is to produce glass with coloured designs in which a greater variety of colours may be obtained at less cost than by the usual method, and this object is attained by placing together two panes of single flashed glass differently etched, so that the coloured part of one frame may coincide with the plain part of the other. A further variety may be obtained by allowing two etched portions to coincide, whereby a portion of the design will appear in clear glass.—B. B.

Improvements in Lears for Annealing Sheets of Glass. G. F. Chance and Chance Bros. and Co., Lim., West Smethwick. Eng. Pat. 12,212, August 5, 1890. 11*d*.

An ordinary "lear" consists of an arched tunnel, kept heated from one end by suitable furnaces, and through which the sheets of glass to be annealed are caused to travel with an intermittent motion. With a view of quickening the rate of working, the patentees have devised a double tunnel, the two parts being wholly or partly separated by a vertical wall, which is heated in the ordinary way and has at the furnace end where the sheets of glass are introduced a "push hole chamber," forming an entrance to the "cooling chamber" as is usual.

The mechanism for conveying the sheets of glass from one end of the lear to the other is of the ordinary type and calls for no special description. The cooling chamber of one tunnel communicates directly with that of the other, and the push hole chamber may be on either side of the pair of tunnels. The sheets of glass are introduced by the push hole chamber into the cooling chamber and shifted on alternately into the two tunnels, which they traverse, and at the ends of which they are withdrawn also alternately.

Instead of two distinct tunnels one of double the ordinary width may be employed.—B. B.

Improvements in Kilns for firing Fire-bricks, Earthenware, and the like. J. Dunnachie, Glenboig. Eng. Pat. 17,573, November 3, 1890. 8*d*.

The patent relates to improvements in the kilns described in Eng. Pat. 3862 of 1881. The arrangement of kilns used by the patentee consists of a number of chambers or kilns used in rotation with regenerative heating by means of producer-gas. The object of the present patent is to introduce into each chamber, as may be required, a number of comparatively small jets of gas for driving off the moisture of the articles to be fired. This end is attained by the use of two small supply flues under the floor of each chamber, which open into the chamber by numerous small tubes, called "steaming holes" by the patentee. "Hopper furnaces" burning solid fuel may be substituted for those adapted for producer gas, the other arrangements being similar to those employed in the complete rotation system.—B. B.

Improvements in Implements for Cutting Glass Tubes. A. F. Hunt, Scranton, U.S.A. Eng. Pat. 3607, February 27, 1891. 8*d*.

The implement consists essentially of two parallel arms, attached to each other at one end by a bow, spring, pivot, or hinge, one of which is provided with a replaceable bevel cutter, and the other with a concave segmental clamp. A stop-piece travels on the arm bearing the cutter, and is provided with a set screw, by means of which it can be fixed on the arm at a predetermined spot. This arm is also graduated. The method of operating consists in inserting the cutting arm into the tube to be divided as far as the stop-piece, which latter has been set at a distance from the cutter equal to the length of tube it is desired to cut off. The arms are then brought towards each other by

hand or by some simple mechanical device such as a screw or sliding collar embracing both, so as to press the cutter against the inside of the glass tube at the exact spot where the concave support is pressed against the outside. On rotating the tube thus clipped between the cutting and the supporting jaw, a circular cut is made in it, and it can easily be broken off neatly by gently tapping. The patent describes many possible modifications of the implement.—B. B.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

Antiseptic Treatment of Building Materials. Résumé by E. Dollfuss of a communication from V. Boyet. Bull. Soc. Ind. Mulhouse, 1890, 546—549.

See under XVIII. C., *page* 563.

The Effect of Preservative Agents on Mine-Timber. Compt. Rend. Mensuels de la Soc. de l'Ind. Min. 223, November 1890; and Proc. Inst. Civil Eng. 1891, **104**, (ii.) 74.

At Saint-Eloy in Auvergne, experiments on the effect of antiseptic agents on the duration of timber underground, have been carried on since 1879, upon the following description of timber:—

1. Oak from the Allier..... 35 years old.
2. Oak from the Nièvre..... 27 years old.
3. Fir from the Allier..... 22 years old.
4. Pine from the Allier..... 20 years old.
5. Birch from the Allier..... 5½ in. diameter.
6. Beech from the Allier..... 5½ in. diameter.
7. Poplar from the Allier..... 5½ in. diameter.

Method of Treatment.—A stem of each description of wood was sawn into 52 discs, each ¼ in. thick, the first and last of which were preserved in their natural condition above ground in the open air, but protected from damp, the remaining 50 were placed in a kind of cage in a damp level underground, where the prevailing temperature was about 75° F. Two discs in each 10 were left unprotected, while the remainder were subjected to treatment by the following substances:—

1. Sulphate of iron.
2. Sulphate of copper.
3. Chloride of zinc.

The strength of the solutions varied from 100 to 450 grms. of the salt to 1 litre of water, and the period of immersion from one hour to 40 days.

4. Creosote, of the impure commercial kind, immersed for similar periods.

5. Painted with three coats of the following oil colours: Pure white lead, white lead and yellow ochre, white lead and emerald green, red lead, white lead and lamp black, white lead and prussian blue.

6. Tar, mineral and vegetable, immersion for five minutes.

After preparation, the samples were kept in the office at the surface for 50 days before exposing them underground, and they were subsequently examined at five different periods—namely, six months, one and a half year, two and a half years, three and a half years, and eight and a half years, the amount of alteration being laid down on a diagram which accompanies the paper. From this it appears that the unprotected specimens were almost all destroyed in a comparatively short time—two and a half years to three and a half years—the observed order of durability being as follows:—

No. 1. Beech.
No. 2. Oak No. 1.
No. 3. Poplar.
No. 4. Oak No. 2.
No. 5. Birch.
No. 6. Fir.
No. 7. Pine.

The preservative effects of the different substances employed is given in the following table, which represents the increase in the duration of the protected specimens in terms of that of the unprotected ones, the latter being taken as unity.

—	Oak. No. 1.	Oak. No. 2.	Fir.	Pine.	Beech.	Birch.	Poplar.
Tar.....	28·7	24·6	263·5	87·5	105·4	23·2	150·5
Chloride of zinc.	10·5	9·2	50·0	26·3	18·6	52·5	34·7
Oil paint.....	6·1	10·2	31·7	54·5	25·0	12·1	2·5
Sulphate of copper	42·1	26·4	12·0	8·0	1·8	2·5	15·5
Sulphate of iron.	18·0	12·5	12·1	4·2	4·7	3·5	2·9
Creosote.....	1·7	0·9	2·5	4·4	0·6	3·3	1·3

PATENTS.

Improvements in Coating Iron, Steel, or other Metals or Materials with Portland or other Cement. C. Kellner, Vienna, Austria. Eng. Pat. 6952 May 6, 1890. *6d.*

See under XIX., *page* 566.

Improvements in the Manufacture of Artificial Stone. J. Hartnell, Cardiff. Eng. Pat. 8413, May 30, 1890. *6d.*

Three pounds of sugar of lead, 4 lb. of alum (powdered and burnt on an iron plate placed over a fire), 4 lb. of "common soda" (also previously heated), 2 lb. of powdered bluestone are "immersed in 30 gallons of cold water," and 8 lb. of oil of vitriol added. After the reaction has ceased and the mixture cooled, the resulting solution is added to a mixture of crushed stone (preferably granite), 3 parts; gravel, 2 parts; and "cement," 1 part, all by weight, in the proportion of 1 gallon to 14½ cwt. of the dry ingredients, the wetting being done by degrees, and the superfluous moisture being gradually patted to the surface.

The composition may be used for breakwaters, dock walls, pavements, stairs, mantelpieces, &c. In laying a pavement, a foundation consisting of 2 in. of lime concrete is first made, allowed to set for a day, and then the patented mixture laid on to the depth of 2 in. It may be used for foot passengers in one day, and vehicular traffic after a week. Moulded articles such as window sills may be removed from the moulds after one day, and fixed at the end of a week.—B. B.

Improvements relating to the Production of a Plastic Moulding Material and to Articles made therefrom. H. H. Lake, London. From E. Sochaczewski, Waltershausen, Germany. Eng. Pat. 3365, February 24, 1891. *4d.*

One part of French or Cologne glue is dissolved in 3 parts of water by the aid of heat; 1½ parts of burnt marble or "pure or mixed minerals, such as porcelain material," and 1½ parts of burnt gypsum are added with continuous stirring.

In casting this composition the moulds are cooled both before and after the operation. "When the finished articles are to be employed in hot chambers, it may be expedient to add about ¼ part of colophony or other resin in the molten state," but this is not claimed as novel.

The material is said to be hard, strong, and cheaper than unmixed plaster of Paris.—B. B.

X.—METALLURGY.

Zinc Desilverisation. H. Roessler and B. Edelmann. Eng. and Mining J. 1891, 51, 104—106.

The authors' desilvering scheme of treating the silver-lead maintained at 600° with successively increasing quantities of zinc, and allowing each portion of the latter metal to pass through four times, proves successful on small quantities of pure silver-lead. The oxidation is only slight, and a product is obtained which can be worked up directly without previous liquation. But in operations on a large scale with base bullion of commerce, containing copper, arsenic, and antimony, oxidation is considerably increased and a scum difficult to separate is obtained, necessitating such a rise of temperature that much of the silver passes back into the lead during the first skimmings. Therefore, although the desilverisation is ultimately achieved, yet the advantage is not as great as anticipated from the experiments with pure silver-lead. It is now observed that the additon of 1 or even 0·1 per cent. of aluminium to the zinc impedes oxidation in pure silver-lead, but in the case of ordinary impure silver-lead the amount of aluminium required becomes too costly. Copper seems the chief cause of the oxidation in the zinc-carrying lead, for the protective action of aluminium becomes more evident with base bullion after copper has been removed by some zinc. Results tabulated in the paper demonstrate that the first additions of zinc serve to remove useless impurities and to contribute to the lead the proportion of zinc required to remove the silver present. It was therefore next tried to both saturate and desilverise the lead with one addition of zinc, and in order to ensure the saturation it was found necessary to add the requisite proportion of zinc in a molten state to red-hot lead; for although the higher temperature is more favourable to oxidation, yet when it is employed less stirring is required, and the concomitant exposure of fresh surface for oxidation is proportionately diminished. In fact, with aluminium added to the zinc, oxidation is then almost entirely obviated. Under these circumstances the zinc dissolves completely, and in gradually cooling reappears as a scum carrying with it all the silver, which can be thoroughly melted out. With impure silver-lead, as in the previous experiments, a 'preliminary removal of the copper is required to ensure success, which in all cases depends on retaining the proper proportions of zinc and the correct temperature. If the latter is too high oxidation takes place and irregular results are obtained. Richer skimmings, as referred to in the first paragraph, are obtained under these circumstances by using the poorer or second skimmings of a previous experiment as part of the charge of zinc. For example:—

	Grms. of Silver
To 100 parts of lead melted with	150
are added... 1·2 parts of zinc	
and..... 1·3 parts of zinc in skimmings with	130
In all... 2·5 parts of zinc with	280
Skimmed off are	
0·6 parts of zinc with.....	150
and... 1·3 parts of zinc with.....	130
Leaving... 0·6 parts of zinc with the lead.	

When copper is present, it is removed by zinc in a preliminary small skimming, which runs high in copper, but low in silver. (See also this Journal, 1890, 1133—1134.)

—D. A. L.

Wolfram Mining in New Zealand. Otago Daily News.

A recent cablegram stating that German firms are inquiring if wolfram is procurable in Australia, and offering to take a large quantity, should reopen a neglected though important mining industry in Otago, which is perhaps richer in that particular metal than any other locality in the world. Wolfram, or tungsten, belongs to a group of rare metals, and till a comparatively recent time was known only to the chemist, and its value was only in the laboratory. With the invention of 100-ton guns the demand for tungsten soon made that previously obscure metal well known throughout the mining world. It was soon found that the steel tube lining the bore of these enormous guns could not resist the shock entailed by discharging many shots without becoming fractured, when of course an expensive piece of ordnance became useless. Experiment proved that the addition of a small quantity of tungsten to the fine steel employed in gun-making rendered the latter metal wonderfully elastic, so that the steel tube will expand under the tension of firing and contract again to its normal size a great many times before the quality of the metal is in any way impaired. The German gun factories consequently absorb most of the tungsten found in the world, and from being a mere curiosity seen only in the laboratory of the chemist, this rare metal has acquired considerable value. Wolfram (erroneously called tungstate of iron in the cablegram) generally occurs in combination with iron in Europe, but is also found in scheelite, or tungstate of lime. It is in the latter form that it occurs in Otago. The metal itself is of a white colour, extremely brittle, and heavy, the specific gravity being 19·1, that of gold being 19·3. It will thus be seen that tungsten is a very heavy metal, being only very slightly lighter than gold.

PATENTS.

Improvements in Cleaning and Annealing Iron and Steel, and Apparatus therefor. G. C. Fricker, Putney. Eng. Pat. 1369, January 25, 1890. 8*d*.

This patent refers to the cleaning of iron sheets, wire, &c. previous to tinning or galvanising the same. Instead of the usual pickling solutions for removing the scale the patentee employs hydrogen or other similar gas containing hydrogen, such as coal-gas or sulphuretted hydrogen. The materials are heated to a very high temperature in a chamber enclosed in a furnace, and into which the gas is led from a gas-holder, and whence the steam and unused hydrogen are conveyed to a condenser. The steam is condensed and the excess of hydrogen recovered. Various plans are adopted and described for conveying the hydrogen to and from the heated materials, such as using a fan or blower, allowing fresh hydrogen to be drawn in by the rarefaction resulting on the condensation of the steam, or by using two gas-holders and by alternating the pressure passing the gas backwards and forwards through the reducing chamber from one to the other. There are 11 illustrations in the specification. The necessary hydrogen is preferably prepared by passing steam over iron clippings heated to redness.—A. W.

Improvements in or relating to the Treatment or Utilisation of Scrap Tin or Terne Plates and the like. W. P. Thompson, Manchester. From E. Carez, Brussels, Belgium. Eng. Pat. 1913, February 5, 1890. 6*d*.

The process is one for removing the tin and lead from tin plates without injuring the iron of the plates, and for the recovery of the tin. The plates are treated with a concentrated solution (of about 30° B.) of the "polysulphide of sodium obtained either from the sulphurets of sodium residues from the Leblanc soda manufacture or from the polysulphides of calcium mixed with hyposulphite of calcium, which is transformed by means of carbonate of soda into sulphuret and hyposulphite of soda, or from the sulphurets of sodium mixed with a little nitrate of sodium resulting from the manufacture of nitrate of barium by means of sulphide of barium and nitrate of sodium, or from any other sulphuret of sodium," by boiling the sulphides with a slight excess of sulphur. The plates are dipped in this solution, which is heated by steam to from 50°—70° C., and to which has been previously added a little ammonium chloride. The addition of ammonium chloride counteracts the solubility of sulphuret of iron in the polysulphide of sodium solution, "and even any attacking of the metallic iron by the alkaline sulphide." After being dipped for three or four minutes the plates are washed with water. The lead is removed by the alkaline sulphide solution, and precipitated as sulphide whilst the tin goes into solution. When the polysulphide solution is saturated with tin it is decanted, and the tin recovered from it in a suitable way.—H. S. P.

Improvements in the Reduction of Metallic Ores. G. Simonin, Li Bourne, France. Eng. Pat. 3275, March 1, 1890. *4d.*

The improvements relate to the treatment of ores of antimony, and of zinc. The sulphides, carbonates, and other ores of these metals are roasted with reducing agents in a revolving reverberatory furnace, heated by gas-fuel. The gases and matters passing from the furnace enter a chamber filled with coils of pipes in which the air used for the combustion of the gas-fuel becomes heated. From this chamber the gases then pass into a second chamber or series of chambers, in which they become further cooled and the metallic oxides volatilised in the furnace become deposited. In order to recover the whole of the oxide the gases are then passed through a scrubber. If it only be desired to reduce the sulphides or carbonates to oxides without driving off the oxides, a lower temperature is used in the furnace, and the reducing agents are omitted.—H. S. P.

Improvements in or relating to Blast or Smelting Furnaces having Water-Jackets. J. W. Chenhall, Totnes. Eng. Pat. 2544, February 17, 1890. *8d.*

This is a method of constructing blast furnaces for lead or other ores to enable the lower jackets to be easily removed for inspection and repairs. The specification is illustrated with drawings, and a way of making the tuyere openings so as to avoid any joints being exposed to the fire is described.—D. A. S.

Improvements in the Manufacture of Copper. H. H. Vivian, Swansea. Eng. Pat. 6821, May 2, 1890. *4d.*

The impurities are dissolved out of the finely-divided oxidised compound by an organic acid. When the material is metallic copper it is melted, granulated, and roasted, and the oxide finely ground. When it is a matte it is first ground and then roasted. Towards the end of the roasting a little salt may be added and well mixed with the charge, as it facilitates the extraction afterwards. The resulting copper oxide is lixiviated with a solution of tartaric acid, which dissolves out the arsenic, antimony, gold, silver, and other foreign substances, leaving a residue which, upon reduction with carbon in a reverberatory furnace, yields a copper of high quality. The quantity of acid used for every ton of oxide is about 2 lb. dissolved in 200 lb. of water. It is not essential that the matte be roasted, for it will be much improved if it is finely powdered and treated direct with the acid, and will yield a purer copper. The solution after lixiviation is submitted to the action of an electric current through insoluble anodes, by which means the dissolved metals are deposited and the acid liquor left ready for a second usage. Citric, acetic, and oxalic are the other organic acids claimed.—A. W.

Improvements in the Manufacture of Steel-plated and Gated Ingots, and in the Moulds for Same. J. Neill, Sheffield. Eng. Pat. 6960, May 6, 1890. *8d.*

The present method of making combination ingots, technically known as "gated" or "plated" ingots, consists of first casting the low quality steel which forms the bulk of the ingot, quickly removing a side plate and substituting another one with the necessary cavity and pouring in the higher class steel, which welds itself to the hot face of the previously cast metal and forms a compact solid combination ingot with a hard steel corner or face. This latter portion is generally permeated with minute holes, which, on working are to some extent removed, but which still remain imperfections. The patentee's object is to overcome this drawback by casting the steel "gate" first, and his specification relates to specially-constructed ingot moulds, of which and their parts there are 12 illustrations. In the case of the gate mould the portions of the two sides which constitute the gate corner are made some inches higher than the top of the remainder of the mould. Into this corner is placed a right-angled plate, which is fixed tightly by a ring and wedge against these two extended pieces—thus forming a corner mould inside a larger one. The lower end of this angle-plate is kept in position by a shoulder cut in the base of the mould, where also there is a second and lower shoulder which keeps the cast gate piece erect, and prevents it falling across the mould, when the angle-plate is removed. The high quality steel is first cast in this corner mould, and the angle-plate being quickly removed mild steel or iron is run in to fill up the remaining bulky space of the large mould. By this means improved castings are said to be obtained, especially in respect to the steel corner; moreover the corner piece is longer than the bulk of the ingot, and forms a topping head.—A. W.

Improvements in the Manufacture of Steel and Iron and in Apparatus to be employed in such Manufacture. J. Heaton and G. H. Holden, Manchester. Eng. Pat. 7070, May 7, 1890. *1s. 1d.*

This patent relates to some mechanical improvements and arrangements in the Heaton process of converting cast iron into steel by the use of nitrates or chlorates (Eng. Pats. 798, 1866, and 1295, 1867). The iron is melted in a cupola and run into a measuring vessel or receiver, whence it is run through a plugged or valved passage into the converter. The converter is divided into two portions, the upper and the lower. The former is a kind of chimney open at the base, and the latter consists of a removable vessel in which is placed the nitrate. This vessel or kettle is supported by trunnions on a truck running on rails and consists of an iron casing lined with refractory material and with a circular perforated plate which is fixed in position above the nitrate. When ready the whole of this lower portion of the converter is run on to the table of a hydraulic ram underneath the upper portion, and the two parts are pressed and clamped tightly together. The molten cast iron is then introduced from the measuring vessel. The upper portion of the converter is so arranged that the gases may be led to a condensing chamber and by-products obtained therefrom. The specification contains eight claims and 15 drawings.

—A. W.

A Process and Apparatus for Reduction of Iron and other Oxide Ores and for Fusion and Purification of the Produced Metals. J. D. Danton, Paris, France. Eng. Pat. 7129, May 7, 1890. *8d.*

The apparatus consists of a tall circular furnace divided into concentric compartments. The centre one receives the reducing gases and is separated by a perforated wall from an annular compartment into which the ore is supplied from the top. This compartment is separated by another perforated wall from an outer annular chamber, into which the gases pass after having traversed laterally through the ore from the innermost chamber. The reducing gases may be prepared and heated elsewhere, or they may be generated in a producer placed at the base of the central compartment. The ore falls through the second compartment, wherein it is partially reduced in its descent by the transverse currents of gases, and is withdrawn from below. The reduction is completed by fusion with bituminous coal in another furnace. The outer chamber may contain air or water tubes for utilising the heat of the waste gases before they are finally expelled. There are five drawings illustrating various modifications of furnaces involving the same principle. The explanation of the reduction by carbon monoxide is that the gas is decomposed, one portion of its carbon taking up additional oxygen and passing off as carbon dioxide, while the other portion is deposited in the pores of the ore ready to operate in the final portion of the reducing process. The operation relates principally to the ores of iron.

The molten metal is refined immediately it is tapped by allowing it to descend in a shower through a heated chamber having perforated walls, wherein it is exposed to streams of air carrying in suspension any powders suitable to the metal, such for instance, as silica, which produces a slag and eliminates the phosphorus. There are 12 claims in the specification.—A. W.

The Application of Water-Gas to the Manufacture of Iron and Steel, in connexion with Siemens and other Gas Furnaces. S. Fox, Leeds. Eng. Pat. 7827, May 20, 1890. *8d.*

The object of the patent is to mix water gas with the ordinary Siemens or producer gas used in the manufacture of iron and steel, so that the temperature necessary and the elimination of the impurities of the metal may be more readily attained.

Drawings are shown in the specification of a Siemens gas furnace, a puddling furnace, and a crucible furnace, the water-gas being in all cases introduced by jets or nozzles so disposed as to mix with the air and producer gas supplying the furnaces.—B. B.

A Method of Extracting Gold from Auriferous Ores by an Improved Process of Amalgamation, and Apparatus therefor. J. W. Macfarlane, Cathcart. Eng. Pat. 8884, June 9, 1890. *11d.*

This specification contains 15 claims and 18 drawings. A cylindrical vat is revolved at high speed on a vertical spindle in the centre of its base. Mercury is placed in the vat and by the centrifugal action spreads itself evenly on the inner surface and so forms a vertical wall of the liquid metal, which acts as the amalgamating surface. The finely-ground ore is washed into the centre and bottom of the vat and is made to pass over the surface of the mercury and to rise up and overflow at the top edge. Various appliances and mechanical devices for preventing the ore from becoming stationary and to cause it to pass in a thin continuous stream over the mercury, are fully described in the specification. In the treatment of some kinds of ores "a diluted solution of calomel in aqua regia" is charged in with the ore for the purpose of assisting the amalgamation.—A. W.

A New or Improved Process for the Utilisation of Oxide of Iron obtained as a By-product in the Smelting and Extraction of Copper from Pyrites, or from Spent Oxide produced in the Manufacture of Sulphuric Acid. J. Bradbury, Manchester. Eng. Pat. 10,062, June 30, 1890. *4d.*

The residue of oxide of iron from burnt pyrites and copper extraction is treated with hydrochloric acid in a suitable vessel provided with a steam coil for heating the same. An excess of oxide must be present, and the mixture is heated until the acid is saturated. A little nitric acid should be added if any ferrous oxide be present. The solution of ferric chloride so obtained is then used, either alone or with other materials, such as lime or alkalis, for the purification of water, sewage, &c., for making oxide of iron paint, or Prussian blue, and for the decolorisation of sugars and syrups.—A. W.

Improvements in the Process of Treating Metalliferous Ores. J. H. Molesworth, Adelaide, Australia. Eng. Pat. 13,723, September 4, 1890. *8d.*

The patentee roasts sulphide ores containing gold and silver by heating them in a calciner and submitting them to the action of air and nitrogen peroxide, the advantage being that the operation is more rapid and is performed at a low temperature. The apparatus consists of a revolving cylinder heated externally and fed with the ore by a screw from a hopper at one end. Air enters at the other end together with the products of the decomposition of crude nitre by sulphuric acid which are brought there by a pipe from a retort placed above the cylinder. The gases from the calciner are drawn by means of an exhaust fan through a so-called condensing chamber. The nitrogen peroxide from crude nitrate of soda contains much chlorine, so that the acid which condenses in this chamber is "nitro-chlorohydrochloric acid." This liquid is then placed in a vat with the roasted ore to extract the gold therefrom. In this operation nitrogen peroxide is regenerated, and is led to the mouth of the calciner for repeated usage therein. Its function in the roasting operation is to oxidise the last traces of sulphur and arsenic in the ore. One ton of pyrites for roasting by this process and subsequent extraction of the gold requires "about 8 lb. of nitrate of soda and 4 oz. of sulphuric acid."—A. W.

Improvements Relating to the Treatment of Slag, and to the Removal thereof from Furnaces. O. B. Peck, Chicago, U.S.A. Eng. Pat. 15,311, September 27, 1890. By Internat. Conv. March 3, 1890. *6d.*

This is a patent for a method of carrying off furnace slag by dividing it into small particles by centrifugal action and pumping it away mixed with water. The apparatus consists of a circular pan supported in the centre of its base by a vertical revolving shaft and enclosed in a larger outer vessel into which water, steam, or spray can be injected. The molten slag is run into the revolving pan, whence it flies out in small spheres into the larger one, in which it is rapidly cooled by the water spray. The small pellicles are then withdrawn with the water through pipes by the aid of a centrifugal or other force pump and driven onwards through other pipes to the place of deposit.—A. W.

Improvements in Apparatus for the Treatment of Slag. O. B. Peck, Chicago, U.S.A. Eng. Pat. 15,312, September 27, 1890. By Internat. Conv. March 3, 1890. *6d.*

This patent is the same as the preceding one, with the addition of a self-acting trap which is placed in the conduit pipe connecting the granulating vessel with the pump. It is so constructed that if the pump becomes clogged the slag will accumulate on the trap and force it down, which action will by the aid of a cord simultaneously close the pipe and open a second one leading to another force pump.—A. W.

Improvements in Centrifugal Apparatus for Treating Molten Material. O. B. Peck, Chicago, U.S.A. Eng. Pat. 15,313, September 27, 1890. By Internat. Conv. March 3, 1890. *8d.*

This invention relates more particularly to the construction of the curbing that surrounds the receiving-vessel, and to providing means for protecting its interior. The curbing surrounding the receiving vessel is constructed of two cast-iron plates, preferably provided with annular flanges. These plates form the top and bottom of the curbing, and are held together (preferably) by sheet iron riveted to the flanges. To prevent the curbing being injured by the molten metal thrown off from the receiving vessel, a cast-iron lining, preferably made in sections, is provided, and placed over the interior of the wall of the curbing.—E. S.

Improvements relating to Centrifugal Apparatus for Treating Molten Material. O. B. Peck, Chicago, U.S.A. Eng. Pat. 15,348, September 27, 1890. By Internat. Conv. March 3, 1890. *8d.*

This invention is intended to provide convenient means for developing and applying the operating power, and for adjusting the various parts of the apparatus to each other.

In combination with a centrifugal machine, a bed plate or frame is constructed of a suitable length and breadth. One end of this frame carries the receiving vessel, curb, &c., and the other end the engine plate, to which is attached the engine and driving wheel, which is mounted directly on the engine shaft in a horizontal position, thus allowing a compact arrangement of the machinery and the use of a short, straight belt to connect the driving wheel with a pulley on the shaft of the centrifugal machine. This belt can be adjusted by moving the engine-plate backwards or forwards by a hand-wheel and screw-thread shaft. Other means are added for obtaining the proper amount of pressure on the belt as may be necessary from time to time.—E. S.

Improvements relating to Centrifugal Apparatus for Treating Molten Material, and to Means for Removing the said Material from such Apparatus. O. B. Peck, Chicago, U.S.A. Eng. Pat. 15,349, September 27, 1890. By Internat. Conv. March 3, 1890. 6*d*.

The object of this invention is to provide simple means for treating and removing the molten material, and also for removing any gas or steam that may be formed.

The bottom of the curb is connected by a pipe with a centrifugal pump, which forces the material from the curb to any desired point. To prevent the pump being clogged with lumps of the material, crushing rollers provided with cog-wheels are used. In order to carry off any gas or steam that may be formed a "suction fan" is employed. The pump, fan, and rollers are actuated by the ordinary machinery.—E. S.

An Improvement in the Manufacture of Cast Iron. J. B. Renshaw, Hartford, U.S.A. Eng. Pat. 16,724, October 21, 1890. 4*d*.

"This invention is applicable to the treatment of grey iron as used in foundries; and it consists in a process of eliminating, from melted iron, surplus graphitic carbon, and also a substance resembling carbon, which is called 'kish,' and is also produced in blast furnaces, and which, when in excess, causes kishy unsound surfaces on castings." The excess of carbon is removed by treating the melted iron with finely-divided iron oxide. The novelty consists in impregnating "sawdust, shavings, straw, or other vegetable fibre, of which the wood material used by upholsterers and called 'Excelsior' is a good variety," with the finely-divided iron oxide. To do this the fibrous material is moistened with water and the iron oxide is then thoroughly mixed with it, and the fibre is afterwards dried. When used, a quantity of from 1 to 3 lb. of the impregnated fibre for every 100 lb. of iron is placed upon the iron before it is melted, or mixed with the iron when it is melted, or placed in a ladle into which melted iron is to be poured. The fibre burns away leaving the iron oxide free to act upon the carbon in the iron.

—H. S. P.

Improvements in and Connected with the Galvanising of Sheet Metal. Davies Bros. & Co., Lim., and M. Bayliss, Wolverhampton. Eng. Pat. 18,066, November 10, 1890. 11*d*.

The object is to dispense with manual labour in the conveyance of the iron sheets from the cold rolls, used by the patentees (this Journal, 1889, 898), through the galvanising bath and onwards through brushes, &c. The sheets pass from the cold rolls through a pair of small rolls one above the other near the edge of the bath, down guides to another pair of rolls revolving side by side just above the flux pot. The latter rolls push the sheets through the metal bath along guides to another set of side by side rolls, which withdraws them. To prevent interference with the proper crystallisation of the coating metal these withdrawing rolls are provided on their surface with corresponding studs. The sheets are then guided on to a system of grooved drums, the first of which is studded on the outer curves of the corrugations, with endless chains or wire ropes carried within the grooves by which they are taken to another set of rolls, the brushes, and delivered cold and ready for handling.—A. W.

XI.—ELECTRO-CHEMISTRY AND ELECTRO METALLURGY.

PATENTS.

Improvements in the Production of Ductile Iron from Cast Iron. H. H. Lake, London. From S. H. Emmens, Emmens, U.S.A. Eng. Pat. 17,627, November 5, 1889. 8*d*.

The invention relates to producing ductile iron from ordinary grey, white or mottled pig iron, or from any other kind of cast iron, such as "scrap" cast iron. The cast iron is made the anode of an electrolytic cell, whilst the cathode is made of wrought iron or other suitable material, and a "suitable electrolyte" is used. The iron that is deposited by the passage of an electric current from a dynamo, upon the cathode or (when the cathode is made of wrought iron) the cathode together with the deposit of iron upon it, is then heated to welding heat in a furnace and worked up as required.—H. S. P.

Improvements in the Manufacture or Production of Aluminium. G. Shenton, London. From M. J. Berg, Paris, France. Eng. Pat. 2002, February 6, 1890. 6*d*.

Aluminium is made by passing a powerful electric current through a mixture of ground coke, coal, or carbon and a mineral containing aluminium, such as cryolite, bauxite, sulphate of aluminium, crude clay, &c. The point of the invention consists in adding to such a mixture a certain quantity of nitrate of sodium or potassium or of sulphide of sodium or potassium, or both the nitrate and the sulphide together. About 2 parts of sodium nitrate or sulphide to 100 parts of bauxite gives a good result. The nitrate oxidises the iron and silicon which then pass into the slag, whilst the sulphide converts the iron into sulphide of iron, which also goes into the slag.—H. S. P.

Improvements in Voltaic Cells or Primary Batteries. G. R. Postlethwaite, Aston. Eng. Pat. 2273, February 12, 1890. 11*d*.

The cells are arranged in a vertical or horizontal series, and the electrolyte passed from one end to the other in a continuous stream, going in its course through all the intervening cells. The whole electrolyte is thus kept in continual agitation.—E. T.

Improvements in Apparatus to be used for Electrolytic Purposes. J. C. Richardson, Clerkenwell, and T. J. Holland, Snodland. Eng. Pat. 2297, February 12, 1890. 8*d*.

When a solution of common salt is electrolysed, caustic soda and hydrogen are given off at one plate and chlorine at the other, and are usually kept apart by a porous partition. To replace the latter, which is expensive and fragile, and increases the electrical resistance, non-porous partitions are so arranged as to catch the results of electrolysis, which all rise towards the surface, the hydrogen carrying with it the caustic soda. In one design, out of several, each electrode is covered by a sort of funnel, chlorine being drawn off at the top of one, and hydrogen and caustic soda near the top of the other.—E. T.

Improvements in Amalgamating and Extracting Gold from Refractory and other Ores. W. Crookes, London. Eng. Pat. 3532, March 5, 1890. 6*d*.

"The present method of extracting gold from refractory ores (such as sulphides, tellurides, arsenio-sulphides, &c., of zinc, copper, iron, bismuth, antimony, &c.) by direct amalgamation with mercury is very imperfect, as the sulphides, arsenio-sulphides, and other minerals in the ore"

cause the mercury to "flour" and "sicken," so that its fluidity is destroyed, and it either assumes a powdery character or becomes a tenacious mass. In either case, its amalgamating action is almost entirely destroyed, with the result that from 30 to 80 per cent. of the gold escapes the action of the mercury. Even when the mercury retains its active state, it will seldom take up more than one-half or two-thirds of the gold present in the ore, owing to the coat of tarnish which almost always covers the particles of gold—a coating which can only be removed chemically or mechanically—the long grinding required to remove the tarnish mechanically then tending to "flour" the mercury.

Another method of extracting gold is to roast the ores till free from sulphur and treat them with chlorine or other solvent for gold, after which the gold is precipitated from solution by suitable means, but this process is expensive. Cyanide of potassium or a soluble cyanide is sometimes used instead of chlorine, but its solvent action on gold is feeble.

The improvements consist in treating the ores with a solution of (preferably) cyanide of mercury, or some other soluble salt of mercury, as, for instance, the sulphate, which salts remove the film of tarnish and superficially amalgamate the particles of gold. When carrying out the process in this way, it is proposed to use a solution of two or three pounds of cyanide of mercury dissolved in 80 to 100 gallons of water for each ton of ore, but special circumstances may lead to varying these quantities. When the action is complete the mercury solution may be drawn off and the ore treated in amalgamating pans in the ordinary way. Heating will accelerate the action of the cyanide solution.

But where it is practicable the process is best worked in conjunction with the current from any alternating dynamo machine.

The gold ore, tailings, sulphurets, &c., are reduced to powder and mixed with a solution of any soluble mercury salt, and then a rapidly alternating current of electricity is passed through the mass, either at rest or when agitated. "The bulk of the mass is not a very good conductor of electricity, while the fine particles of gold sparsely disseminated through the mass are (as is well known) excellent conductors . . . . and the equipotential lines of force will converge towards them, with the result that more of the electric current passes through them than through the rest of the mass, and the two sides of each particle of gold act alternately as anode and cathode. On one side (the anode for the time being) sulphuric acid (if mercuric sulphate be the mercury salt used) is liberated, and on the other side (the cathode for the time being) no mercury is liberated; but the affinity of gold for mercury is so great that the two metals instantly unite and the gold becomes amalgamated. At the next alternation, the side of the gold particle which had the sulphuric acid liberated on it now has the mercury precipitated on it." The mercury, instead of recombining with the sulphuric acid, again attacks the gold, and thus each alternation leads to liberation of mercury on the particles of gold. In this way the finest "float" and "flour" gold will be amalgamated, and neither does the coarseness of the ore make any difference; so long as the solution is able to penetrate to one part of the piece of gold locked up in the ore amalgamation will take place. The use of an alternating current has a further advantage in heating the mass, owing to the sudden and violent decompositions and recompositions that take place, and this heating facilitates the amalgamation.

The mercurial salt may also be used to advantage (with or without the electric current) in the crushing and amalgamating apparatus, so that the cleansing of the particles of gold from the tarnish that covers them and the amalgamation go on simultaneously. Cold may also be used in concentrating and vanning machines.—H. S. P.

A New or Improved Secondary Element. L. F. Buechner, Leipzig, Germany. Eng. Pat. 5938, April 18, 1890. *8d.*

A zinc electrode, covered at the bottom and closed with non-conducting material, is immersed deeply in a solution of zinc oxide in potash or soda lye. During charging strong granular crystals of zinc are deposited and potash rises to the surface. When charged the electrode is raised to near the surface, and in this position, which is the normal one during discharge, there is said to be no local action. The anode is of porous metallic copper, prepared by heating pulverised copper oxide with deoxidising carbonaceous substances. The E.M.F. is 0·85 volt.—E. T.

Improvements in Galvanic Batteries. M. Ancizar, Manchester. From R. Zerda-Bayon, Bogotá, South America. Eng. Pat. 6223, April 23, 1890. *6d.*

The cell is a carbon-zinc one, the carbon being placed in a porous pot and packed round with a mixture of dry earth containing vegetable or nitrogenous matter and sodium chloride. The electrolyte is a saturated solution of the latter salt. The salt is in some cases replaced by sulphate of alumina. For pocket use the zinc and carbon are separated by a piece of woollen or such material and enclosed in an india-rubber bag. The metals are surrounded by the above-mentioned mixture in a moist state.—E. T.

Improvements in Secondary Batteries or Electrical Accumulators. N. de Bernardos, St. Petersburg, Russia, and J. Howard and J. H. Lloyd, Birmingham. Eng. Pat. 8534, June 2, 1890. *4d.*

An improvement on Eng. Pat. 14,024 of 1887 (this Journal, 1888, 678). The bars are united to the frames by electric welding, instead of by soldering.—E. T.

Improvements in and Connected with Zinc for Galvanic Batteries. J. Moseley, Manchester. Eng. Pat. 13,463, August 27, 1890. *8d.*

To diminish local action and promote more uniform wear, the zincs are made of numerous laminæ, or, if of rod shape, of numerous concentric tightly-fitting tubes, each such lamina or tube being separately amalgamated. The whole is bound closely together by zinc, or preferably ebonite, rivets.—E. T.

Improved Process for the Production of Pure Aluminium. A. Schneller and A. Astfalek, Cologne, Germany. Eng. Pat. 13,486, August 27, 1890. *8d.*

The oxide, sulphide, chloride, and fluoride of aluminium can all be reduced by hydrogen, if brought to a sufficiently high temperature. The inventors propose to obtain the latter by using an electric arc of 20,000 or 30,000 volts between aluminium electrodes, since with smaller ares carbon must be mixed with the aluminium compounds to increase the electrical conductivity, and the aluminium so obtained is not pure. A crucible or furnace with the necessary electrical fittings is illustrated and described in the specification. It is stated that the silicon present in aluminium ores may be got rid of in the furnace as SiH_4.—E. T.

Improvements in Galvanic Batteries. C. E. Dutton, jun., Washington, U.S.A. Eng. Pat. 20,126, December 10, 1890. *8d.*

The cell and its cover are provided with grooves and recesses so as to secure the zinc porous pot and carbon in fixed and co-axial positions, and so obtain uniform and therefore economical action on the zinc. Rubber washers, &c., are freely made use of to protect the various parts of the cell from jarring when the whole is moved about, and to render the whole watertight. The terminals of the cell are two knobs at the bottom, which are supposed to touch springs placed on the board supporting the cell.—E. T.

Improvements in and relating to the Manufacture of Insulating Compositions for Electrical Uses. T. D. Bottome, Hoosick, U.S.A. Eng. Pat. 20,289, December 12, 1890. 4*d*.

Very finely powdered quartz is dried and made into a plastic mass with a solution of crude potassium or sodium silicate, colouring substances being added if desired. The mass is moulded to the required shape and may have pieces of metal imbedded in it for lamp-holders. It is then slowly dried and finally brought to a red heat. A glazing mixture may be used to give a final finish to the whole. The composition is said to be useful for insulation between commutator segments, for bases, lamp fittings, &c.—E. T.

Improvements in Electric Batteries for Lighting Miners' Safety Lamps. O. Y. Rhodes, Leeds. Eng. Pat. 21,143, December 29, 1890. 6*d*.

Each lamp must be provided with internal electric ignition apparatus ending in suitable contacts on the outside of the lamp. When, through accidental extinction, it has to be lighted in the mine, it is placed on a sliding plate—which covers the top of the box—in such a way that its contacts press against others on the plate itself. The current is now made to pass through the ignition apparatus by sliding the plate, and with it the lamp, forwards on the box, the electrical circuit being thereby completed *inside* the latter The battery is separate from the box and sliding plate which only act as a well enclosed switch.—E. T.

An Improved Carbon Stick or Pencil for Arc Lights. H. J. Allison, London. From B. B. Ward, New York, U.S.A. Eng. Pat. 616, January 13, 1891. 6*d*.

To prevent an arc from hissing and spluttering when run at a low voltage, the inventor coats the inside of a cored carbon with sodium or potassium silicate, preferably the former. A vapour is produced of relatively high conductivity which allows the arc to lengthen and so obviates the defects mentioned.—E. T.

Apparatus for Separating Ores and Metals by the Aid of Electricity. E. Ferraris, Rouco ligure, Italy. Eng. Pat. 1007, January 20, 1891. 6*d*.

Twenty-four electro magnets are arranged radially on a hub, their outer poles being all joined by a circular metal rim like a broad tyre, the whole resembling a wheel. The magnet coils are all joined in one continuous circuit like that of a Gramme armature with connexions to a commutator. When a current is led into the latter, one-half of the rim becomes of north and the other half of south polarity, the commutator keeping the position of the poles in space unchanged during rotation. The surface of the magnetised rim is notched or furnished with projections, and ore, fed upon its surface from above, falls from the wheel into heaps in different positions according to its magnetic susceptibility, the most magnetisable being carried right underneath the wheel. By the peculiar construction of the commutator, resembling in principle that of the Immisch motor, two neutral zones are left between the two magnetised segments of the ring.—E. T.

Improvements in or relating to Accumulator Plates. H. T. Cheswright, Carcassonne, France. Eng. Pat. 2360, February 9, 1891. 6*d*.

The present invention is an improvement on Eng. Pat. 4087 of 1890 (this Journal, 1890, 812). The tubes employed in that specification are now placed vertically and attached top and bottom to horizontal bars. The plate is hung from the top bar, the ends of which project beyond the edges of the plate and rest in notches in suitable supports. The projections on the tubes to hold the active material in place have also been altered in shape.—E. T.

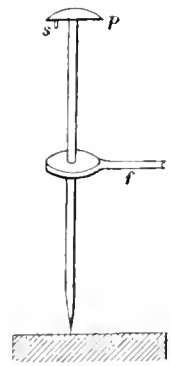
XII.—FATS, OILS, AND SOAP MANUFACTURE.

Researches on Turkey-Red Oil. Scheurer-Kestner. Bull. Soc. Ind. Mulhouse, 1891, 53—66.

Already abstracted from Compt. Rend. **112**, 158—160 and 395—397 (this Journal, 1891, 471).

A Method of Determining the Consistency of Lubricating Grease. R. Kissling. Chem. Zeit. 1891, **15**, 298—299.

The consistency is estimated by observing the time required for a rod to sink a certain distance in a compact mass of the grease at a temperature of 20°. A tin-plate cylinder or canister with a perforated or removable bottom and having a height of 120 mm. and diameter of 80 mm., is almost filled with the grease to be tested. On the surface of the grease there is placed a pointed rod (see Fig.), 30 cm. in length and 8 to 10 mm. in diameter, which is held in position by a suitable support *f*, and provided with a head *p*, from which a small pin *s* projects downwards.



An Apparatus for Testing Lubricating Grease.

The height of the support is so adjusted that a distance of 100 mm. intervenes between the bottom of the pin *s* and the top of the support, and then, the rod being allowed to fall, the time required for it to sink this distance is observed. There are three rods of the dimensions given above, which are composed respectively of brass, zinc, and glass, and weigh respectively 150, 100, and 50 grms. The glass rod is used for determining the consistency of the softest greases; the brass rod that of the most solid.

The author gives the following examples of the results obtainable by this method:—

Lubricating Grease.	Price per 100 Kilos.	Time (in Seconds) required in Sinking 100 Mm.		
		Brass Rod.	Zinc Rod.	Glass Rod.
No. 1	M. 64	Above 800	Above 600	..
2	60	150—200	300—400	..
3	56	25—100	50—200	..
4	53	..	Under 30	Above 1,000
5	39	..	..	300—800
6	38	..	..	Under 200

—E. B.

The Varnish and Wax Productions of China. Consul Gardner. Foreign Office Annual Series, No. 888.

The varnish exported from the district round about Hankow is the gum of a tree—the *Rhus vernicifera*. On this tree,

before daylight, incisions are made; the gum that runs out is collected in the dark and strained through a cotton-cloth bag, leaving behind a large amount of dirt and refuse. This operation can only be performed in the dark, as light spoils the gum and causes it to cake with all the dirt in it. It cannot be strained in wet weather, as moisture causes it to solidify. When the Chinese use this varnish they rub it on with a sort of mop, or swab, made of soft waste silk. It should only be used in wet weather, as if the atmosphere be dry when it is rubbed on it will always be sticky. As used by the Chinese this varnish takes about a month to dry. During the time it is drying it is poisonous to the eyes. Consul Gardner thinks it possible that the celebrated Cremona varnish may have had in it some of this gum as one of its ingredients, and he suggests that it might be worth the while of our musical instrument makers to make experiments with this gum with a view to producing a varnish that would give a mellow instead of a glassy sound. White wax is produced by a winged insect of the family of *fulgorida*, order *homoptera*. In the production of this commodity the insect at a certain stage of its development is moved from one kind of tree to another. It is believed that the trees on which the insect is reared are the *Ligustrum lucidum* and the *Ligustrum japonicum*. The wax is particularly hard, and is used in China for casing tallow candles. Two facts account for the decreased export in 1890, as compared with 1889, of 835,793 lb., or nearly 40 per cent. First, the increased use by Chinese of kerosine oil, causing a decreased demand for tallow candles; and, secondly, in England, the extended use of paraffin candles and of electricity reduced the selling price of white wax in Shanghai to below its cost of production. It would seem, therefore, that unless a cheaper mode of production can be discovered, or other uses of the commodities be found, the interesting industry of producing white wax is a doomed one.

Vegetable-Oil Production in China. Report by Consul Warren on the Trade of Taiwan (Formosa).

Consul Warren states that from the ground or pea nut, which is largely cultivated throughout the plain lying between the hills and the west coast of South Formosa, is expressed an oil which is in great request all over the island, both as an article of food and for lighting purposes. The supply of this is insufficient to meet the demand, and large quantities of nuts are imported by junk from the Pescadores, which are said to be of a finer quality than those produced in Formosa. The nuts are first dried in a brickwork tank, under which a slow fire is kept constantly burning; they are then crushed by means of a horizontal roller, forming the radius of the circle which it works in, the machine being driven by oxen. By this means the husks are broken up and the kernels cracked. It takes about six hours to crush 14 cwt. of nuts in an ordinary sized mill. The mass is then sifted to clear it of the larger portions of husk, which latter are again put under the crusher. The pulverised mass is made into circular cakes, which are wrapped round with rice-straw, twisted together at the rims. These cakes are then put into a press, which is formed by two semi-cylinders, resembling in form native cobble-tubs, which, when placed together, form a complete closed cylinder, the two parts of the press being kept together by iron bands. Each of the cakes is surrounded with an iron ring, and they are arranged in loose, but regular, order throughout the length of the press. A wedge is then inserted between the last cake and the end of the press, and is driven home by means of a swinging-hammer. Another wedge is inserted and treated in a similar manner, and this is continued until the whole mass is so closely pressed together as to render further insertion of wedges impossible. As the oil drains out and the pressure slackens, more wedges are driven in until the whole of the oil has been expressed; 1 cwt. of nuts will give about 25 lb. of oil, worth 30s. The leaves and stalks of the plant are sometimes worked into the soil, and form very good manure; they are also largely used as food for cattle, and are extremely nutritious. The method of extracting pea-nut oil as above detailed seems somewhat cumbrous, taking a considerable time and involving great waste of material; but, seeing that labour is so cheap and that the people have for so long a time been accustomed to the machine now in use, it appears doubtful whether the introduction of more elaborate machinery would be of any practical use. Such an introduction has been often proposed, but hitherto no effective steps have been taken to carry it out. Castor oil is another of the products of the south of Formosa to which little or no attention has been paid. The castor-oil plant (*Ricinus communis*) grows wild over the greater portion of the known districts of South Formosa. No attempt is made by the natives to cultivate it, and, with the exception of a small quantity of crude oil, which is expressed for use in mixing with ink for stamps and printing, as far as is known no effort has ever been made to obtain the oil in sufficiently large quantities to make it worth while exporting it. This is strange, seeing that the natives are well aware of the medicinal properties of the oil, and purchase and use freely that which is imported from foreign countries. As a lubricant castor oil is daily becoming in greater demand throughout the world, and there is no doubt that, considering the ease with which the raw material can be obtained, and the comparatively simple method necessary for extracting the oil, there is a large and profitable opening for capital and enterprise in this direction. Large tracts of land that are now considered useless for ordinary cultivation would suit admirably for the growth of the castor-oil plant, which, indeed, is often the only form of vegetation to be met with on them.

PATENT.

Improved Method of Decolourising Mineral, Animal, and Vegetable Oils, Fats, and the like, and the Employment of Silicic Acid for the Purpose. H. Stern, Warsaw, Russia. Eng. Pat. 7142, May 7, 1890. 6*d*.

When silica obtained by precipitation from soluble silicates is well washed and perfectly dried, it constitutes a cheap decolourising agent which has no chemical action on any oil but only retains the colouring material. The silica is added to the warm or cold oil and the mixture filtered, or the oil is passed through a filter-bed filled with silica. To regenerate the filtering material it is washed with a suitable solvent for the substance under treatment and if necessary ignited.—K. E. M.

XIII.—PAINTS, PIGMENTS, VARNISHES, AND RESINS.

Determination of Turpentine in Paints and Varnishes. H. J. Phillips. Chem. News, 1891, **63**, 275.

See under XXIII., *page* 577.

The Varnish and Wax Productions of China. Consul Gardner. Foreign Office Annual Series, No. 888.

See under XII., *page* 555.

PATENTS.

Improvements in the Manufacture of Waterproof Boards, Paper, and such like Materials. C. Weygang, London. Eng. Pat. 3004, February 25, 1890. 8*d*.

Porous substances, such as moss peat, wood pulp or porous paper, boards, or more or less felted materials are saturated with preparations of resinous, oily, tarry, fatty, or similar substances, *e.g.*, by saponifying common resin with tallow, then adding petroleum, or tar, &c., and afterwards diluting with water. Moss peat, wood pulp, &c., after being treated in this way, are ground in edge-runners and then added to ordinary paper stock in the beating engine. Free alkalis, if

present, have to be neutralised. Peat boiled with caustic alkali or a farinaceous substance (compare Eng. Pat. 7904, 1886) may be added to the materials while in the beater as a hardening or binding agent. Antiseptic, disinfecting or similar substances can be added as well if desirable. The pulp is manufactured into boards or paper in the ordinary way.—H. S.

An Improved Method of and Apparatus for Preparing Copal and other Gum Resins and Resins, and Manufacturing Varnish. A. F. St. George, Redhill. Eng. Pat. 5380, April 9, 1890. 8*d*.

This inventor employs a melting pot provided with cooling tubes or condensers, and communicating with a still or retort, and treats the gum resins or resins "by digestion in their own vapours or distillates," for the purpose of rendering them more readily soluble in oils or spirits.—E. G. C.

Improvements in or Appertaining to Paints, Colours, Varnishes, and Distempers, and in the Method of Applying them to Canvas or other like Surfaces. W. P. Thompson, Liverpool. From A. F. von Pereira, Stuttgart, Germany. Eng. Pat. 6805, May 2, 1890. 6*d*.

The medium with which the inventor mixes majolica colours, consists of glycerin, 40 grms., oleum rosarum palmarum, 10 drops, and liquid yellow honey, 60 grms. The varnish necessary for these paints is composed of rectified alcohol, ½ litre, balsam of copaiva, 2 grms., mastic, 8 grms., rectified turpentine oil, 8 grms., and Venice turpentine, 6 grms. The canvas is coated with a mixture of white or red pipe clay, glue and honey.—E. G. C.

Improvement in the Manufacture of Varnishes. B. Piffard, Hemel Hempstead. Eng. Pat. 8668, June 4, 1890. 4*d*.

This improved varnish consists of the lead salts of the isomeric acids constituting colophony and is prepared as follows:—2 parts of rosin are mixed with 1 part of lead oxide and $\frac{1}{12}$ to $\frac{1}{8}$ part beeswax or paraffin is added. The mixture is then heated in an oven at about 250° F. until combination is obtained and the excess of lead oxide has subsided. The product called "Artificial Copal," is allowed to cool and ground to a fine powder. The powder is then dissolved in turpentine or other suitable solvent in the proportion of 2 parts by weight of the lead salt to 3 parts fluid measure of the solvent. The varnish may be used either hot or cold and hardens rapidly.—B. H.

An Improved Ink. T. W. Just, R. Weiler, and O. Heidepriem, Melbourne, Australia. Eng. Pat. 16,757, October 21, 1890. 4*d*.

See under VI., *page* 541.

Improved Anti-Corrosive and Anti-Fouling Compounds. M. E. Dejonge, Stapleton, U.S.A. Eng. Pat. 19,160, November 25, 1890. 4*d*.

The materials used are colophony, paraffin, fusel oil, zinc dust, and talc or asbestos.—E. G. C.

Improvements in and relating to the Manufacture of Insulating Compositions for Electrical Uses. T. D. Bottome, Hoosick, U.S.A. Eng. Pat. 20,289, December 12, 1890. 4*d*.

See under XI., *page* 555.

A New or Improved Process for Utilising Leather Waste and Preparing therewith a Material for Covering Floors, Walls, Roofs, and the like. W. Barton, Rixdorf, Germany. Eng. Pat. 2808, February 16, 1891. 4*d*.

See under XIV., *page* 558.

Process for Converting Carbonate of Lead, obtained by Decomposition of Sulphate of Lead or other Compound of Lead with Carbonate of Sodium, into Basic Salt. J. N. Zeitler, Cannstatt, Germany. Eng. Pat. 2812, February 16, 1891. 4*d*.

This invention relates to a process for producing white lead from various salts of lead, principally the sulphate, obtained as by-products in different manufactures. The amount of lead is first determined in the product to be treated, and it is then converted into neutral carbonate of lead by treatment with the proper quantity of carbonate of sodium. The neutral carbonate of lead so obtained is then converted into basic carbonate ("white lead") by boiling it with the requisite amount of caustic soda lye, the following reaction taking place:—

$$3\ PbCO_3 + 2\ NaOH = 2\ PbCO_3.Pb(OH)_2 + Na_2CO_3.$$

The white lead is then separated from the solution, washed and dried.—B. H.

XIV.—TANNING, LEATHER, GLUE, AND SIZE.

The Theory of the Currying Process. W. Fahrion. Zeits. f. angew. Chem. 1891, 172—175.

Currying consists in dressing the properly prepared hides with train oil, and subsequently exposing them to the atmosphere. This will give rise to chemical reactions accompanied by an elevation of temperature, under the influence of which substances are formed, which possess the property of converting hide into leather.

The nature of this process may be elucidated by investigating the *dégras* (moëllon) or surplus oil remaining after pressing the hides.

Jean found (Monit. Scient. **15**, 1889), that this *dégras* contains about 10—20 per cent. water, and that its property of forming emulsions with water depends on the presence of a "resinous substance." This he considered to be a product of the oxidation of train oil, and found it to be insoluble in petroleum ether. As any *dégras* is perfectly soluble in petroleum ether, it follows that this "resinous substance" must have been formed in the currying process.

According to *Schreiner* (Ledermarkt. **38**, **51**, 1888), the main product of the oxidation is a glyceride of dioxypalmitic acid.

Eitner (Der Gerber, **375**, 1890), however, disputes the oxidising nature of the process, and finds that train oil in contact with animal fibre produces a nitrogenous substance, which on its part will give rise to a sort of after-tanning in the oiled leather. This "tanning substance" is to be found in train oils ready formed and in varying quantities.

Simand describes this substance as the *dégras* former.

The author's investigations lead him to believe that Jean's old oxidation theory offers the correct explanation of the currying process. He oxidised cod-liver oil with nitric acid, extracted the saponified product with petroleum ether, and the residue with ether. The ether solution yielded, on nitrifying, yellow crystals, which melt at 35°, and which may also be isolated from tallow, olive oil, linseed oil, and palm oil, a proof that the ether solution consisted of an hydroxyoleic acid. The insoluble part yielded on nitrifying an amorphous yellow substance, which is characteristic of train oil. Its analysis shows that train oil contains in all likelihood an unsaturated fatty acid of the formula $C_{16}H_{32}O_2$, but besides this it may contain one or more unsaturated fatty acids.

The author succeeded in separating from the *dégras* and from the curried hide the above yellow crystals and the amorphous yellow substance, thus proving that the process is an oxidising one.

As to Eitner's "nitrogenous substance" or "tanning substance" the author finds that the nitrogen is due to impurities. On exposing curried and oiled hide to the atmosphere for about three months, and extracting part of

it with ether, a yellow fat will result, which, on saponifying and treatment with petroleum ether, will yield about 22 per cent. of the *dégras* former. *This was found to contain nitrogen.* However, on shaking the ether solution with water, filtering, and evaporating, the *dégras* former proved to be *free from nitrogen*. It is now evident that the *dégras*, in contact with the hide, takes up nitrogenous substances, which it retains with great tenacity. It will be also seen that old train oil contains more of the *dégras* former than fresh oil, which again only strengthens the supposition that the *dégras* former is a product of oxidation. The substances known as "resinous substance," "tanning substance," and *dégras* former, the author proposes to name "oxyfatty acids" or "oxyacids."—H. A.

Elephant Leather. Journal of Commerce, Boston.

The tanning of elephant hides is comparatively a new industry. The method employed is practically the same as in the tanning of cow hide, except that a stronger combination of the tanning ingredients is required, and greater length of time, about six months, is necessary to perform the work. When the hide is taken out of the vat it is 1½ in. thick. Articles made of elephant hides are expensive luxuries. A small pocket-book of elephant's leather, without any silver or gold ornamentation, costs about 8*l*. A small satchel made of the same leather costs from 60*l*. to 80*l*. Cigar cases, card cases, and similar articles vary from 5*l*. to 20*l*. Floor rugs are also made out of the leather. In finishing the hide no attempt is made to glaze or polish it. Everything is done to preserve its natural colour and appearance. It is a very enduring leather, several years' wear having but little effect on it.

PATENTS.

Improvements in or relating to the Waterproofing of Leather or Pulp Boards and the like. C. L. Lawrence, Leicester. Eng. Pat. 19,216, November 26, 1890. 6*d*.

The leather or pulp boards, either in the sheet or cut out into blanks or soles, are waterproofed by putting them through a solution of paraffin wax in "benzoline," and then immediately passing them over hot plates or through hot air or over steam cylinders.—B. H.

A New or Improved Process for Utilising Leather Waste and Preparing therewith a Material for Carriage Floors, Walls, Roofs, and the like. W. Barton, Rixdorf, Germany. Eng. Pat. 2808, February 16, 1891. 4*d*.

The waste leather is first dried, by placing it in a steam-jacketed boiler and heating it, with constant stirring, for three hours. It is then passed between hot rollers. To reduce the waste to a still finer powder, it is again heated and dried, and then ground under stones, preferably granite.

The leather powder is then mixed with hard-boiled linseed oil, then with burnt and sieved lime, next with colouring matter, and finally with a mixture of colophony and petroleum. The resulting mixture is subsequently pressed between iron rollers upon jute, linen, or other suitable material.—B. H.

XV.—MANURES, Etc.

Removal of Vapours containing Fluorine in Manure Works. Chem. Ind. **13**, 493.

A Government commission in Copenhagen has been investigating this question at a manure works in that city, and has adopted the following method, said to be effective, in preventing the nuisance arising from the bad-smelling and injurious vapours, containing hydrofluoric and hydrofluosilicic acids, which are produced invariably in superphosphate works where raw material containing fluorine compounds is acted on by sulphuric acid.

The bad-smelling vapours are drawn out of the mixing machine and mixing chamber by a fan, care being taken to avoid undue admixture with air. The gases are then mixed with steam from a jet and are led into a good-sized chamber where they are brought in contact with water-spray thrown from two or three Korting sprays or Grinnel's fire extinguishers. The fluorine compounds are dissolved by the water, and, together with the finely-divided silica, are deposited in the chamber. If the chamber is large enough the working is very effective. To remove the last traces of fluorine, the vapours are finally driven through a large filter made of pieces of quartz about the size of hazel nuts, so as to form a layer or bed about 1 metre thick, which is kept constantly moistened with cold water.

The slightly acid wash-waters are run directly into the sewers, but they can be run off without doing any harm in an open drain, or if need be, they can be neutralised with lime before running off. (See also this Journal, 1891, 338—340.)—H. S. P.

XVI.—SUGAR, STARCH, GUM, Etc.

Some Derivatives of Levulose-Carboxylic Acid. G. Düll. Ber. **24**, 348—351.

Action of Ammonia.—If a strong solution of levulose-carboxylic acid be saturated with ammonia, and allowed to stand a short time, prismatic crystals of the ammonium salt are deposited. Acids forming lactones when treated thus sometimes yield amides. Dextrose-carboxylic acid behaves like the levulose derivative.

Oxidation.—Levulose-carboxylic acid is oxidised with dilute nitric acid at 40° C. The solution is evaporated to a syrup and extracted with ether until all the nitric and oxalic acids have been removed. The residue is neutralised with potash and calcium chloride added until the precipitate which first forms is re-dissolved. On standing a difficultly soluble calcium salt is deposited as a crust. The purified salt has a composition corresponding to the formula $(C_7H_7O_{10})_2Ca_3.6\,H_2O$. The free acid is obtained by decomposing the calcium salt with its equivalent of sulphuric acid and extracting with alcohol. The alcoholic solution is evaporated to a syrup, and from this large colourless crystals separate, which may be dried over sulphuric acid. Their composition corresponds with the formula $C_7H_{10}O_{10}$. It requires three equivalents of potash to neutralise it. This body is therefore a tribasic acid having the constitution—

$$COOH.(CH.OH)_3C(OH)(COOH)_2$$

and may be called tetrahydroxy-n-butenyl-tricarboxylic acid. It melts at 146°—147°, and appears to form a lactone.

The acid forms well-crystallising salts. The potash salt is very characteristic, forming large prismatic crystals $2\,(C_7H_7O_{10}K_3).3\,H_2O$. The acid yields a phenylhydrazide occurring in tufts of fine long yellow crystals; it is insoluble in cold water, alcohol, and acetic acid, it dissolves in cold concentrated sulphuric acid with a violet colouration. It contains two phenylhydrazine groups in the molecule.

—A. L. S.

Reduction of Saccharic Acid. E. Fischer and O. Piloty. Ber. **24**, 521—528.

The authors have already (this Journal, 1890, 638), shown that saccharic acid on reduction yields an acid closely resembling glucuronic acid. They now prove that these bodies are identical.

Synthesis of Glucuronic Acid.—Saccharic acid is reduced by sodium amalgam, the solution being cooled in ice and kept always acid with sulphuric acid. The reduced solution is neutralised, concentrated, and poured into hot alcohol. The acid contained in the alcoholic liquid is purified by first preparing its barium salt and then its lead salt; the purified concentrated solution of the acid deposits, crystals of the lactone of glucuronic acid, which is identical with the lactone prepared from other sources, melting point 175·8° $[\alpha]_D$ = + 19·1 in a 4 per cent. solution.

d-Gulonic Acid.—By the further reduction of glucuronic acid, or preferably by the reduction of saccharic acid, an acid is obtained which the authors have called gulonic acid. When the reduction has proceeded until the solution has lost the power of reducing Fehling's solution, all the glucuronic acid has been reduced. The reduced solution is acidified and poured into hot alcohol, the alcoholic solution is concentrated, neutralised with baryta, and evaporated to a syrup; the syrup is dissolved in a little water, and the unaltered barium saccharate crystallises out, the barium is removed from the mother-liquor by sulphuric acid, and the syrup which remains deposits crystals of the lactone of gulonic acid. The purified lactone melts at 180°, and has $[\alpha]_D$ = + 55·1. It forms a phenylhydrazide, melting point 147°—149°, which is soluble in hot water and alcohol.

d-Gulose is produced by the reduction of gulonic acid by sodium amalgam. It forms a colourless syrup, easily soluble in water and difficultly soluble in absolute alcohol. It is with difficulty, if at all, fermentable by beer yeast. When oxidised both *d*-gulose and *d*-gulonic acid yield saccharic acid; *d*-gulose yields an osazone totally different from *d*-glucosazone. The following formulæ show the relation of these new products to glucose, gluconic, and saccharic acids:—

$CH_2(OH).CH(OH).CH(OH).CH(OH).CH(OH).COH$

Glucose.

$CH_2(OH).CH(OH).CH(OH).CH(OH).CH(OH).COOH$

Gluconic acid.

$COOH.CH(OH).CH(OH).CH(OH).CH(OH).COOH$

Saccharic acid.

$COOH.CH(OH).CH(OH).CH(OH).CH(OH).COH$

Glucuronic acid.

$COOH.CH(OH).CH(OH).CH(OH).CH(OH).CH_2OH$

Gulonic acid.

$COH.CH(OH).CH(OH).CH(OH)CH(OH).CH_2OH$

Gulose.

—A. L. S.

On Xylose. E. Fischer and R. Stahel. Ber. **24**, 528—529.

The authors have recently shown that a carboxylic acid may be prepared from xylose in the usual way (this Journal, 1890, 1053; also 1891, 473). This acid now proves to be the optical opposite of *d*-gulonic acid (see previous abstract), and may be therefore called *l*-gulonic acid. The composition of its lactone is expressed by the formula $C_6H_{10}O_6$, melting point 185°. Its solution is levo-rotatory, having $[\alpha]_D$ = − 55·3. It forms beautifully large crystals of the lactone, which have been measured. It is easily soluble in hot water, but only with difficulty in cold water and alcohol. It has a sweet taste and neutral reaction; on standing its solutions become acid, owing to the hydration of the lactone. It forms a phenylhydrazide, melting point 147°—149°, and which is much more soluble in water than the corresponding compounds of gluconic and mannonic acid.

l-gulose is obtained by reducing the above lactone by sodium amalgam, the solution being kept acid by sulphuric acid. The reduced solution is neutralised and concentrated and poured into hot absolute alcohol; the alcoholic solution is distilled and the sugar obtained as a colourless syrup. It has a sweet taste, is unfermentable, and slightly dextro-rotatory. It yields a hydrazone forming white needles, melting point 143°, easily soluble in warm water, but only moderately so in cold water and absolute alcohol. The sugar also yields an osazone, forming a yellow crystalline mass, melting point 156°. It is appreciably soluble in hot water, and thus differs from the osazones of all the natural hexoses, and resembles those of arabinose and xylose, and very closely *β*-acrosazone; and it is possible that this may be the inactive form of it.

i-gulonic acid lactone is obtained by mixing solutions of equal quantities of *d*- and *l*-gulonic acids. On concentration the inactive lactone separates out in well formed crystals.

Oxidation of l-gulonic acid.—When oxidised by nitric acid *l*-gulonic acid yields *l*-saccharic acid.

Reduction of l-gulose.—It is preferable to start with the lactone of *l*-gulonic acid and reduce this as far as possible by sodium amalgam; during the latter part of the reduction the solution is allowed to become just alkaline. When the reduction is complete the solution no longer reduces Fehling's solution. As dextrose and ordinary saccharic acid when reduced yield sorbitol, *l*-gulose would probably yield *l*-sorbitol. The product of the reduction closely resembles sorbitol and is purified by means of the benzaldehyde compound; this compound also resembles the corresponding one of sorbitol. The alcohol obtained appears to be *l*-sorbitol, as it differs in no way from natural sorbitol except that a solution of it containing borax is levo-rotatory whilst a similar solution of the natural product is dextro-rotatory.

Constitution of gulonic acid.—As *d* gluconic and *d* gulonic acids yields the same saccharic acid, and the same holds good for the two *l*-acids, the constitution of gulonic and gluconic acids can only differ as the two following formulæ:—

$COOH.CH(OH).CH(OH).CH(OH).CH(OH)\ CH_2(OH)$

$CH_2(OH).CH(OH).CH(OH).CH(OH).CH(OH).COOH$

Constitution of xylose.—The ease with which xylose yields furfural renders it probable that this sugar contains a normal carbon chain. The above results render this certain, and show that it belongs, like arabinose, to the *l*-mannitol or *l*-sorbitol group. It appeared possible that xylose might be related to arabinose like gluconic and gulonic acids are to one another; in this case both sugars should yield the same alcohol on reduction; this, however, is not the case. Xylose is reduced by sodium amalgam, and the reduced alcohol purified by means of the benzaldehyde compound, the purified alcohol, xylitol, is quite different from arabitol. It could not be obtained crystallised.—A. L. S.

On d- and i-Manno-saccharic Acid. E. Fischer. Ber. **24**, 539—546.

Kiliani (Ber. **20**, 341) obtained by the oxidation of arabinose-carboxylic acid, an acid forming a well crystallising double lactone, and which he called meta-saccharic acid. As arabinose-carboxylic acid has been shown to be *l*-mannonic acid, it is preferable to call meta-saccharic acid, *l*-manno-saccharic acid. Fischer has prepared the corresponding *d*- and *i*- varieties of this acid as follows:—

d-Manno-saccharic acid is prepared by oxidising *d*-mannonic acid by nitric acid. The calcium salt of the new acid is prepared, this crystallises out and from this the calcium is removed by oxalic acid, and the double lactone of *d*-manno-saccharic acid crystallises from the solution. It forms colourless long needles, having the formula $C_6H_8O_6$, melting point 180°—190°.

It reduces Fehling's solution, is easily soluble in hot water, but not very in cold, in which it differs from the *l*- acid of Kiliani which is fairly soluble in cold water. It is dextro-rotatory, having $[\alpha]_D$ = + 201·8; the author has examined

the *l*-acid and finds it just as strongly rotatory, but in the opposite direction. The two acids combine to form an optically inactive acid. The *d*-acid is most conveniently prepared from mannose. Shaken with ammonia, the double lactone of *d*-mannosaccharic acid yields a diamide, of which the formula is $C_6H_8N_2O_4$. It forms colourless crystals, melting point 189°. With phenylhydrazine this acid forms a monophenylhydrazide, forming colourless microscope needles, easily soluble in hot water, but with difficulty in cold, melting point 190°—191°; and a diphenylhydrazide crystallising in glistening plates, melting point 242°.

i-Mannosaccharic acid may be prepared by mixing the two active acids or by the oxidation of *i*-mannonic acid. It crystallises in fine long prisms, melting point 190°, easily soluble in warm water but with difficulty in alcohol. Its compounds closely resemble those of the *d*-acid described above. The diamide forms tabular crystals, meting point 183°—185°. The monohydrazide is fairly easily soluble in hot water, melting point 190°—195°; the dihydrazide forms fine colourless plates, melting point 220°—225°.

Of the 10 theoretically-possible acids of the hexoses containing a normal carbon chain, there are already six known, namely, two active saccharic acids, two active mannosaccharic acids, mucic acid, and Tiemann's tri-saccharic acid. The author has obtained a seventh by heating galactonic acid with quinoline to 145°, when it becomes changed into an isomeric body and oxidising this. The acid will be described in a future communication.—A. L. S.

The Quantitative Estimation of Penta-glucoses in Plants. G. de Chalmot and B. Tollens. Ber. **24**, 694—695.

See under XXIII., *page* 577.

On the Adulteration of Gum Arabic. A. Jacksch. Chem. Zeit. **15**, 77.

The disturbances in the Soudan and other countries of Inner Africa are well known to be the only cause that good gum is at present rate and expensive (compare this Journal, 1890, 905). The consequence is that other substances are introduced from Australia, South America, and other countries as a substitute. None of them, however, are as good as the genuine gum arabic. Besides these, other substances have been sold which are insoluble by ordinary means, and the quality of which is very bad. Lately such inferior materials have been brought into the market mixed with gum Ghezira and sold as "gum in granulis," and many times have been deceived in consequence. It is impossible to recognise this by simply dissolving the substance, as the gelatinous parts are suspended in the solution and remain invisible, but the adulteration can easily be detected by the following test.—Some of the substance is mixed with 10 times its quantity of hot water, and allowed to stand for three or four hours. During this time it must be stirred at intervals. After the insoluble parts have settled down one half of the liquid is poured off, the same quantity of cold water added, the whole again stirred, and then allowed to stand. In the course of the next hour this must be repeated twice. The last of these mixtures after a short time separates into two parts, the upper one of which consists of water, and the lower of a gelatin like substance. As little as 5 per cent. of the adulteration can be detected in this way with accuracy.—H. S.

Pine Tree Honey Dew and Pine Tree Honey. H. W. Wiley. Amer. Chem. J. 1891, 24—29.

Honey at one time was supposed to be practically nothing else but invert sugar, with a doubtful trace of cane sugar. In order to detect the adulteration with starch syrup, it was considered sufficient to examine a sample with the polariscope, to take its copper-reducing power, and to calculate from these data the percentage of both dextrose and levulose. If the first predominated, this was considered sufficient evidence of adulteration with starch syrup, supposing pure invert sugar to contain equal quantities of both.

When analysts began to pay more attention to the matter, it soon appeared this was all *theory*; in fact many a 10 per cent. solution of undoubtedly genuine honey was found not to show any polarisation at all, proving a natural slight excess of dextrose. At one time analysts also thought that, if more than 2 per cent. of cane sugar was found in a sample of honey, this might be taken as an absolute proof of adulteration with cane sugar; but although this is true in a sense, it has now been ascertained beyond reasonable doubt, by the investigation of Bensemann, that the bees themselves may be the real culprits, because when in the neighbourhood of sugar refineries, they swarm there in their thousands to regale themselves on the sugar. The honey they produce often contains as much as 16 per cent. of cane sugar, which Bensemann thinks is caused by their lack of sufficient acidity (formic acid?) to properly invert the sugar. The analysis of honey grows in fact more and more complicated every year. Another constituent has now made its appearance. Authur and Stern have proved that undoubtedly genuine honey may contain a fair percentage of dextrin, if the bees get a chance to feed on malt in breweries. The presence of this body cannot be proved by the simple alcohol test, as it has been proved by the investigation of Van der Marck that this test altogether fails, unless the amount of dextrin in vegetable products is considerably over 10 per cent. Authur and Stern allowed the honey to ferment, and tested for dextrin in the resulting fluid, by a very complicated but reliable process, which was originally published in the Zeits. f. angew. Chem. 1889, 575. The present author examined the original honey-dew of the pine tree, and found it to contain 45·59 per cent. of solid matter, including 17·44 per cent. of glucose. Examined in a Ventzke's polariscope, it showed an angular deviation of 36° 56′ sugar-scale. Supposing the glucose to have consisted of pure invert sugar, its levogyrate influence would be equal to 4° 97′ of the cane sugar scale. Adding this number to the direct polarisation, will give the figure 41·53. Deducting from this the right-handed polarisation due to sucrose, viz., 8·16, we get 33·7 right-handed rotation, due to foreign bodies in the dew. Deducting this from the total solids present, viz., 45·59, this leaves us 19·99 per cent. of solid matter, of right-handed polarisation.

The author fully expected to confirm the researches of other investigators, who had found the honey produced by the bees from such dew to be also strongly right-handed, but the sample which he investigated actually showed a left-handed rotation of not less than 13° sugar scale; showing the bees had thoroughly inverted the substance.

The author will not of course draw too many conclusions from the analysis of a single sample. He hopes to further investigate the matter. Up to the present time he has, however, not come across a genuine sample of American honey which showed a right-handed polarisation, and he therefore still looks upon such samples with the greatest suspicion.—L. de K.

PATENTS.

Improvements in Washing and Cleaning Raw Sugar. C. F. Redfern, London. From M. Weinrich, St. Louis, Missouri, U.S.A. Eng. Pat. 5282, April 5, 1890. 6*d*.

The raw sugar to be purified is mixed with clear syrup, and with 8—30 per cent. of some light material, such as cork, corn cobs, wood, bagasse, wood or bone char, &c., in pieces of about $\frac{1}{8}$ to $\frac{1}{4}$ of an inch in diameter, and as regular as possible. The mixture is run into a series of cylindrical vessels, resembling and connected like the cells of a diffusion battery, and is washed by means of a current of pure syrup drawn from a tank placed 40—80 ft. above the level of the apparatus. In order to prevent the separation of the sugar from the cork or other material during washing, the mass in each cylinder is covered by a perforated iron disc, moving up and down on guides. The process is worked continuously,

the clear liquor tank being always connected to that cell of the battery in which the washing of the sugar is most advanced. The washed sugar is finally separated from the admixture of inert material by sifting, or solution in water.
—H. T. P.

Improvements in the Manufacture of Sugar. G. F. Redfern, London. From M. Weinrich, St. Louis, U.S.A. Eng. Pat. 5283, April 5, 1890. 6*d*.

The invention relates to the filtration of sugar solutions, and to facilitate the operation the saccharine liquor is treated with any one of the following materials or with mixtures of them:—(1.) With bagasse, comminuted to a fine meal or flour. (2.) With the crude cobs of maize, comminuted to a fine meal or flour. (3.) With the charred cobs of maize, comminuted into small pieces like bone charcoal or ground to meal or flour. (4.) With ground oak bark or with any other bark containing tannin or with ground cork. (5.) With sugar cane, sorghum cane, or sugar beet comminuted to slips or slices and then dried. After treatment the solutions may be filtered by any of the usual processes.—A. J. K.

Production of a New Glutinous Material similar to Gum Arabic and other By-Products from the Seed Kernels of the Fruit of the Carob Tree (Ceratonia). A. Niemoller, Gutersloh, Germany. Eng. Pat. 7737, May 17, 1890. 8*d*.

The fruit of the carob tree, known as "St. John's bread," has long been cultivated as human and cattle food. The kernel consists of a red-brown and slightly lustrous shell, which encloses two hard yellowish slightly transparent discs, between which lies the germ, together with a mealy disc or layer. The two yellow transparent discs contain the glutinous body, which is very nearly equal to gum arabic in quality. The discs are ground to powder, and the glutinous substances extracted by digesting with hot water and evaporating to any desired concentration. The shell produces a colouring matter, and the mealy portion is ground up into a food-stuff.—A. J. K.

An Improved Process for Treating Vegetable Cellular Membranes with the object of obtaining Glutinous Substances. E. Steiger, E. Schulze, and C. Auer. Zürich, Switzerland. Eng. Pat. 8029, May 22, 1890. 6*d*.

Carbohydrates occur in the most diverse cellular membranes of vegetable origin and can be converted into glutinous substances bearing a great resemblance to gum arabic. The substances principally used are the waste of field-crops of any kind, lixiviated beetroot slices, residuary liquors from the distillation of spirits, &c. The bodies are boiled with a suitable acid of one-twentieth to one-tenth per cent., or with milk of lime, with or without pressure, or with any other alkaline earth or an alkali. The liquor is now expressed, decolourised, filtered through bone-black, and evaporated to the desired consistency. If the glutinous substances be required in a very pure state, the protein substances which occur with the cellular membrane must be previously removed in the cold state by treatment with culinary salt or alkalis.—A. J. K.

XVII.—BREWING, WINES, SPIRITS, Etc.

Addition of Sugar and Water to Acid Wine. C. Amthor, Chem. Zeit. **15**, 222—223.

A reasonable addition of sugar and water to new acid wines cannot be considered an adulteration, as it produces no injurious effects whatever, and may be a great improvement to the quality of the wines. But as an unlimited permission of adding sugar and water to wine would exert by no means a good influence upon the trade, a congress recently held at Wiesbaden (Germany) adopted the resolution that the addition of sugar and water shall be allowed only before the new wine is drawn off for the first time. As regards the maximum quantity of sugar and water to be added, nothing has as yet been settled. Fresenius, on the above-mentioned congress, was of opinion that the proportion of 60 parts of water to 100 parts of wine should be the utmost, and the author (who founds his view on practical experience) is for a further restriction, viz., that the proportion of one part of water to two parts of wine should be the maximum, and that certain limits for the quantities of extracts, acids, and perhaps also of mineral substances in wines should be legally fixed, in order to prevent all unfair dilutions and manipulations which would prove a great drawback to the beneficial effect of adding a reasonable amount of sugar and water to new acid wine.
—H. S.

PATENTS.

Improved Appliance for Aërating Brewers' Yeast and Mixing the same with Wort and other Ingredients. F. M. Maynard, Southampton West. Eng. Pat. 6075, April 22, 1890. 8*d*.

The apparatus consists of a conical or cylindrical upright vessel, inside of which is placed a second cylinder, open at both ends. The outer vessel is fitted with a steam and water-jacket. The top of the inner cylinder carries a perforated tray, whilst an agitator, shaped like a screw-propeller, is placed near its lower end. The central spindle of the agitator passes through the tray and may be turned by hand or otherwise. When the vessel is filled with wort and yeast, the agitator being rotated forces the liquid up between the outer and inner cylinders, causing it to overflow into the tray placed over the inner cylinder. The wort, passing through the holes in the tray, descends in a shower of drops, and thus becomes perfectly aërated. A tap near the bottom of the outer vessel serves for the withdrawal of the liquid after aëration.—H. T. P.

Improvements in or relating to the Preparation of Yeast and Malt, and the Fermentation of Amylaceous Matter. A. J. Boult, London. From the "Société Generale de Maltose," Brussels, Belgium. Eng. Pat. 7098, May 7, 1890. 6*d*.

The improvement in question consists in the employment of hydrofluoric acid or its salts. In order to manufacture yeast, malted grain is mashed in the usual way for three-quarters to one hour. The wort is cooled to 18°—22° C., and from 6 to 10 grms. of hydrofluoric acid, or an equivalent weight of a suitable fluoride, are added to every 100 litres of it. Yeast is then added and fermentation carried on in the ordinary way. The advantages claimed are: (1.) The usual preliminary acidification of the wort may be dispensed with and the whole process finished in 8–12 hours. (2.) The yeast forms in a uniform and reliable manner and contains much unexhausted diastase which, owing to its saccharifying action on dextrin and starch, renders this yeast peculiarly suitable for distilleries. Hydrofluoric acid may be employed in malting as follows:—8—12 grms. of the acid, or an equivalent amount of a fluoride, are added to every 100 litres of the steep liquor, germination and other operations being performed in the ordinary way. The malt obtained contains much less acid than ordinary malt, and is free from injurious ferments. As regards beer brewing, 5 grms. of hydrofluoric acid may be added to every 100 litres of wort, preferably, just before pitching.
—H. T. P.

Improvements in Machinery or Apparatus for Drying Distillers' or Brewers' Draff or Grey, but which is also applicable for Drying other similar Materials. J. Mitchell, Edinburgh. Eng. Pat. 7728, May 17, 1890. 8*d*.

This is a slightly simpler arrangement than that described on the next page (Eng. Pat. 5004 of 1891).—A. L. S.

A Process for Preparing Raw Grain or other Amylaceous Substances for Mashing in Brewing or Distilling Operations. H. T. Brown and G. H. Morris, Burton-on-Trent, and F. R. Moritz, London. Eng. Pat. 7880, May 20, 1890. 4*d*.

The raw grain or other starchy material, previously ground or finely pulped, is mixed with water, and with 10—15 per cent. of its weight of green or air-dried malt. Instead of using the green or air dried malt itself, an infusion of green or air-dried malt may be employed. The materials are well mixed in a vessel provided with an agitator, and jacketed for altering the temperature of its contents, which should not exceed 120° F. After some time the walls of the starch cells become dissolved leaving the starch amenable to diastatic action; and rendering the material fit for use in conjunction with malt for the production of wort by mashing in the usual way.—H. T. P.

Improvements in the Manufacture of Whisky and other Spirits. T. J. Taylor, London. Eng. Pat. 8850, June 7, 1890. 6*d*.

The distilled spirit as it comes from the still is collected in a vessel having an opening at the bottom, through which the spirit passes at such a rate that the vessel remains full of spirit. This vessel then retains the lighter part of the distillate, which is also the most impure.—A. L. S.

Reek Dissipator for Improving Malt Kilns. H. W. Joyce, Great Yarmouth. Eng. Pat. 9233, June 14, 1890. 6*d*.

This invention relates to an attachment to a malt kiln consisting of a pear-shaped air heating chamber which is suspended above the fire in the furnace of the kiln. The chamber is supplied with cold air by a pipe passing through the wall of the kiln. The hot air ascends from the heating chamber through a vertical pipe which passes through the heat-disperser and malt floor and projects about 2 ft. above the latter. The end of this pipe is widened out considerably, forming a funnel-shaped orifice. In the enlarged end of the pipe is suspended a conical plug, similar to it in shape, but smaller in diameter, so that a space of, say 1 in., is left all round between the two. By this means the hot air is spread all over the floor of the kiln, and quickly disperses the "reek" or steam that arises from the malt.—H. T. P.

Improvements in the Process of and Apparatus for Purifying Alcoholic Liquids. D. A. Boullanger, Canterbury, France, and A. Schennert, Dresden, Germany. Eng. Pat. 9040, June 26, 1890. 8*d*.

Peroxide hydrogen is passed through the alcoholic liquids; this converts the fusel oils into resinous and insoluble matters. Air or oxygen is then passed through to free the liquid from the bad odour, and the liquid is then filtered and distilled if required.—A. L. S.

Apparatus for Distilling and Rectifying. A. C. Burkhardt, Stuttgart, and C. Schuhe, Hohenheim, Germany. Eng. Pat. 1214, January 23, 1891. 6*d*.

See under I., *page 529.*

Improvements in and relating to the Manufacture of Alcohol and in Apparatus therefor. H. H. Lake, London. From Guignard and A. Hedouin, Paris, France. Eng. Pat. 2294, February 7, 1891. 8*d*.

The juice which is to be fermented is first sterilised by heating to 125° C.; it is then cooled to 20° C. by passing it through a pipe immersed in cold water; from this it passes through a closed filter, previously sterilised by steam, and the filtered juice is passed in a fine spray through another sterilised vessel which is supplied with sterilised air. The aerated juice then passes to a closed fermenting vessel where it is fermented with a pure culture of a selected yeast. When the juice is fermented it is separated from the yeast by a sterilised filter. The yeast is then collected in a pure form and may be used for other fermentations.

The fermented liquor is neutralised and distilled, an alcohol is thus obtained free from acid; the alcohol is redistilled from an acid solution and the result is said to be a very pure product.—A. L. S.

A Method of Improving Wine and other Alcoholic Liquors. H. J. Haddan, London. From J. Batallé, Barcelona, Spain. Eng. Pat. 2936, February 18, 1891. 4*d*.

The process consists in exposing the wine or other liquid to sunlight, the liquid being contained in bottles or, preferably, in shallow glass vessels only partially filled with it. The precipitate, which is continuously formed under these conditions, is filtered off at intervals more or less frequent according to the result required. In absence of sunlight, electric or other light, or even heat may be employed. By the above process, a degree of ageing is produced in 3—9 months, which under ordinary conditions could only be attained in 10—100 years.—H. T. P.

Improvements in Machinery or Apparatus for Drying Distillers' or Brewers' Draff or Dreg, but which is also applicable for Drying other similar Materials. J. Mitchell, Edinburgh. Eng. Pat. 5001, March 20, 1891. 8*d*.

One or more series of horizontal troughs are arranged in a suitable air chamber. The troughs are heated by steam-jackets, and a current of air is kept through them by means of a fan. Through each trough a shaft passes, carrying a number of blades. The wet material enters on to one end of the first of a series of troughs, and is fed along and tossed up by the revolving blades to the other end of the first trough, where, by a peculiar arrangement of the blades, it is thrown into the end of the adjacent trough of the same series, and it is then passed in a zig-zag direction through each of the troughs of the series, until it is dropped from the end of the last trough into a similar series of troughs below, where it is passed through the said series in a similar manner, and so on until it is dried.—A. L. S.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

(*A.*)—CHEMISTRY OF FOOD.

PATENTS.

Improved Means and Appliances for Preserving Flesh Food. W. S. Simpson, London. Eng. Pat. 6102, April 22, 1890. 6*d*.

The inventor proposes to preserve meat, in a raw or partly raw condition, in tins or cans of especial construction, there being an inner and an outer tin, with a space between, serving as an insulator for the protection of the contents of the inner can from the effects of atmospheric variations.

—E. G. C.

An Improved Process of Preserving Milk and Cream. W. J. Clarke, London. Eng. Pat. 6883, May 3, 1890. 4*d*.

The milk or cream is "scalded" in a water-bath, until it acquires a temperature of about 160° F., care being taken to slowly agitate it during the operation. The scalded milk or cream is then at once transferred to vessels which

have been first heated to 160°, and these "are to be completely filled and tightly stoppered, so as to exclude the air. The milk or cream having been allowed to cool in these vessels for about 24 hours, the scalding operation is to be repeated at the same temperature and in the same way as before," and the milk or cream is then sealed up in glass or earthenware vessels.—E. G. C.

(C.)—DISINFECTANTS.

Antiseptic Treatment of Building Materials. Résumé by E. Dollfus of a communication from V. Bovet. Bull. Soc. Ind. Mulhouse, 1890, 546—549.

The author points out the necessity, on hygienic grounds, for the use, in building and decorating dwelling-houses, of thoroughly aseptic materials, and for public buildings, such as hospitals and barracks, of materials rendered, by impregnation or admixture with suitable substances, as antiseptic as possible. The antiseptic substances which may be used for this purpose are limited to such as are inoffensive to health. For this reason the employment of corrosive sublimate, sometimes recommended by medical men, is inadmissible. The new antiseptic compounds, zinc salicylate and hydroxynaphthoic acid, are recommended by the author as possessing special advantages. A one per cent. solution of the first salt not merely prevents the putrefaction of fresh meat, but effectually arrests decomposition when it has already commenced. The salt, moreover, is not dangerous to health. Injections of it administered subcutaneously to rabbits did not make the animals ill. Its action on those who dip their hands into solutions of it is confined to a partial destruction of the skin. It may be advantageously used for impregnating wall-papers, hangings, &c. For use in mixing plaster, a five per cent. solution is recommended; woodwork should be well moistened several times with a four per cent. solution. Plaster to which zinc salicylate has been added sets well, but takes a pink colouration, which, however, disappears under the influence of light.

Hydroxynaphthoic acid, on account of its feeble solubility, must be mixed in the powdered state with the plaster before adding water. It communicates to the plaster a brown colour, which is destroyed by exposure to light. The salts of this acid have no antiseptic power. It has not been determined whether the acid is completely innocuous.

According to Bovet, the additional expense of the antiseptic treatment of building materials does not amount to more than 2 per cent. of the total cost of construction.

Dollfus, being unable to test the antiseptic properties of the new compounds in the direction indicated, has tried one of them, namely, zinc salicylate, with respect to its suitability for use in calico printing and finishing. He reports that it is quite unfitted for use in the latter process, on account of the decided pink colour it imparts to the pastes, and is, moreover, less efficient than sodium bisulphite as a preservative of starch paste and glue size. Further, it is unadapted for preserving solutions of blood albumen and casein, since it partially coagulates these bodies.

Dollfus adds that, with an addition of 1 per. cent. of a solution of sodium bisulphite at 17° B. to glue solutions and starch pastes, he has succeeded in keeping the same in good condition for upwards of a month, whereas without such an addition they decompose in the course of a few days.

—E. B.

PATENT.

Improvements in the Preparation of Disinfectants for more Convenient Transmission, Carriage, Storage, and General Application. G. Walker, London. Eng. Pat. 8937, June 10, 1890. 4*d*.

Potassium permanganate, alone or combined with other material, is compressed "into small consolidated blocks, to be hermetically sealed and ready for use at any time."

—D. A. L.

XIX.—PAPER, PASTEBOARD, Etc.

On the Composition of Woody Matter and the Influence of Alkalis and Calcium Bisulphite on Wood. A. Ihl. Chem. Zeit. **15**, 201—202.

Wood consists of about equal parts of cellulose and lignin. What lignin is cannot at present be decided with certainty. Singer has found in woody matter vanillin, coniferin, wood gum, and another body soluble in water which shows a yellow colouration by hydrochloric acid. The tests with aniline sulphate and with phloroglucinol are well known, and according to the author an alcoholic pyrrhol solution is the most sensitive reagent for woody matter (compare Chem. Zeit. **14**, 304 and 438, and this Journal, 1890, 555 and 770). The author has shown that delicate colour reactions exist between phenols and wood in the presence of acids. Alcoholic solutions of orcinol and resorcinol especially, show such reactions on wood in presence of hydrochloric acid. As all these reactions differ from those on vanillin and on coniferin, there must be still other substances contained in woody matter. Now, the author has found that some ethereal oils, such as clove oil, pimento oil, and more especially cinnamon oil, show the same colour reactions as lignin (compare Chem. Zeit. **13**, 264, 560, and 831; this Journal, 1889, 421 and 640). Cinnamon oil consists of a carbohydrate and cinnamic aldehyde, and the latter shows almost the same colour reactions as lignin with the following substances:—Pyrrol, aniline sulphate, phloroglucinol, orcinol, resorcinol, and other phenols, sulphuric acid, urea, lepidine, and antipyrine, and therefore it is very probable that cinnamic aldehyde is contained in woody matter; and this assumption is supported by the fact that the urine of plant-eating animals contains more hippuric acid than that of the carnivora, and it is proved that hippuric acid is secreted when cinnamic acid has been taken as a medicine (compare Beilstein, p. 899). The author therefore draws the conclusion that physiologically cinnamic aldehyde is first converted by oxidation into cinnamic acid and then into hippuric acid. It is not impossible that besides cinnamic aldehyde other derivatives of allylbenzene, such as eugenol, safrol, and anethol, which show similar colour reactions as lignin, are contained in small quantities in woody matter. All these organic compounds are derivates of the same carbohydrate, viz., allylbenzene, and have the following formulæ:—

Allylbenzene	$C_6H_5.CH:CH.CH_3$
Cinnamic aldehyde..	$C_6H_5.CH:CH.COH$
Eugenol	$C_6H_3(OH)(OCH_3)(C_3H_5)$
Safrol	$C_6H_3(O_2CH_2)(C_3H_5)$
Anethol	$C_6H_4(OCH_3)(C_3H_5)$
Coniferyl alcohol ...	$C_6H_3(OH)(OCH_3)(C_3H_4.OH)$
Vanillin	$C_6H_3(OH)(OCH_3)(CHO)$

It is not likely for cinnamic aldehyde to be present in lignin in a free state, as it cannot be extracted from wood by the usual solvents. But the author ascertained by experiments that also cinnamon itself does not contain free cinnamic aldehyde, and he is of opinion that cinnamon oil, as well as clove, pimento, and sassafras oil, are formed only if the several plants are distilled with water containing salt. In cinnamon the cinnamic aldehyde probably forms a compound with a carbohydrate, which compound may perhaps contain still other components, clove oil consists of eugenol and a sesquiterpene, $C_{15}H_{24}$, &c. Probably the aromatic substances of lignin, viz. cinnamic aldehyde, eugenol, vanillin,

&c., form similar compounds with terpenes, resins, camphor, and gum, and perhaps also with cellulose. These compounds are decomposed by boiling with alkalis or acids, especially if great pressure is employed. A partial decomposition already takes place if wood is boiled in water. The author places lignin, because of its composition, amongst the class of the so-called "gum-resins," although resinous substances are only of quite minor importance in lignin. Some balsams and resins show almost the same reactions with phloroglucinol and aniline sulphate as lignin does. But the gummy matters, on the other hand, are of very great importance in lignin, most of the incrusting substances consisting of them. They show a great similarity with arabin, and are found in the products of the sulphite process as well as of the caustic soda process. If sulphite ly which has been used for pine wood is carefully evaporated, a yellowish-brown and transparent resinous substance is obtained, which is described by the author as the calcium salt of the "arabic acids" of the wood. This substance shows similar properties and reactions as gum arabic. These "arabic acids" of the wood are soluble in hot water, and form, with metallic oxides, compounds which are easily soluble in water, but precipitated by alcohol.

Moreover, these arabic acids are comparatively strong acids, and decompose carbonates, sulphites, and sulphides, especially under pressure, a property which is of importance in the explanation of the sulphite process, as the salts of the arabic acids are the chief components of lignin. If wood is boiled under great pressure with caustic soda, the lignin is decomposed. The gummy matters, resins, and phenols are dissolved, and the volatile compounds, *e.g.*, terpene, &c., escape. Cinnamic aldehyde and vanillin polymerise, and coniferin is decomposed. It is well known that sulphurous acid has a decomposing or polymerising effect upon many groups of organic compounds. In the sulphite process it first decomposes lignin, then the free arabic acids decompose the sulphite of lime, hereby forming the calcium salt of the arabic acids, which remains in solution, whilst the free sulphurous acid escapes. The author is of opinion that the sulphite process is, in the main, hereby explained. The terpenes and aldehydes mostly polymerise and escape together with the other volatile aromatic compounds of the woody matter as well as the sulphurous acid, whilst the non-volatile substances, *e.g.*, the resins, are left, parts of which remain as the calcium salt of the resin acids. (See also "Wood Sugar and Wood Gum," this Journal, 1891, 173.)—H. S.

On the Quantitative Determination of Mechanical Wood Pulp in Paper. R. Benedikt and M. Bamberger. Chem. Zeit. **15**, 221–222.

See under XXIII., *page* 576.

Celluloid and its Manufacture. Industries, 1891, **10**, 571–572.

In France celluloid is made from a solution of camphor and nitro-cellulose in alcohol, whilst in Germany, in addition to the alcohol, ether is employed as a solvent.

The paste formed in this way is gently warmed, and then rolled out into thin sheets, and in this state loses the last portions of its volatile solvents. The product so formed is a brittle, transparent, horny mass, consisting of either an intimate mixture of camphor and pyroxyline or possibly of a chemical compound of these two bodies. H. Beckmann gives the following analyses of two samples of this material:—

	German.	English.
Nitrocellulose	64·80	73·70
Camphor	32·80	22·79
Colouring matter	2·75	3·51
Total	100·00	100·00

The former of these is met with in commerce in rods, whilst the latter occurs in blocks.

The nitro-cellulose used for this manufacture is obtained by nitrating paper, cotton wool, or wood shavings. A mixture of two parts sulphuric acid and one part fuming nitric acid at a temperature not exceeding 22° C. gives the best results. In some works a mixture of 115 parts of sulphuric acid, sp. gr. 1·84, and 93 parts of nitric acid is heated to 80° C., and cotton wool plunged into this bath for a few minutes, and then withdrawn and well washed. This product is entirely soluble in alcohol. Should the nitration be incomplete, a mixture of alcohol and ether will fail to completely dissolve the nitrated cellulose.

Unless the cellulose used has been previously bleached, it is absolutely necessary to perform this operation after nitrating. The nitro-cellulose is disintegrated, washed with carbonate of soda, then with water, and finally transferred to truncated bleaching tubs holding about 10 cubic metres (2,200 gallons). These vats are provided with perforated copper bottoms, through the centre of which pass agitators. The washed nitro-cellulose is added, with three times its volume of water containing 2 per cent. of potassium permanganate; it is left for about an hour, when a fresh quantity of water is added. Then, after standing for half an hour, a strong brine is added, together with some hydrochloric acid. This mixture is allowed to react on the pyroxylin for an hour; then the whole mass is thoroughly washed, first with water and finally with sulphuric acid, to remove all foreign matters.

The pyroxylin thus prepared, when freed from acid, is carefully dried, cut into small fragments by special machinery, mixed with camphor, and reduced in a suitable mill to a fine powder, about 10 per cent. of water being added to prevent the pyroxylin taking fire. The meal obtained is compressed by a hydraulic press into cakes, which are subsequently broken into fragments and transferred to a closed vessel, where they come in contact with from 15 to 35 per cent. of alcohol of 96 per cent. In twenty-four hours a gelatinous mass is obtained, which is then generally spread out by hollow rollers heated internally by steam to keep the temperature of the exterior surface at about 60° C.; this rolling is continued between cylinders more and more closely set together until a sheet is obtained about 12 mm. thick, having the required resistance and consistency.

In order to expel air bubbles from these sheets, heat and a hydraulic press are used, and finally the celluloid is again compressed in the cold into large blocks, which can be easily stored. When the celluloid is sent out into commerce, these blocks are split into leaves, more or less thick, by means of special planes, or by circular saws moistened with steam. After this treatment the cut leaves are placed in ventilated drying rooms, kept at about 90°. At the end of twelve hours the material is dry enough for sale. Crude celluloid is a transparent horny substance of a pale yellowish colour, with a characteristic odour of camphor; its specific gravity varies between 1·25 and 1·45. It is softened by heat, and is then capable of receiving an impression. At 90° C. it becomes very plastic; further heat softens it, and a temperature of 140° C. decomposes it into pyroxyline and camphor aldehyde. At 195° C. the decomposition is instantaneous; the nitro-cellulose inflames and the camphor is vaporised.

Celluloid is readily inflammable and burns with a crackling flame; on blowing, the flame is easily extinguished, but the mass continues to burn, liberating thick vapours of camphor. It is not affected by concussion, and does not detonate even in contact with fulminates. Sulphuric acid decomposes it rapidly on warming; hydrochloric acid has a much slower action. Nitric acid attacks it slowly in the cold, very rapidly when warmed, and soda lye acts similarly. If it is desired to imitate either marble, ivory, or tortoise-shell in celluloid, it must be coloured uniformly or with layers of different tints. In the first case the colouring matter is incorporated with the mixture of pyroxyline and camphor, for which purpose mineral colours are generally employed. In the second case, different tinted celluloids in the gelatinous state are prepared, and then united to form the desired object having a required colour, the harmonious

blending of the colours depending entirely upon the skill of the workmen.

The amount of camphor in a sample of celluloid can be estimated by F. Foerster's process, described in Ber. **23**, 2981—2989 (this Journal, 1890, 1159—1160).

On the Action of Nitrosulphuric Acid on Vegetable Fibres. J. Lifschütz. Ber. **24**, 1186—1192.

The object of the author's experiments has been the complete isolation of cellulose from vegetable fibres, and at the same time to obtain a good yield of it. He finds that the best results are obtained by treating the fibre with a mixture of nitric acid of 25 to 30 per cent. strength and sulphuric acid. The specific gravity of the acid mixture is from 1·34—1·36, and the mixture itself contains 32 per cent. of H_2SO_4, and 18—20 per cent. of HNO_3. For the experiments pine wood was used and the following process is recommended. One part of pine wood free from knots and bark was cut into cubes, the sides of which were 10—15 mm., were covered with 10—15 parts of the acid mixture, and heated for 14 to 16 hours. After this time evolution of gas had ceased. The product was taken out whilst still warm and washed, first with cold and then with warm water, and afterwards boiled with dilute solution of soda until the fibres were separated. It was then removed from the brown lye and washed with water and vigorously shaken up with water. After filtering and washing until the filtrate is quite colourless, pure cellulose is obtained which is white and silky in appearance, is perfectly neutral, shows no reaction for lignin, is strong, and easily felted. It contains 1·5—1·8 per cent. of ash and no trace of nitro-cellulose, and the yield of cellulose from this operation is from 38 to 41 per cent. The residual bright yellow acid mixture remained clear on dilution with water. It contained a considerable amount of oxalic acid and smaller quantities of other fatty acids. It reduced Fehling's solution, thus indicating cellulose sulphuric acid. The original amount of sulphuric acid was still present, but the solution was poorer in nitric acid by about the weight of the wood which had been treated in it. In order to convert the cellulose sulphuric acid as much as possible into oxalic acid, this mixture was used for 4—5 other operations, the relative proportions between nitric acid and wood being maintained. The process was conducted as before, except that at each operation the temperature was raised 5° higher than in the preceding one. In this way all the nitric acid was utilised; its action was the same in the last as in the first operation. This acid liquor on standing for 24 hours deposited a considerable amount of oxalic acid crystals. From these processes the average yield of cellulose was 38 to 40 per cent., and of oxalic acid 29 to 30 per cent. on the weight of dry wood used. The remaining acid liquor contains 1·5 to 2 per cent. of oxalic acid, and can be regenerated by the addition of nitric acid, and when necessary some sulphuric acid, and used again for the treatment of wood. The following table shows the results of treating pine wood in the above manner with regenerated acid mixture. 112 kilos. of the mixture of sp. gr. 1·32, containing 32 per cent. of sulphuric acid, 12·5 per cent. nitric acid, and 1·25 per cent. oxalic acid, was caused to react upon:—

I. 7·0 kilos. of pine wood containing 34·0 per cent. H_2O
II. 5·0 „ „ „ 30·3 „ „
III. 4·5 „ „ „ 30·0 „ „

	Kilos. Dry Wood.*	Oxalic Acid. Weight of Resulting.	Calculated on 100 Parts Wood.	Calculated on 100 Parts of missing Cellulose.†	Cellulose dried at 100° from 100 Parts of Wood.
I.	4·62	1·39	32·2	152	38·80
II.	3·48	0·87	25·0	132	40·87
III.	3·15	0·98	30·4	127	36·00

* The former figures are calculated to dry wood in the table.
† Pine wood, after deducting 12 per cent. of water, contains about 60 per cent. of cellulose.

The gases given off during the reaction contain solely N_2O_3, NO, and NO_2, with a small quantity of carbonic acid, and can therefore be easily converted into nitric acid.

—W. M.

New Material for the Manufacture of Paper. Moniteur des Produits Chimiques, May 10, 1891.

For a long time past search has been made in all civilised countries for a substitute for rags, which was formerly the only material known from which paper could be manufactured. The consumption of paper having taken formidable proportions, the store of rags has sensibly diminished in all parts of Europe. Attempts have been made to substitute for rags such substances as wood-paste, straw, alfa, &c., but these, with the exception perhaps of alfa, have failed to produce any but inferior kinds of paper.

The manufacture of alfa for this purpose has already assumed considerable proportions in Algeria, and now another grass, related to alfa, has been discovered to possess qualities which may very advantageously be employed in the manufacture of paper. This plant is *diss*, the *Ampelodesmos tenax* of botanists.

MM. Caselmann and Wetterlé, of Souk-Ahras, have placed before the prefecture of Constantine a request for a patent relating to a process, invented by them, by which paper-paste of a great delicacy, possessing the same qualities as alfa, can be produced from diss. The advantage of the new material is that, owing to the simplicity of the processes to be employed, it can be manufactured in Algeria at half the price of alfa-paste manufactured in France or in England.

The abundance of diss in the north of Africa would easily permit the production of from 50,000 to 100,000 tons per annum. Diss is found in Algeria in the Tell, the mountains, where it grows without being cultivated, whilst alfa is found on the high plateaux—that is to say, at a greater distance from the sea-ports—and in regions very much more difficult to deal with, on account of the lack of water and of means of transport. Diss occupies in Algeria an area 150 kilometres in extent, parallel to the sea. It can easily be mown with a scythe; alfa, on the other hand, requires to be picked, and the cost of this manual labour is much more considerable. Various attempts have been made in France and in England to withdraw the cellulose part of the diss, but hitherto without success, diss, once dry, becoming hard and brittle, its resino-silicious parenchyma offering a great resistance to chemical agents. The process of Caselmann and Wetterlé allows the diss to be used when it is freshly mown, by means of chemical products which only cost half of those which are used for the manipulation of wood, straw, or alfa. The amount of cellulose produced by diss is much greater than that by alfa.

PATENTS.

Improvements in the Manufacture of Waterproof Boards, Paper, and such like Materials. C. Weygang, London. Eng. Pat. 3004, February 25, 1890. 8*d*.

See under XIII., *page* 556.

Improvements in Glazing Paper and in Machinery or Apparatus therefor. J. Robertson, Pollokshaws. Eng. Pat. 4360, March 20, 1890. 6*d*.

The object of this invention is to produce a glaze or finish on that side of the paper left rough in the process of manufacture on a "Yankee" machine. It is attained by the addition of extra cotton rolls fitted outside the main glazing cylinder.—E. J. B.

Improved Processes for the Nitration and the Denitration of Cellulose and for Regaining the Acids Employed and Apparatus Employed in connection therewith. H. D. Chardonnet, Paris, France. Eng. Pat. 5376, April 8, 1890. 8*d*.

The nitration is effected in the ordinary way. The nitro-cellulose and mixture of acids are placed in a centrifugal machine, by which means about three-fourths of the acids are recovered and may be again used after being strengthened with fresh acids. Or it may be heated and the nitric acid which distils may be collected, while the residual sulphuric is further heated to free it from water.

The acids remaining in the nitro-cellulose are removed by washing. The washings are neutralised with lime, and the solution of nitrate of lime is decomposed with sulphate of soda. The nitrate of soda thus obtained is used for the preparation of nitric acid. The nitro-cellulose obtained is bleached with a solution of bleaching powder.

Denitration is effected by means of warm nitric acid, alkaline sulphides, or sulpho-carbonates.—E. J. B.

Improvements in and relating to the Treatment of Paper-making Fibre Materials. J. Johnston and Peter Culter, Aberdeen, and G. Johnston, Wells. Eng. Pat. 6644, April 30, 1890. 8*d*.

When the esparto or other fibrous material has been boiled and partially washed, the boiler is filled with cold water and a current of air is forced in under the perforated bottom. This agitates the material completely, removes residual alkali, and at the same time oxidises the fibres. Drawings showing the necessary appliances accompany the specification.—E. J. B.

Improvements in Machinery or Apparatus for Coating the Surface of Paper or other Flexible Material with Gum or other Adhesive Substances of the like kind, and for Sizing, Staining, and the like, or Varnishing such Material. W. B. Silverlock, London. Eng. Pat. 6735, May 1, 1890. 8*d*.

The sheets of paper, &c. to be treated are placed upon a continuously revolving horizontal cylinder, having openings provided with gripping strips or bands and with pins or studs, by which the sheets are carried round the cylinder, and automatically removed after being gummed, &c. Below the cylinder a moveable vessel containing gum or other adhesive liquid is attached in such a way as to be easily removed and substituted by others when required. This vessel (which may be kept warm by a water-bath, &c.), contains a slowly revolving roller or some similar arrangement, covered with a soft material or a brush which coats the sheets of paper, &c. with the liquid as they are being carried round upon the cylinder. By bars, pads or scrapers, &c., fitted parallel with the roller, the coating is equalised upon the sheets, which are then automatically removed from the cylinder to endless travelling bands. The vessels and rollers being adjustable and removeable, different ones can in turn be used for gumming, sizing, staining, varnishing, &c.—H. S.

Improvements in Coating Iron, Steel, or other Metals or Materials with Portland or other Cement. C. Kellner, Vienna, Austria. Eng. Pat. 6952, May 6, 1890. 6*d*.

One hundred pounds of blue slate finely ground are mixed with 30 to 40 lb. of silicate of soda at 100° Tw., and applied to the surface to be protected in a layer about $\frac{1}{2}$ in. thick. A second coating of similar thickness and composed of equal parts of ground slate and Portland cement made into a paste with water is then applied, and the protecting layer is completed by one of Roman, or preferably Portland, cement alone.

The treatment is recommended for lining vessels or tanks made of brickwork, such as "stuff chests" and rag engines used in the manufacture of paper, where heat, acids, or alkalis have to be resisted (see this Journal, 1891, 380). For protection against acids it is, however, better to use for the second coating a mixture consisting of equal parts of ground glass, ground slate, and Portland cement, and to dispense with the third coating.—B. B.

Improved Apparatus for Separating or Disintegrating Fibres in the Manufacture of Paper Pulp. C. Kellner, Vienna, Austria. Eng. Pat. 6993, May 6, 1890. 6*d*.

The patentee has constructed a machine consisting of a horizontal roller toothed externally and surrounded by an internally toothed cylinder. When the roller revolves these two sets of rings of teeth thoroughly rub and bruise the fibres, but do not cut them. The evenness of the pulp and the quality of the paper are thus improved. Before placing the fibres into this apparatus, they have to be digested in the usual manner and mixed with a suitable quantity of water.—H. S.

Registering Apparatus for Paper-Making Machines. C. J. Richardson, Gateshead-on-Tyne. Eng. Pat. 7598, May 15, 1890. 8*d*.

The apparatus consists of two drums, one of which revolves ten times as fast as the other. They are driven by the paper machine itself at any convenient place. One revolution of the slow drum corresponds to a definite length of paper.—E. J. B.

Improvements in the Manufacture of Paper Pulp. J. F. N. B. Simons, Stratford, and S. Smith, Walthamstow. Eng. Pat. 10,259, July 2, 1890. 4*d*.

The object of this invention is to render bamboo more suitable as a paper-making material. This is brought about by detaching the outer skin of the bamboo to a depth of about one-sixteenth inch. The part so removed is rejected and the residue is treated in the usual way.

—E. J. B.

Improvements in or Relating to the Treatment of Vegetable Parchment and the like. A. Wilbaux, Brussels, Belgium. Eng. Pat. 17,268, October 28, 1890. 4*d*.

This invention consists in rendering vegetable parchment non-hygrometric, and at the same time adhesive by applying to it, either on one or on both sides, layers of oil or oil colour of uniform consistency and softness, or of varnish and the like. When these layers are dry the material may be ornamented by printing, embossing, stamping, and then varnished and glazed in an oven, or otherwise treated to improve its quality and appearance. Thus treated it is said to be capable of being used in many ways not before contemplated, *e.g.*, in the leather, carriage building, book-binding and various other trades.—H. S.

Improvements in Purifying Wood-Pulp and in Apparatus therefor. J. C. Juel and E. Ryan, Fredrikstad, Norway. Eng. Pat. 2349, February 9, 1891. 6*d*.

The apparatus consists of a centrifugal machine into which the liquid pulp is fed. Any heavy impurities contained in the pulp are separated from the lighter pulp.—E. J. B.

Improvements in and relating to the Manufacture of Distinctive Paper for Bonds, Notes, Checks, and other Securities. J. Macdonough, New York, U.S.A. Eng. Pat. 3791, March 3, 1891. 6*d*.

The inventor incorporates with the pulp before it reaches the paper machine a number of "planchets" or pieces of paper punched from sheets of manufactured paper. These may be of any size or colour.—E. J. B.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES AND EXTRACTS.

Constitution of Nicotine. F. Blau. Ber. **24**, 326—329. (Compare Pinner and Wolfenstein, this Journal, 1891, 381.)

The fact that the dipiperidyl (hexahydronicotine) prepared by Liebrecht (Ber. **19**, 2587) from nicotine, boils at a relatively low temperature (250°—252°) compared with the αα-dipiperidyl (boiling point 259°) obtained by the author from αα-dipyridyl (Monatsh. 1889, 294) is contrary to expectation, since, in all probability, the αα-compound boils at a lower temperature than any of the six isomeric dipiperidyls theoretically capable of existence. The author has prepared the αβ-dipyridyl from metaphenylenediamine, as described by Skraup and Vortmann; it boils at 295·5°—296·5° (corr.), and on reduction, first with sodium and alcohol, and then with sodium and amyl alcohol, it is converted into αβ-dipiperidyl. This compound boils at 268°—270° (corr.), melts at about 30°, and is hygroscopic; the hydrochloride and the platinochloride are readily soluble in water, but more sparingly in alcohol; the aurochloride crystallises well and melts at 202° with decomposition. As Liebrecht's dipiperidyl from nicotine is a liquid, and its aurochloride melts at 131°—132°, the two bases are certainly not identical.

From a study of the boiling points of the known dipyridyls and dipiperidyls, it seems highly probable that the as yet unknown β-dipiperidyls, namely, the ββ- and the βγ-derivatives will boil at a higher temperature than the αβ-compound; as the latter boils at a higher temperature than the αα-compound, it seems probable that Liebrecht's hexahydronicotine, which boils at a lower temperature, is not really a dipiperidyl, and consequently that nicotine is not a dipyridyl derivative.

Further experiments on the constitution of nicotine are in progress.—F. S. K.

Digitonin and Digitogenin. H. Kiliani. Ber. **24**, 339—347.

In the present paper the author describes the preparation and properties of pure digitonin, one of the glucosides contained in commercial digitalin (this Journal, 1890, 820).

Digitonin crystallises very readily from 85 per cent. alcohol (sp. gr. 0·831 at 20°), but from stronger alcohol it separates in an amorphous condition; from weaker alcohol it is not deposited so completely, and generally in an amorphous state. As the percentage of digitonin in commercial digitalin (pur. pulv.) is variable, it is advisable to make several small experiments in order to ascertain what quantity of 85 per cent. alcohol gives the best results. In the case of a sample of digitalin obtained from Boehringer and Sons, of Waldhof, it was found advantageous to employ 4 parts of alcohol to 1 part of the crude material; after heating from 50°—60° to ensure complete solution, and then allowing to cool slowly (without previously filtering from a small quantity of a voluminous insoluble substance), the digitonin is deposited in crystals, and after about 12 hours crystallisation is at an end. The crystals are then separated by filtration, washed with 85 per cent. alcohol, and dried: the yield of the crude crystalline product is from 43 to 45 per cent., but by a rather complicated process an additional 6 to 8 per cent. can be obtained from the mother-liquors. For further purification the glucoside is dissolved in 12 parts of boiling 85 per cent. alcohol, the solution heated for two minutes with animal charcoal, filtered, and then allowed to cool slowly, when compact crystals of the pure compound are deposited. The weight of the first crop of crystals is only about 45 per cent. of the crude product, but further quantities can be obtained by concentrating the mother-liquors. It may be remarked, however, that spontaneous evaporation usually gives an amorphous product, and also that when the solution is not going to be filtered, only 10 parts of alcohol should be taken to dissolve 1 part of the glucoside.

Pure digitonin dried at 105° has the composition—

$$C_{27}H_{44}O_{13} + H_2O$$

It softens at 225°, and gradually melts and turns yellow as the temperature rises to 235°. It is levo-rotatory, a 2·8 per cent. solution in 75 per cent. acetic acid having approximately the rotatory power $[\alpha]_D = -50°$; digitonin and its derivatives have no action on the heart. The crystalline compound is only sparingly soluble in cold water, but much more readily on warming, the solution showing an opalescence similar to that observed in the case of inulin and glycogen. It gives with concentrated sulphuric acid a reddish colouration, which is rendered more intense on the addition of a drop of bromine-water, and when heated with dilute hydrochloric acid as previously described (*loc. cit.*) it yields almost the theoretical quantities of dextrose, galactose, and digitogenin, $C_{15}H_{24}O_4$. It does not yield either methyl or ethyl iodide when heated with hydriodic acid and amorphous phosphorus. When boiled with acetic anhydride and sodium acetate it is converted into a colourless, crystalline, acetyl-derivative which melts at 178° and has the composition $C_{15}H_{23}O_3.CO.CH_3$; this compound is *acetyldigitogenin*, and its formation seems to indicate that digitonin is a glucoside of milk-sugar.

When digitonin (1 part) is oxidised with chromic acid (1·4 parts) in acetic acid solution at the ordinary temperature it yields, amongst other products, a monobasic acid of the composition $C_{11}H_{22}O_4$, which the authors name *digitogenic acid*. This substance melts at 146°—150°, has a very bitter taste, and is insoluble in water but readily soluble in chloroform and hot glacial acetic acid. On oxidising digitogenic acid with an alkaline solution of potassium permanganate it yields *oxydigitogenic* acid, $C_{20}H_{42}O_9$ and *digitic acid*, $C_{10}H_{16}O_4$. Both these acids are monobasic; the former melts at about 250°, and is very sparingly soluble in all ordinary solvents, whereas the latter melts at 192°, and is moderately easily soluble in alcohol, chloroform, and glacial acetic acid.—F. S. K.

Cytisine. A. Partheil. Ber. **24**, 634—640.

The author confirms the formula $C_{11}H_{14}N_2O$ which he had previously (this Journal, 1891, 63, 383) established for cytisine, and shows that the formula $C_{11}H_{16}N_2O$ proposed by Plugge and v. d. Moer (Ann. Chem. Pharm. **229**, 48) is incorrect.

Cytisine crystallises from alcohol in large, odourless, prismatic crystals, free from water. Its melting point is 152°—153° C. The presence of methoxyl in the cytisine molecule could not be confirmed. Cytisine is mono- and di-basic, and furnishes two series of salts. *Cytisine hydrobromide*, $C_{11}H_{14}N_2O.HBr$; *hydriodide*, $C_{11}H_{14}N_2O.HI$; *nitrate*, $C_{11}H_{14}N_2O.HNO_3$, and *sulphate*, $(C_{11}H_{14}N_2O)_2.H_2SO_4$, crystallise well, and are obtained by neutralising the base with the respective acids. The identity of Gerrard's *ulexine* (from *Ulex europæus*) with cytisine was proved by comparing the two bases and their respective derivatives. Ulexine may be prepared by the following process:—The coarsely-powdered seeds of *Ulex europæus* are extracted with alcohol acidified with acetic acid. The solution is distilled to remove the alcohol, and the residue is dissolved in hot water and filtered to separate oil and resin. The liquid is precipitated with acetate of lead, filtered, and the filtrate is mixed with an excess of soda solution and repeatedly extracted with chloroform. The chloroform extract on evaporation yields crude ulexine, which may be purified by repeated crystallisation from water or alcohol. The yield of ulexine is about 1 per cent. *Cytisine methyl iodide* forms fine white needles. *Cytisine ethyl iodide* forms colourless crystals. Cytisine methyl iodide, when heated with a 30 per cent. solution of potash, yields the corresponding base, which may be extracted by chloroform. This base gives a reddish-brown precipitate with bismuth potassium iodide, and yields a sparingly soluble platinum salt crystallising in golden yellow leaves. An alkaline solution of potassium permanganate liberates ammonia from cytisine, and substituted ammonias from iodo-alkyl derivatives of cytisine. The author is continuing his researches (see next page).—H. T. P.

Alcoholates. J. W. Brühl and H. Biltz. Ber. **24**, 649—650.

Alcoholates of sodium may be readily prepared from methyl, ethyl, or others of the lower alcohols by dissolving the anhydrous alcohol in toluene or xylene, and treating the solution at 170—180° C. with the theoretical amount of metallic sodium. A considerable length of time is necessary for the complete solution of the sodium, because the metal becomes covered with a protecting crust of alcoholate, but the latter is finally obtained as a snow-white mass suspended in the hydrocarbon, and quite free from alcohol.—H. T. P.

Constitution of Leucin. E. Schulze and A. Likiernik. Ber. **24**, 669—673.

The authors have succeeded in proving that inactive leucin, obtained by heating the active modification with baryta at 160°, is identical with α-amidoisobutyl acetic acid prepared synthetically from isovaleraldehyde; the two compounds have the same solubility in water, they both yield the same product, namely, active leucin, when submitted to the action of *Penicillium glaucum*, and they are converted into one and the same hydroxycaproïc acid on treatment with nitrous acid.

The inactive leucin employed in these experiments was obtained from the vegetable albuminoid *Conglutin*; since it is possible that different animal and vegetable products may yield different kinds of leucin, the above statement must be held to refer only to the compound obtained from *Conglutin* and to those preparations with which it is identical in properties.—F. S. K.

Cytisine. K. Buchka and A. Magalhaës. Ber. **24**, 674—680.

A further investigation of the poisonous substance cytisine (compare this Journal, 1891, 63, 383 and 567) has shown that its composition is expressed by the formula $C_{11}H_{14}N_2O$; it forms two crystalline hydrochlorides, having the composition $C_{11}H_{14}N_2O.HCl + H_2O$ and $C_{11}H_{14}N_2O.2\,HCl + 2\frac{1}{2}\,H_2O$ respectively, and two platinochlorides, namely—

$$(C_{11}H_{14}N_2O)_2.\,H_2PtCl_6 + 2\,H_2O$$

and—

$$C_{11}H_{14}N_2O.\,H_2PtCl_6 + 2\frac{1}{2}\,H_2O$$

but only one aurochloride of the composition—

$$C_{11}H_{14}N_2O.\,HAuCl_4.$$

Cytisine combines with methyl iodide to form *methyl cytisine hydriodide*, $C_{11}H_{13}NO.CH_3.HI$; this compound melts at 253°5, and when treated with alkalis it is converted into *methylcytisine*, $C_{11}H_{13}N_2O.CH_3$, a colourless crystalline substance melting at 245°. The *hydrochloride* of methylcytisine melts at 249—250°, and has the composition $C_{11}H_{13}N_2O.CH_3.2\,HCl + 1\frac{1}{2}\,H_2O$; the *aurochloride*, $C_{11}H_{13}N_2O.CH_3.HAuCl_4$, is a yellow crystalline compound melting at 196°.

Acetylcytisine, $C_{11}H_{13}N_2O.CO.CH_3$, obtained by heating cytisine with acetic anhydride, forms colourless crystals and melts at 208°; *nitrosocytisine*, $C_{11}H_{13}N_2O.NO$, crystallises in colourless needles and melts at 174°.

Ulexine, prepared from the seeds of *Ulex europæus*, is probably identical with cytisine; its aurochloride melts at 205°, and its acetyl derivative at 202—204°, the corresponding cytisine-derivatives melting at 213° and 208° respectively. These slight differences in the melting points may be due to impurities; as, however, the compound obtained from ulexine by the action of methyl iodide melts at 290°, whilst that prepared from cytisine in like manner melts at 253°5, the question of the identity of the two bases is left undecided, although further investigation will probably answer it in the affirmative. (See Partheil, Ber. **24**, 634—640, preceding pages.)—F. S. K.

Anhydro-geraniol; Olefine Terpenes, a new Class of Terpenes; and Benzene Ring Formation. F. W. Semmler. Ber. **24**, 682—685.

The author has previously shown (this Journal, 1890, 889, 1145; 1891, 269, 382) that ethereal oils contain open-chain compounds of the formula $C_{10}H_{20}O$, $C_{10}H_{18}O$, or $C_{10}H_{16}O$, which, on dehydration either retain their open character or are converted into benzene derivatives. Geraniol belongs to the former class. The complete dehydration of geraniol by means of potassium bisulphate and sodium results in the production of a hydrocarbon, *anhydro-geraniol*, possessed of the following properties: Boiling point, 172—176° C.; specific gravity at 20° C., 0·8232; n_D, 1·4835 at 20° C. Analysis shows it to have the formula $C_{10}H_{16}$. Physically, anhydro-geraniol differs from the terpenes, which have a density of 0·84—0·86. Its molecular refraction calculated by the formula $\frac{(n^2-1)\,P}{(n^2+2)\,d}$ is 47·23. A body of the formula $C_{10}H_{16}$, with three double carbon linkings, would have a theoretical molecular refraction of 47·12, which agrees very well with the number observed. Anhydro-geraniol, therefore, cannot be a benzene derivative, and this is confirmed by its chemical behaviour. On reduction it yields a body of the formula $C_{10}H_{20}$, and with bromine it forms the substance $C_{10}H_{16}Br_6$. The author proposes to name hydrocarbons of this type *olefine terpenes*. They have been obtained from coriandrol, linalool, &c.

The occurrence of benzene derivatives in plants may be explained on the assumption that they are produced by the dehydration of open-chain compounds. It is, therefore, well to consider the conditions which must be fulfilled in order that such an action may take place. 1. Only aldehydes are suitable. 2. The aldehyde oxygen must not be able to take two hydrogen atoms from the adjacent carbon atoms to form water, *i.e.*, the grouping must be as follows:—

$$CHO-CH \quad C\begin{matrix}R^1\\ \diagdown\\ \diagup\\ R^2\end{matrix}$$

3. The fifth carbon atom, reckoning from the aldehyde carbon, must be united to two hydrogen atoms, which may subsequently form water with the aldehyde oxygen. From this it follows that one hydrogen atom of the benzene ring formed under the above conditions must always remain as such. Calling the carbon to which this particular hydrogen atom is attached 6, the author prefers to designate that carbon atom of the benzene ring as 1, to which is joined some fatty side-chain, generally C_3H_5. If this theory be correct, no substituted benzene derived from a vegetable organism should possess the structure 1 : 2 : 6. The position 6 should always be unsubstituted. All vegetable benzene derivatives hitherto examined by the author have conformed to this requirement. Similar but more complicated considerations may be deduced regarding terpenes, *i.e.*, hydrogenised benzene derivatives. The author is continuing his researches.—H. T. P.

Spartëine. F. B. Ahrens. Ber. **24**, 1095—1097.

Sparteine on oxidation yields a base $C_{15}H_{24}N_2O$ *Oxy-sparteïne*, which can be extracted from the product of the reaction by means of chloroform. After distilling off the solvent, the base remains as a thick yellow-brown oil which can be obtained in a crystalline condition by converting it into the platinum double chloride and decomposing the latter by sulphuretted hydrogen and caustic soda successively. Thus purified it forms hygroscopic white needles, melting at 83—84°, readily soluble in water, alcohol, ether, and chloroform; the solutions have a strongly alkaline reaction. The hydrochloride of the base forms readily soluble needles having the composition $C_{15}H_{24}N_2O.2\,HCl.(2)H_2O$ which at 48—50° melt in their water of crystallisation. The hydrobromide crystallises in rhombohedra, whilst the sulphate forms readily soluble needles. Oxy-sparteine forms two platinum double chlorides—

$$(C_{15}H_{24}N_2O.HCl)_2PtCl_4 + H_2O$$

and—

$$(C_{15}H_{24}N_2O.2\,HCl)PtCl_4.2\,H_2O$$

of which the latter is the more soluble. They both form clear glittering crystals which became opaque when dried over sulphuric acid, but still retain one molecule of water of crystallisation. They melt with decomposition at 209° C. and 221°—223° C. respectively. The gold double chloride, $C_{15}H_{24}N_2O.HCl.AuCl_3$, can be recrystallised from water, forming glittering plates or needles which decompose gradually on heating. The mercuric double chloride melts at 57°—58° C., the picrate at 176°—178° C., but both soften before the melting point is reached.

Analytical data point to the correctness of the above formulæ.—C. A. K.

The Formation of Nitrogenous Organic Bases by the Decomposition of Albumen in Plants. E. Schulze. Ber. **24**, 1098—1101.

The shoots of *Lupinus luteus*, *Soja hispida*, and *Cucurbita pepo*, after they have been cultivated for from 12—14 days in the dark, when extracted with water yield (after the removal of the albumen) precipitates when treated with phosphotungstic acid. These precipitates are decomposed by lime-water with the formation of organic bases. The base obtained both from *Lupinus* and *Cucurbita* has been shown by the author to have the formula $C_6H_{14}N_4O_2$, and has been named *Arginine* (Ber. **19**, 1177). It only occurs to a small extent in the latter plant, but in such great quantity in the former that it must have been formed at the cost of the albuminoid substances contained. *Soja hispida* contains either the same or a similar base.

That the arginine is really formed as a decomposition product of the albumnoid matter contained in the seeds of *Lupina* is shown by a special experiment, full details of which are given.

By the action of hydrochloric acid and zinc chloride upon casein E. Drechsel obtained a basic substance, *Lysatine*, $C_6H_{13}N_3O_2$, together with ammonia and amido-acids (Ber. **23**, 3098), which differs from *Arginine* as regards its empirical formula only in having one atom of hydrogen and one atom of nitrogen more than the latter.

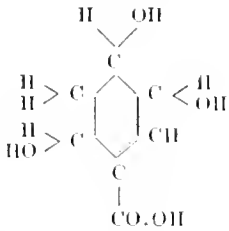
—C. A. K.

Shikimic Acid. J. F. Eykman. Ber **24**, 1278—1303.

Shikimic acid is the name given to a non-poisonous acid occurring in the fruit of *Illicium religiosum* (Jap. Shikimi), to the extent of several per cent. Its isolation has been previously described by the author (Rec. d. trav. Chem. de Pays Bas. 1885, 32) who has also detected its presence in the fruit of the real Chinese star-anise.

The acid forms a crystalline powder consisting of fine needles which melt at 184°, and have a specific gravity of 1·599 at 14° C. Its solubility in water is about 18:100; in absolute alcohol, ether, chloroform, and benzene it is almost insoluble. It decomposes carbonates readily, prevents the precipitation of several metallic oxides by bases, does not reduce alkaline, silver or copper solutions, but decolourises potassium permanganate solution readily in presence of sodium carbonate. Analyses of the free acid and of its calcium and silver salts, as well as a determination of the molecular weight by the cryoscopic method point to the formula $C_7H_{10}O_5$, and to the mono-basicity of the acid. The acid is strongly optically active, the specific rotatory power being $[\alpha]_D = -246.3°$; the rotatory power of the ammonium salt is still greater. This salt forms well-defined rhombic crystals, readily soluble in water. Of the other salts of the acid, all of which are also readily soluble in water, those of the fixed alkalis could only be got in an amorphous condition. The calcium salt when subjected to dry distillation forms phenol, with evolution of carbon dioxide and water; catechol appears also to be formed in the reaction.

Acetic anhydride and its homologues react with shikimic acid with the formation of tri-acetyl and similar compounds, thus pointing to the presence of three hydroxy-groups in the acid. The specific rotatory powers of these esters, which have only been obtained in an amorphous condition, is greater than that of the free acid, and increases with the number of CH_2 groups contained in the acid radicle. Heated with hydrochloric acid shikimic acid yields 1:4 hydroxybenzoic acid, together with other products that have not been identified. On reduction with sodium amalgam a dihydro-acid, $C_7H_{12}O_5$, results which was obtained both in an amorphous and in a crystalline state, the former differing from the latter in the ease with which it is decomposed by hydrochloric acid with the formation of benzoic acid. With bromine a crystalline dibrom-shikimic acid, $C_7H_{10}Br_2O_5$, is formed, which melts with decomposition at 188°; its aqueous solution when evaporated, or better when treated with silver oxide, loses hydrobromic acid to form a lactone, $C_7H_9BrO_5$, which crystallises from water in hexagonal needles melting at 235°. Treated with baryta water the dibromolactone is converted into a dihydroxy acid, $C_7H_{10}(OH)_2O_5$, which begins to melt at 156°, and is fairly soluble in cold water, readily in hot; it has no appreciable rotatory power. A comparison of the relative properties of quinic acid, $C_7H_{12}O_6$, quinide, $C_7H_{10}O_5$ (obtained by the removal of a molecule of water from quinic acid), and shikimic acid follows, the paper concludiog with a discussion of the constitutional formula of shikimic acid. Its decompositions point to its being a trihydroxytetrahydrobenzene monocarboxylic acid, having probably the following formula—



but the position of two of the three hydroxyl groups requires further confirmation.

Tables giving the rotatory power, electrical conductivity and crystallographic measurements of the acid and of its derivatives are given in detail.—C. A. K.

Nicotine. A Pinner and R. Wolffenstein. Ber. **24**, 1373—1377.

By the action of benzoyl chloride on nicotine, Will obtained a crystalline compound to which he assigned the formula $C_{10}H_{14}N_2.2C_6H_5.CO.Cl$. In repeating this experiment the authors obtained a basic hydrochloride of nicotine $C_{10}H_{14}N_2.HCl$ mixed with a little benzoate, the formation of which salts is traced to the decomposition of the benzoyl chloride ioto benzoic acid and hydrochloric acid by the moisture of the air. The nicotine was dissolved in anhydrous ether, and in one experiment in which the mixture was kept in a closed vessel over strong sulphuric acid, *i.e.*, in a perfectly dry atmosphere, no crystalline product was formed.

Although no compound of nicotine and benzoyl chloride could be obtained according to the method described by Will, the two substances do combine when heated on the water-bath for about 20 minutes to form a thick colourless syrup, hardly attacked by caustic soda in the cold but which behaves as a mon-acid base, being readily soluble in dilute hydrochloric acid. The base could not be obtained in a crystalline condition, but an analysis of the picrate, the only salt that could be obtained crystalline, points to the formula $C_{10}H_{14}N_2.C_6H_5.CO.Cl$. for the base. This salt is scarcely soluble in water and melts at 139° C.—C. A. K.

What is Aristol, and how is it Manufactured? G. M. Beringer. Am. Jour. Pharm. April, 1891; Pharm. J. 1891, 1135—1137.

A formula based upon the experiments of Messinger and Vortmann would be—

	Grms.
Thymol	15
Soda	20
Iodine	50·8
Potassium iodide	66·4

The thymol and soda are dissolved in 250 cc. water. The iodine and potassium iodide in 1,000 cc., and gradually added to the first solution, continually stirring. The precipitate is collected, washed, and dried. The precipitate obtained by this formula was at first of a purple-brown colour, but while drying gradually became lighter in colour, until when dry it was of the same yellow-red colour as the commercial article. The filter on which the precipitate was collected and dried was stained with iodine. The filtrate gave no indication of free iodine, and a portion acidulated and extracted with ether yielded no thymol, showing that the reaction was complete. It is not believed that this is the process adopted by the manufacturers, as it requires the use of a large amount of iodide of potassium and iodine, the greater portion of the latter being lost in the drying of the precipitate.

The following formula is offered as an economical process:—

	Grms.
Thymol	15
Soda	20
Iodine	6·35
Potassium iodide	8·3
Solution of chlorinated soda, a sufficient quantity.	

The thymol and soda are dissolved in 250 cc. of water. The iodine and iodide of potassium are also dissolved in 250 cc. of water and the two solutions mixed, resulting in an opalescent solution with a distinct green tint, the slight precipitate first formed being redissolved. Solution of chlorinated soda is now added gradually while stirring, until no further precipitation is produced, and a slight excess is indicated by the odour. About 650 to 700 cc. will be required. The precipitate, a light red-brown in colour, is collected, washed, and dried by spreading on bibulous paper in a suitable room where it can be protected from the light, at a temperature not exceeding 50° C. The filtrate showed the absence of iodides in any quantity, and a portion acidified and extracted with ether yielded no thymol. The yield by this and the preceding formula was about 29 grms., corresponding in colour, melting point, and solubilities, with the aristol in the market, and closely approximating the theoretical yield 29·285 grms. calculated from the formula $C_{20}H_{24}I_4O_2.2\,H_2O$.

The thymol used in this formula must be free from essential oil or thymene, or there is produced some iodoform in the reaction, which remains as a contamination of the finished product. As most of the commercial thymol contains a small portion of hydrocarbon it must be first purified, which is easily accomplished by percolating the powdered thymol with a small quantity of purified petroleum spirit, which dissolves of course a portion of the thymol as well as the thymene, but it can be recovered by evaporation of the solvent and used for other purposes. The solution of chlorinated soda used should contain no excess of chlorinated lime, and in its preparation for this purpose it is advisable to use an excess of sodium carbonate, as an excess of this latter salt does not affect the product.

In the "Repertoire de Pharmacie," 1890, 355, M. Louis Roulé furnishes the following formula for the preparation of aristol. Crystallised thymol, caustic soda and potassium iodide each 5 grms., dissolved in 50 cc. of water and then poured into 250 cc. concentrated solution hypochlorite of soda. It will be observed on calculating the quantities used that there is an insufficient amount of iodine supplied by the potassium iodide to furnish a product of the above composition. In the absence of sufficient iodine a certain amount of the thymol combines with the chlorine. Upon adding solution of chlorinated soda to an alkaline thymate solution, there is precipitated a compound of a pinkish tint soluble in ether, alcohol, and chloroform, and precipitated from its alcoholic solution by water. The filtrate from this precipitate yields but a slight trace of thymol upon acidifying and extracting with a solvent. A similar product is obtained by passing chlorine into an alkaline solution of thymol until there is a decided excess of chlorine.

These are evidently chlorine compounds with thymol, most likely a dithymol compound, and worthy of further investigation.

Formosa Camphor. Report by Consul Warren on the Trade of Taiwan (Formosa). Pharm. J. 1891, 1137.

FORMOSA camphor is obtained from the *Laurus camphora*, immense forests of which extend over most of the lower ranges of hills in the island, extending up the lower slopes of the mountains inhabited by the savage tribes. Many of these forests have not been touched, and the statement that the camphor supplies in South Formosa are becoming exhausted, applies only to those districts which are purely Chinese. The supply from other parts is practically inexhaustible. Even in purely Chinese districts it is only at certain places that the supply is falling off in consequence of the reckless manner in which the trees have been destroyed, partly for the sake of the timber and camphor, and partly, no doubt, simply to clear the ground for cultivation.

It has been often stated that the method of obtaining crude camphor in Formosa is by steeping the chopped branches in water, and boiling until the camphor begins to adhere to the stick used for stirring, when the liquor is strained, and by standing the camphor concretes. By this method it does not necessarily follow that the tree is destroyed, in fact with a little care there is no need that it should be. But although this method may have been in use in former days, it certainly is not now. On the contrary, the writer was assured by several natives engaged in the trade, whom he had questioned on the subject, that the yield of camphor from the branches was too small to repay the labour of extraction.

The method in general use now is as follows: The camphor expert selects a tree and scrapes into the trunk in different places, using an instrument somewhat resembling a rake, with the view of ascertaining whether it contains sufficient camphor to repay the labour of extraction. A tree is said not to be worth anything for camphor purposes until it is 50 years old, and the yield is very unequal; sometimes one side only of the tree contains enough camphor to satisfy the expert, and in this case that side alone is attacked. The trunk is scraped to as great a height as the workmen can conveniently reach, and the scrapings are pounded up and boiled with water in an iron vessel over which an earthenware jar, specially made for the purpose, is inverted. The camphor sublimes and condenses on the jar, which is removed from time to time, scraped, and replaced. The root of the tree and the trunk, for some eight feet up, contain, as a rule, the greatest quantity of camphor. If the scrapings from the trunk yield well, the chipping is continued until in the end the tree falls. The roots are then grubbed up as it is certain they will give a proportionately good return. If, however, the scrapings do not turn out well, the tree is abandoned, and work is commenced on another. No attempt is made to extract camphor from the fallen trunk or from the branches. In some cases the trunk is sawn up into timber, but this depends on the locality; from many districts, owing to absence of roads, timber would not pay for its transport.

It is impossible to imagine a more wasteful method of procedure, and it is fortunate that the camphor forests of Formosa are practically inexhaustible.

The quantity of camphor produced depends, of course, on the amount of labour employed in the business. Ten of the iron pots mentioned above and their accompanying jars make up what is called a "set," and are worked by four men. One set will produce about 65 lb. in 10 days, or, say, 1¾ cwt. a month, but this only under the most favourable circumstances, a fair average is about 1¼ cwt.

Recently a great change has been made in the camphor monopoly. It is now proposed by the Chinese authorities that the camphor stills should be licensed before they are permitted to work. The cost of the license will be equivalent to a tax of about 22*s.* 6*d.* per cwt., a heavy tax, seeing that the actual value of the camphor at the place of production is very little over this amount.

PATENTS.

Manufacture of Artificial Tartaric Acids by Means of Cellulose, Saccharine, or Amylaceous Substances. A. U. Brehier and B. G. Talbot, Bordeaux, France. Eng. Pat. 3240, February 28, 1890. 6*d*.

The process is based upon the production of oxygen by the decomposition of an alkaline permanganate in the presence of chlorine, and the action of the nascent oxygen upon the glucose bodies, converting them into tartaric acid. The glucose solution at 10° to 15° B. is contained in a closed cylindrical receptacle, and is subjected in the cold for four or five days to the action of alkaline permanganate and chlorine gas under slight pressure, and in absence of air. The solution is now exposed to the air in a chamber where the temperature is not below 20° C., and the process of oxidation and acidification is here completed. A clear limpid solution of tartaric acid is thus obtained, the particular form of tartaric acid varying according to the nature of the raw material used in its production.—A. J. K.

Improvements in the Production and Application of the Solution of Calcium Phosphate in Carbonic Acid Water for Use as a Beverage, or in Medicine or Pharmacy. T. H. Williams and W. H. Symons, London. Eng. Pat. 8454, May 31, 1890. 4*d*.

Calcium phosphate is dissolved in water by the aid of carbonic acid under a pressure of 100—120 lb., the excess of carbonic acid allowed to escape, and the settled liquor drawn off for use as a beverage or in medicine. The liquid may be charged with an excess of carbonic acid and bottled. —H. A.

A Process or Processes for the Manufacture of Artificial Musk. F. Valentiner, Plagwitz-Leipzig, Germany. Eng. Pat. 15,687, October 3, 1890. 4*d*.

A mixture of equivalent proportions of isobutyl-, isopropyl-, or isoamyl-alcohol and xylene, turpentine or cymene is added gradually to concentrated sulphuric acid, care being taken that the temperature does not rise above 45° C. The product is added to fuming nitric acid and the dinitro-compound produced is precipitated with water, washed and purified by repeated crystallisation from alcohol. Thus obtained, the dinitro-compound can be used as a substitute for musk.

In order to obtain a perfume soluble in water and therefore suitable for perfuming soap, the product before nitration is heated at 150°—160° with strong and fuming sulphuric acid; the sulphonic acid produced is then nitrated and a soluble product obtained having an intense musk-like odour.—A. K. M.

Improvements in the Manufacture of Artificial Perfumes. G. Link, Wiesbaden, and R. Avenarius, Ganalgesheim, Germany. Eng. Pat. 48, January 1, 1891. 4*d*.

Tertiary amyl chloride, bromide, or iodide is boiled with three-quarters of its weight of chloride or bromide of iron until the evolution of acid has ceased. The product is then distilled with steam, dried and fractionated, and that portion passing over at 200°—208° which contains tertiary amyltoluene, $C_{12}H_{18}$, is collected. One part of this is mixed with six parts of nitric acid of sp. gr. 1·5, 20 parts of fuming sulphuric acid, and heated on the water-bath for 20—30 hours. The melt is poured on to ice forming a viscid oil of a light brownish-yellow colour which solidifies, and after several crystallisations from alcohol yields light yellow prisms having a musk-like odour.—T. A. L.

Improvements in the Manufacture of Artificial Perfumes. G. Link, Wiesbaden, and R. Avenarius, Ganalgesheim, Germany. Eng. Pat. 115, January 3, 1891. 4*d*.

This is a process for obtaining tertiary butyltolylmethane and its homologues and a hydrocarbon of the formula $C_{13}H_{24}$ and its homologues; further the conversion of these hydrocarbons into trinitro-derivatives which have an intense musk-like odour.

Iron chloride (0·75 part) or bromide is added by degrees to a mixture of isodibutylene hydrochloride (1 part) hydrobromide or hydroiodide with toluene (7 parts), and the whole is boiled with reflux condenser as long as acid is evolved. The product is subsequently fractionated, the portion distilling between 190° and 205° containing tertiary butyltolylmethane, whilst the fraction 230°—250° contains the hydrocarbon $C_{15}H_{24}$:—

$$C(CH_3)_2Cl.CH_2.C(CH_3)_3 + C_6H_5.CH_3 = CH_3.C_6H_4.CH_2.C(CH_3)_3 + CH_3.CH:CH_2 + 2\,HCl$$

$$C(CH_3)_2Cl.CH_2.C(CH_3)_3 + HCl + 2\,C_6H_5.CH_3 = CH_3.C_6H_4.CH_2.C(CH_3)_3 + CH_3.C_6H_4.C_3H_7 + 2\,HCl$$

$$C(CH_3)_2Cl.CH_2.C(CH_3)_3 + C_6H_5.CH_3 = CH_3.C_6H_4.C_8H_{17} + HCl$$

When the homologues of toluene are employed in the place of the latter hydrocarbon, homologous products, *e.g.* $C_{13}H_{20}$, $C_{16}H_{26}$, &c., are obtained.

To obtain artificial musk the butyltolylmethane is treated with a mixture of 6 parts of nitric acid (sp. gr. 1·525) and 20 parts of fuming sulphuric acid.—A. K. M.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

Some Recent Advances in Photography. C. H. Bothamley.

See pages 523—524.

Washing Platinum Prints. A. Huszar. Der. Amat. Phot. **5**, 74—75.

A one per cent. solution of crystallised copper sulphate may be used in place of hydrochloric acid for washing platinum prints.—C. H. B.

Some New Addition Compounds of Thiocarbamide, which afford evidence of its Constitution. J. Emerson Reynolds. Proc. Chem. Soc. 1891 [97], 78—79.

In the course of the author's work on silicon compounds, a thiocarbamide derivative containing silicon tetrabromide was obtained which broke up on treatment with ethyl alcohol, affording among other products the fine crystalline substance $(H_4N_2CS)_4H_4NBr$. The same compound was subsequently obtained by direct union of its components, as was described in a former paper (Trans. Chem. Soc. **53**, 857).

Thiocarbamide combines with ammonium bromide, iodide and chloride at the temperature of boiling alcohol, forming characteristic compounds of the type $(H_4N_2CS)_4H_4NR'$. But no compounds were formed under the conditions specified which contained fewer than four molecular proportions of amide to one of ammonium salt.

The author demonstrates on the basis of experimental results that the view that thiocarbamide is $CS(NH_2)_2$ is untenable, but these results are altogether in favour of the unsymmetrical structure $HN:C(SH)NH_2$.

It is pointed out that an interesting practical application of the compound $(H_4N_2CS)_4H_4NBr$ has recently been made by Colonel Waterhouse to the production of direct positive

photographs. So effective is the agent in securing the reversal of the photographic image, that the presence of only $\frac{1}{1000}$th of a grain per ounce of "eikonogen" developer causes the negative image that first appears to change into a rich-coloured positive.

In the discussion which followed, Mr Groves, referring to the reversed photographs exhibited by Professor Reynolds, drew attention to the curious fact that the silver deposit which, in the early stage of development, apparently behaved like that forming an ordinary negative image, in the later stage became soluble.

The Decomposition of Silver Chloride by Light. Arthur Richardson. Proc. Chem. Soc. 1891 (97), 81–82.

The author describes experiments which have been made with a view to determine whether silver chloride which has been darkened by exposure to light under water contains oxygen. The nature of the change which occurs during decomposition of the chloride was also studied with reference to the part played by water.

Pure silver chloride was prepared by addition of dilute hydrochloric acid to a solution of pure silver nitrate, the precipitate being washed by decantation till free from acid. The following facts were observed during exposure:—

(1.) Oxygen was evolved, a part of which was present as ozone.

(2.) When small quantities of water were present, chlorine and hydrogen chloride were found in solution.

(3.) When a large volume of water was taken, hydrogen chloride, but no chlorine, was detected.

The influence of hydrogen chloride in retarding the decomposition of silver chloride is considered, and is explained from experimental results given, which show that even minute quantities of hydrogen chloride exercise a marked influence on the stability of chlorine water when exposed to light, the rate of decomposition of the silver chloride being dependent on the readiness with which the chlorine in solution and water interact to form hydrogen chloride.

In the examination of the darkened product for oxygen, a portion of the substance was taken which had lost 8 per cent of its total chlorine during exposure. After it had been dried at 110° C. till it ceased to lose weight, it was heated in a current of pure hydrogen, the gaseous products of the reduction being passed through a weighed phosphorus pentoxide tube. Before using this substance as an absorbent of moisture, it was ascertained that hydrogen chloride was not absorbed by it after contact for a few hours only.

The results show that the gain in weight of the drying tubes after the decomposition of the silver compound, which lasted from 7–8 hours, is so small as to preclude the possibility of the presence of an oxygen compound in the darkened product. The darkening of the carefully dried chloride was also observed to take place when exposed to light in a tube containing dry carbon tetrachloride from which all air had been removed by boiling. From these facts the author concludes that the darkened silver compound is of the nature of a subchloride rather than an oxychloride.

PATENTS.

An Improved Sensitised Flexible Film for Photographic Purposes. E. W. Foxlee, London. Eng. Pat. 3393, March 4, 1890. *6d.*

A roll or web of heavily calendered or "surface" paper is coated with india rubber or some other waterproof material, and then with gelatin containing sufficient alum to make it wholly or partially insoluble. When the gelatin is dry it is coated with celluloid or other pyroxylin compound in a fluid or plastic condition, and when the latter is dry it is coated with sensitive gelatino bromide emulsion. After the emulsion has dried the back of the paper is moistened with the solvent originally employed with the waterproofing material and the sensitised film is separated from the paper. The claim made is for the combination of these processes and not for any one of them separately.

—C. H. B.

Improvements in or relating to Flexible Phototype Plates. G. Balagny. Eng. Pat. 4178, March 17, 1890. *6d.*

A flexible support of collodion, gelatin, celluloid, paper parchment, oilcloth, leather, &c. is coated with a film of gelatin or silver gelatino-bromide, or an emulsion prepared with any organic body forming a surface sensitive to light when sensitised with potassium dichromate. The films, after being dried, can be kept for a long time. When required for use they are sensitised by immersion for five minutes in a 3 per cent. solution of potassium dichromate, and are dried. They are then exposed in ordinary printing frames, and, since the film is flexible, it can be examined during the process of printing. When silver salts are present, the image is much darker than with dichromate or organic matter alone, and hence the proper depth of printing is more easily secured. The print is washed in water, supported on a lithographic stone or planed steel block, and inked up in the usual manner.—C. H. B.

Improvements in Photographic Printing Apparatus for Producing Photographic Copies at a Rapid Rate. W. F. Greene and F. H. Varley, London. Eng. Pat. 4956, March 29, 1890. *8d.*

An apparatus for obtaining, on a continuous sensitised band, rapid consecutive reproductions of photographic prints from photographic negatives of various subjects. Claims are made for the use, in combination, of a continuous roll of suitable paper, a series of sensitising, developing, toning, fixing, washing, and other tanks, with means for supplying the requisite solutions, and means for drawing off the waste liquids; means for squeezing the liquid from the band as it passes from each tank; means for exposing one face of the sensitised band, and means for simultaneously exposing both faces, the band being kept stationary during exposure, and released immediately afterwards; means for continually feeding the printing frame with the exact length of sensitised band required for each print.—C. H. B.

Improvements in Apparatus for Use in Developing Photographic Plates or Films. E. Fairweather, Forest Hill. Eng. Pat. 5742, April 16, 1890. *8d.*

The apparatus is designed for the development of photographic plates, &c. without the use of a dark room. It consists of a dish with a transparent non-actinic bottom and top, the top being removable in order to allow of the introduction of the plate. At the side, or in any other convenient position, are one or more funnels communicating with the inside of the dish; and there is also a waste-pipe, to allow of the dish being emptied. Development is watched through the top, or if a piece of mirror is placed under the dish, at an angle of 45°, development, &c. can also be watched through the bottom.—C. H. B.

Improvements in Photographic Baths for Developing and like Purposes. J. B. Brooks, Birmingham. Eng. Pat. 9413, June 18, 1890. *8d.*

With a view to prevent the spilling of liquids, staining of hands, &c., the upper edges of the dishes (which may be made of ebonite, wood, metal, china, &c.) are provided with a hollow beading terminating in a flange or overhanging part directed inwards. The corners of the dish (or a special spout) have wings or flanges turned inwards. A movable spout or corner attachment, consisting of a cover plate with spring clips or other holders, may also be used.

—C. H. B.

Improvements relating to Films for Use in Photography. V. Planchon, Boulogne-sur-Mer, France. Eng. Pat. 14,189, September 9, 1890. 8*d.*

Rigid frames of suitable size and shape are fastened by simple pressure or by means of some adhesive substance to films, sensitive or insensitive, prior to the evaporation or oxidation of the solvents. When the film is completely dry the frame keeps it tight and smooth.—C. H. B.

An Improved Preparation of Chemicals adapted to the Development of Photographic Plates and the like. A. McDonald, Silloth. Eng. Pat. 15,091, September 24, 1890. 4*d.*

One part of sodium oxide, four parts of sodium carbonate, and eight parts of sodium sulphate, are fused together and made into sticks or pellets of convenient size or weight. Any proportions other than those given may be used if preferred. The sticks or pellets are dissolved in a measured quantity of water, together with a definite amount of solid pyrogallol.—C. H. B.

An Improved Process of Printing in Colours. W. Schumacher and L. C. Raegener, New York, U.S.A. Eng. Pat. 3342, February 24, 1891. 4*d.*

This invention relates to an improved process of printing in colours in such a way that the well-known character of a water-colour painting is closely imitated. The different colours of the picture are reproduced in wash tints by means of lithographic ink or crayon on the surface of as many separate transfer sheets as there are colours to be printed, these sheets being made of celluloid or other suitable hard unimpressionable surface. The several tints are then transferred to separate stones or plates having grained surfaces. The printing surfaces are next coated with a layer of gum solution, dried, washed off, and rolled up in the usual way with transfer ink. They are then prepared with gum and acid, like a crayon drawing. Finally the different colours are printed from these prepared surfaces in register to correspond with the colours of the original picture.—W. E. K.

XXII.—EXPLOSIVES, MATCHES, Etc.

The Annual Report (Fifteenth) of Her Majesty's Inspectors of Explosives for 1890.

The report of Her Majesty's Inspectors of Explosives just issued states that there has been no falling off in the high standard hitherto attained in the state of the factories and magazines visited under the Act. One new factory was licensed during the year, but no new explosives have been added to the list of authorised explosives. Five years ago there were 108 factories employing 7,484 persons, now there are 123 factories giving employment to 9,820 workers. During the year there were accidents during manufacture causing the death of eight persons. In regard to importation there has been an extraordinary decrease in the amount of foreign dynamite brought into this country compared with former years, only 371,650 lb. being imported last year as against an average of 1,000,000 lb. a year for the previous eight years. Part of this decrease is doubtless to be accounted for by an increase in the amount of the gelatinous forms of nitro-compounds imported, but still the total amount of nitroglycerin explosives imported was more than 400,000 lb. less than during the previous year. Dr. Dupré, in his report to the inspectors on the chemical work of the department, points out that although the gelatinised preparations are displacing the original Kieselguhr dynamite, they have dangers of their own which the manufacturer has not yet completely overcome. The chief of these is their liability to exude a thin gelatin which is liquid at ordinary temperatures, and it seems also more difficult to insure absolute stability under the most trying conditions of temperature and storage. No authentic case of the spontaneous ignition of dynamite is on record, whereas there are several such in regard to gelatinous preparations. In the hottest climates these should be stored in water, when practicable, and carefully inspected periodically. Many of the imported samples of blasting gelatin failed to pass the prescribed tests, but the condition of the other explosives was, on the whole, very satisfactory. The French chalk to be used in the heat test will, in future, be defined as follows: "French chalk.—Commercial French chalk is carefully washed with distilled water, dried in a water oven, and then exposed under a bell jar to moist air until it has absorbed about 0·5 per cent. of moisture at the most. The chalk is then thoroughly mixed and bottled for use." The useful effect which the Explosives Act has exercised is seen from the facts that the average number of deaths during the last 10 years is eight per annum, whereas during the seven years preceding the Act the average number of deaths was 39·5 per annum; at that time there were only 55 factories, now there are 123.

Under the heading of Foreign Explosions the report notices that at Dupont's gunpowder factory, near Wilmington, U.S.A., about 80 tons of brown prismatic powder exploded. This is the largest amount of gunpowder accidentally exploded within the experience of the inspectors. An explosion which took place in a picric acid factory at Mannheim possesses several interesting points. The accident is considered to have originated in the ignition (by friction or otherwise) of some picrate of lime which had been formed by the action of the picric acid upon the whitewash and mortar of the walls. It was also found that 2,510 kilos. of picric acid burnt away without explosion. The report also notices the more important explosions and fires which were due to petroleum.—W. M.

PATENTS.

A New Combustible Compound. W. Rucktæschell, St. Petersburg. Eng. Pat. 1349, December 16, 1885. Second Edition. 6*d.*

This is an invention for producing a special kind of nitrocellulose for actuating an explosion-engine patented by the same inventor. Wood fibre is first boiled with potash and then with dilute nitric acid. One part of the purified wood-fibre is then nitrated by treatment with one part of nitric and one part of sulphuric acid.—W. M.

Improvements in the Manufacture of Explosives. C. O. Lundholm and J. Sayers, Stevenston. Eng. Pat. 12,338, August 3, 1889. Second Edition. 4*d.*

The inventors combine nitroglycerin and so-called insoluble nitrocellulose by means of heat and pressure. As this product is sometimes brittle, some soluble nitrocellulose or nitroxycellulose or nitrocellulose is added to the insoluble nitrocellulose. One per cent. of a camphor or mono- or dinitro-derivative of the aromatic group has a distinct effect in reducing brittleness and facilitating gelatinisation. The heat employed may be from 40° to 100° C., and the pressure at least one ton per square inch. (See also this Journal, 1889, 414, 764, and 893.)—W. M.

Improvements in the Manufacture of Gunpowder. H. Kolf, Bonn, Germany. Eng. Pat. 8811, June 7, 1890. 6*d.*

This invention consists in nitrating "carbon hydrates or plants or their waste products, which possess the qualities of carbon hydrates in a nitrogenous condition," under a pressure of from 2 to 5 atmospheres. After washing and drying, the mass is treated with sulphuretted hydrogen or a solution of potassium or sodium sulphides, &c., under a pressure of about 5 atmospheres; after again washing, the

material is treated under 4 or 5 atmospheres with a solution of an alkaline nitrate. The product is next treated with a solution of a "binitro-carbon hydrate" and moulded into suitable forms.—W. M.

Improvements in Blasting Cartridges. T. Puskas and I. Schlenker, Budapest, Austria-Hungary. Eng. Pat. 10,662, July 9, 1890. 6*d*.

The invention consists in making cartridge shells of every possible shape thicker along the surface or side further from the object to be blasted, whilst the opposite surface or side is made thin, so that the gases of the exploding blasting material have more difficulty in bursting the strong surface farther from the object to be destroyed and less difficulty in bursting the thin surface nearer the said object, whereby the whole effect of the gases produced is directed towards the object to be burst, which is of great advantage. —W. M.

Improvements in the Manufacture of Matches. C. R. E. Bell, London. Eng. Pat. 330, January 7, 1891. 4*d*.

This invention consists in the use of coloured paraffin for coating matches, so that a glance is sufficient to show whether the matches have been properly paraffined or not. —W. M.

Improved Lucifer Matches. G. A. Rosen Rotter, Groningen, Holland. Eng. Pat. 3679, February 28, 1891.

This invention consists in using washed turf, peat, or moss, with or without addition of clay or resin, &c., pressed into suitable forms in place of the usual wood splints.—W. M.

XXIII.—ANALYTICAL CHEMISTRY.

APPARATUS.

A Method of Determining the Consistency of Lubricating Grease. R. Kissling. Chem. Zeit. 1891, **15**, 298—299.

See under XII., *page* 555

A Convenient Apparatus for the Determination of Melting Points. R. Ebert. Chem. Zeit. **15**, 76.

The results obtained by different apparatus, several of which have been introduced lately (compare this Journal, 1890, 894) vary to a considerable extent, and the author recommends the following modification of the method with a sulphuric acid bath, which he has found accurate and convenient during a period of seven years. The apparatus consists of a test cylinder of about 25 mm. diameter, 15 mm. from the bottom of which a piece of perforated platinum foil is fitted, in order to prevent unequal heating. The cylinder is closed with lead foil or asbestos, in which the thermometer and the capillary tubes are fixed. The thermometer is about 15 mm. distant from the platinum foil, and the capillary tubes, which are longer than usual, are placed as near as possible to the bulb of the thermometer. Another capillary tube, bent at right angles at the lower end and passing through the lead foil or underneath the asbestos, reaches below the thermometer near the platinum foil, and serves to introduce a slow current of air. In working with this apparatus a small flame only is used, and the rising of the temperature is slow but equal. A further advantage is that no shaking of the liquid is necessary. The same sulphuric acid may be used many times, especially when the air passes through a calcium chloride tube before entering the apparatus. The cylinder employed should be of sufficient length, so that no inconvenience may be experienced from the escape of the sulphuric acid vapours.—H. S.

INORGANIC CHEMISTRY.—QUANTITATIVE.

Determination of Carbon in Steel. A. A. Blair. J. Anal. and Appl. Chem. March, 1891.

The author has repeated Dudley's experiments in connexion with the use of ammonium copper chloride as a solvent when estimating carbon in steel and confirms Dudley's results (this Journal, 1891, 67—68) to the effect that the double chloride contains carbonaceous matter, and that when used the quantity of carbon found diminishes with each crystallisation of the double salt, and is also lower when neutral than when acid solutions of the double salt are used. This latter occurrence is, in Langley's opinion, due to the precipitation of carbon from the acid solution of the double salt, whereas the author thinks that the neutral solution becomes slightly alkaline and dissolves some of the carbonaceous residue; he also attributes the carbon present in this salt to hydrocarbonaceous matter derived from the gas-liquor from which the ammonium salt is prepared; he finds, however, that this source of trouble may be entirely avoided by the use of potassium copper chloride which in experiments proved not only quite efficient, but also a safer and more desirable solvent than the ammonium copper salt.

For the combustion of the carbonaceous residue from the steel, the author employs a platinum tube 26 in. long and $\frac{5}{16}$ths of an inch diameter, the front part in the furnace is filled for 6 in. with granulated copper oxide kept in position by platinum gauze plugs, a similar plug being used behind the platinum boat; the latter is 6 in. long and just large enough to go in the tube; and for the direct combustion of steel in oxygen it is provided with a platinum foil cover having half circles cut through at intervals of half an inch, and in use the semi-circular flaps thus formed are set up at an angle of 45° so as to direct the current of gas down into the boat. The oxygen and air are admitted under pressure, passing through potash and over fragments of pumice before entering the tube. The issuing gas is in the author's opinion most conveniently and safely purified by the following arrangement:—Two of the U-tubes ordinarily employed for such purposes are used; the larger bulb of the first tube is filled with fragments the size of split peas of dry cuprous chloride for absorbing hydrochloric acid and chlorine, the remaining part of the tube being charged with granular anhydrous copper sulphate and a plug of asbestos; in the small bulb of the next tube a plug of cotton is placed and moistened with one, or at the outside two, drops of water, to adjust equilibrium of moisture, the other portion of this tube being filled with dried, not fused, calcium chloride; the author fears the presence of lime in the fused salt. The experiments also indicate the great value of using a standard iron of known carbon content for such investigations as these.—D. A. L.

Errors in the Volumetric Determination of Zinc by Potassium Ferrocyanide and how to avoid them. D. F. Moldenhauer. Chem. Zeit. **15**, 223—224.

The extreme sensitiveness of copper sulphate paper as an indicator (this Journal, 1890, 108—109) has enabled the author to make observations on the above subject. The potassium ferrocyanide solution which has to be used for the titration of zinc, is first colourless, but soon some ferric oxide is precipitated and the liquid assumes a yellow colour. This may be prevented by adding 1—2 grms. of caustic alkali to 1,000 cc. of the solution, and keeping the latter in opaque bottles and dark places. The correctness of the volumetric determination is not affected by calcium-, strontium-, aluminium-, lead-, and ferric-oxide; much ferric oxide, however, may produce a slight difference. But in the presence of magnesia 3—6 per cent. more than the correct quantity of potassium ferrocyanide may be necessary for the titration. Manganese oxide produces a similar difference which however seldom exceeds 4 per cent.

To avoid these errors the author recommends the following method:—

2·50 grms. of zinc ore are dissolved in hydrochloric acid, some nitric acid added, and the liquid diluted without

filtration to 250 cc. A Geissler's burette is rinsed and filled with this liquid, 50 cc. of which are mixed in a flask with 10 cc. of ammonia and 5 cc. of a solution, 100 cc. of which contain 5 grms. of ammonium carbonate, 5 grms. of ammonium chloride and 10 cc. of ammonia. The mixture is heated until a precipitate is formed and is then allowed to stand until cool. Meanwhile 25 cc. are poured off from the burette, and mixed with 10 cc. of ammonia and titrated approximately; another 25 cc. of the original liquid are added, and then an accurate titration is made. To the liquid in the first flask, when cool, between 1 and 2 cc. (not more) of sodium phosphate solution of 10 per cent. strength is added, and the mixture shaken, manganese oxide and magnesia, if present, being thereby precipitated; then another titration is made, the final reaction of which has to be controlled after a short time. The difference between this and the first titration gives the amount of magnesia or manganese oxide present. The advantages of this method are, that no filtrations are necessary, that the titrations can also be made by artificial light, and that the final reaction is very delicate.—H. S.

Arsenic in Crude Acids. Chem. Zeit. **15**, 43.

In reply to a complaint that crude acids often contain large quantities of arsenic, the following figures are given which show that, as a rule, this is by no means the case:—

Arsenic in 100 Kilos. of Sulphuric Acid.	Arsenic in 100 Kilos. of Hydrochloric Acid.
Grms.	Grms.
1·3	2·4
4·4	3·1
2·3	10·4
0·8	0·7
0·8	1·7
1·2	5·7
1·3	9·7
1·0	..
1·4	..
0·8	..
1·9	..
0·8	..

—H. S.

ORGANIC CHEMISTRY.—QUALITATIVE.

A Test for Strophanthin. Helbing. Schweiz. Wochenschr. f. Pharm. **25**, 239.

If a trace of strophanthin, dissolved in a drop of water, be mixed with ferric chloride and a drop of sulphuric acid added, a reddish-brown precipitate forms, which either at once or after standing some hours turns to an emerald green colour.—H. S. P.

Gayon's Test for Aldehyde. H. Bornträger. Zeits. Anal Chem. **30**, 208.

As a test for aldehyde in spirit, Gayon (Compt. Rend. **105**, 1182; this Journal, 1888, 238) recommends the use of a solution of magenta, which has been decolourised by means of a little hydrochloric acid and a large quantity of acid sodium sulphite. The author finds this method unreliable, partly because the action of the air induces the oxidation of the acid sodium sulphite to acid sodium sulphate and causes the reappearance of the magenta colour. On the other hand the presence of acetal which occurs in nearly every spirit that has not been very well rectified, and especially in Russian spirit, destroys the colour of the magenta, so that when a little aldehyde is present together with much acetal, no colour reaction takes place.—H. S. P.

Ihl's Tests for Lignin: A Question of Priority. M. Niggl. Chem. Zeit. **15**, 298.

The author considers that Ihl ignores the existence of the greater portion of literature concerning the chemical reactions of lignin, since that chemist continues to describe as new reactions which are already well known. Thus, Ihl in a recent article (Chem. Zeit. **15**, 201; see page 563), refers to a paper published by himself in 1885, in which the property possessed by phenols of yielding colour-reactions with lignin is pointed out. This property was discovered several years before that date by v. Höhnel (Sitzungsbericht. d. Akad. d. Wissensch. Wien, 76), who observed the reaction with phenol, and subsequently by Wiesner, who showed that such colour-reactions were produced with catechol, resorcinol, pyrogallol, and phloroglucinol. The author, again, in 1881 drew attention to these reactions in an article discussing the chemical nature of lignin.

The pyrrol reaction (see this Journal, 1887, 306; 1888, 51; 1889, 421, 640, 914, 1012; 1890, 418, 555, 770; 1891, 165), also, to which Ihl gives preference as being the most delicate test for lignin, was known and described before it was discovered by Ihl. It is mentioned, for instance, by Behrens in his work (Hilfsbuch zur Anleitung Mikroscopischer Arbeiten, 1883), a book in which descriptions are given of most of the "new" reactions discovered by Ihl. The author has long since replaced pyrrol in his investigations by indole, which is a more stable and delicate reagent; Singer, Behrens, Tschirch, and Zipperer have all testified to the superiority of indole.

Further, to avoid mistaking membranes which are merely lignified for true lignin, the necessity for concurrent microscopical investigation, whilst making the chemical tests, is pointed out. Ihl appears to have overlooked this.—E. B.

ORGANIC CHEMISTRY.—QUANTITATIVE.

Supplementary Notes on the Chemistry of Whisky. A. H. Allen.

See pages 519—521.

A Note on Löwenthal's Method of Tannin Analysis. R. L. Whiteley and J. T. Wood.

See page 523.

On the Determination of Pine-Rosin in Bees-wax. H. Röttger. Chem. Zeit. **15**, 45.

To effect such determination various methods are known, the degree of accuracy of which is different.

1. *Donath's Method.*—Some of the wax is boiled in a test tube for 15 minutes with concentrated nitric acid, and then cold water added in a fine jet, by which the wax is solidified. The liquid is now poured off and, when cold or if water is added to it will, if pine-rosin is present, yield a yellowish flocculent precipitate which dissolves in ammonia, giving a red-brown colouration. The author finds that this method gives accurate results, but that the following is more convenient.

2. *E. Schmidt's Method.*—Five grms. of wax are boiled with four or five times as much crude nitric acid (1·32—1·33 sp. gr.). After one minute the mixture is diluted with cold water to twice its volume, and then ammonia must be added until a strong odour of ammonia is given off, the liquid during the operation being frequently shaken. The liquid, which has to be poured off from the solidified wax, is yellow, if the wax was pure, but if it was adulterated by pine-rosin, it shows a more or less red-brown colouration (in consequence of the nitrogenous products which have been formed). This method is a very good one, and the author confirms the statement, that as little as 1 per cent. of pine-rosin can be determined with perfect accuracy. It can be made still more accurate if the alcoholic extract described in the subsequent test be used.

3. *Hager's Method* is modified by the author as follows:—A sample of the wax to be tested is boiled with 15 times its volume of dilute alcohol (of 50 per cent. strength volumetrically), and when perfectly cold filtered, if necessary. Then the liquid is diluted with water to double its volume. If the wax is pure, this diluted liquid is clear, but if pine-rosin be present it is of a milky appearance, and not clear. As little as 2 per cent. of pine-rosin can with accuracy be detected by this method.

4. *Sedna's test*, which consists in dissolving the wax in chloroform and adding lime water, is, according to the author, of no value whatever, as he never succeeded in obtaining the grey-brown flocculent substance which Sedna describes as indicating the presence of pine-rosin. (See also this Journal, 1890, 83 and 771; and 1891, 165.)

—H. S.

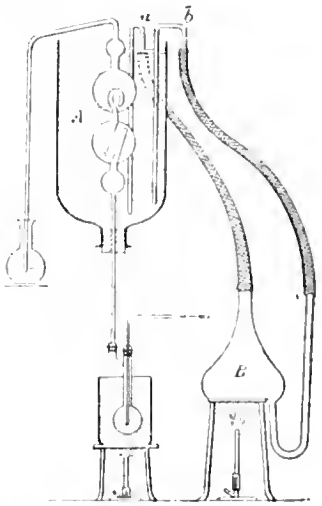
On the Composition of Woody Matter and the Influence of Alkalis and Calcium Bisulphite on Wood. A. Ihl. Chem. Zeit. **15**, 201—202.

See under XIX., *page* 563.

On the Quantitative Determination of Mechanical Wood Pulp in Paper. R. Benedikt and M. Bamberger. Chem. Zeit. **15**, 221—222.

Two methods have hitherto been usually employed for this purpose, viz.:—

1. Godeffroy's method (compare Mittheil. d. k. k. Techn. Gew. Museums, 1888, 18, 66—77, and 1889, 9—11; this Journal, 1888, 863—864; 1889, 574—576). The paper to be tested has to be extracted in consecutive order by the following liquids: cold and boiling water, hot solution of



The Determination of Methoxyl in Lignin.

tartaric acid in alcohol of 80 per cent. strength, hot water and cold water, and, finally, alcohol and ether. After that the residue is boiled with a dilute solution of gold chloride, and the gold which is hereby obtained, weighed, as

Size.	Water.	Ash.	Methyl Number.	Mechanical Wood-Pulp found.	Actual Composition of Paper.	
					Mechanical Wood-Pulp.	Other Substances.
	Per Cent.	Per Cent.		Per Cent.	Per Cent.	
Unsized	7·62	0·64	15·46	68·40	70	30 per cent. of linen rags.
Unsized	7·53	0·71	13·51	58·89	60	40 per cent. of linen rags.
Unsized	7·12	0·90	11·69	51·73	50	50 per cent. of linen rags.
Vegetable size	6·97	1·80	11·81	52·25	50	50 per cent. of linen rags.
Vegetable size	6·97	1·80	11·74	51·94	50	50 per cent. of linen rags.
Unsized	6·63	0·94	8·82	39·02	40	60 per cent. of linen rags.
Vegetable size	7·61	1·90	8·73	38·80	40	60 per cent. of linen rags.
Animal size	6·63	2·04	8·77	38·80	40	60 per cent. of linen rags.
Unsized	6·85	1·02	6·21	27·47	30	70 per cent. of linen rags.
Animal size	6·88	2·15	5·90	26·10	30	70 per cent. of linen rags.
Vegetable size	6·32	2·26	5·19	22·96	20	80 per cent. of linen rags.
Unsized	6·62	1·17	2·16	9·56	10	90 per cent. of linen rags.
Vegetable size	6·88	12·19	10·55	46·68	43·5	a 43·5 per cent. of linen rags. b 43 per cent. of China clay.
Vegetable size	7·76	1·90	11·95	53·05	50	50 per cent. of cellulose.

mechanical wood-pulp has the property of reducing 11·285 per cent. of gold on the average. Ehmann has proved that this method gives fairly good results, but the great number of extracts which have to be made, if a reliable result is expected, render this method very inconvenient.

2. Teclu's method (see Jahresber. d. Wiener Handelsak. 1890, 159). This test is based upon the observation that mechanical wood-pulp, if digested with a mixture of 60 per cent. of sulphuric acid and 40 per cent. of water, is said always to yield a residue of 24·5 per cent. But this observation cannot be considered conclusive, as it is based only upon two determinations.

Now the authors have recently shown that lignin has a rather high "methyl number" (compare this Journal, 1889, 735 and 925; 1890, 659 and 1156—1157), and they have already pointed out that it will be possible to calculate the quantity of mechanical wood-pulp in paper by finding the methyl numbers of lignin contained in it. Although the methyl numbers of different kinds of wood have been found to vary, those woods which are mostly used in the manufacture of mechanical wood-pulp do not differ much in this respect, and, besides, the different kinds of wood may be ascertained by a preceding microscopical examination of the paper and the corresponding methyl numbers chosen. The following table contains some of the woods which are of practical value:—

	Methyl Number of Woods dried at 100° C.
Pine	22·6
Red fir	22·5
White fir	24·5
Ash	22·6

The determinations have been made with the apparatus of Benedikt and Grussner (see this Journal, 1889, 735—736; 1891, 163) which is modified, however, in the following way (see Fig.):—The two glass tubes *a* and *b* reaching to the bottom of A are connected by india-rubber tubes of large diameter with a copper vessel B of the shape indicated in the Figure. A and B are filled with water, and B is heated by a Bunsen burner. As soon as the water in B boils, the opening at the end of the tube *a* is closed with the finger for a short time, and the consequence is that *b* fills with water, and as soon as *a* is opened again a regular circulation takes place from A through *b* to B and from there through *a*, back to A. Instead of the copper vessel described, a glass flask may be used, arranged like an ordinary washing bottle, the longer glass tube being bent downwards.

The determination of the methyl number should be made as carefully as possible, as a difference of one in this number represents 5 per cent. of mechanical wood-pulp. The test is finished only when the silver nitrate solution remains perfectly clear above the precipitate (compare this Journal, 1889, 736). For each test 1·5 to 2·0 grms. of the substance and 30 cc. of hydriodic acid of 1·70 sp. gr. are used. Small quantities of sulphur, as may be contained in the animal or vegetable sizes of the paper, do not interfere with the test, but a larger amount of sulphur makes the methyl number smaller by forming mercaptan. This method therefore cannot be used for papers containing gypsum or barium sulphate. The table on previous page shows the results obtained by this method, as compared with the actual composition of different kinds of paper.

The method may further be used for finding the amount of lignin in cellulose.—H. S.

Estimation of Fatty Bodies in Vegetable Organisms. W. Maxwell. Amer. Chem. J. 1891, 13—16.

The author chiefly experimented with cotton seed, which had been reduced to the greatest state of fineness, and extracted in the Knorr apparatus. It was found that in order to ensure complete extraction the ether ought to act for at least 15 hours. The same sample when treated for 8½ hours yielded 37·39 per cent. of extract, calculating on the dry substance, but a 15 hours' extraction gave 38·38 per cent.

The substituted glycerides, or lecithins, have lately become of some analytical importance, as their presence enables an analyst to testify as to the presence, and even to approximately estimate the quantity, of several fatty matters, such as the oily substance of the seeds of the vetch, and horse-bean, or even of yolk of egg. The ethereal extract has only to be burned with mixed alkali salts (nitrate and carbonate?) and the ash examined for phosphoric acid. From its amount the percentage of lecithin may be calculated by multiplying by the factor 10·87.

The author has, however, found that only about one-half of the lecithin is readily extracted by the direct treatment with the ether. The residue must again be extracted with boiling alcohol, and the extract once more immediately exhausted with ether, when it will give up the remainder of the lecithin.—L. de K.

On the Behaviour of the Fatty Bodies and the Rôle of the Lecithins during Normal Germination. W. Maxwell. Amer. Chem. J. 1891, 16—24.

The author, after pointing out the difficulties in the way of estimating the normal glycerides in vegetable organisms, owing to the presence and solubility of cholerestin, &c., remarks that the lecithins may be estimated in germinated materials from the organic phosphorus, separated with ether and alcohol. This is supported by proof that the phosphorus is present as a lecithin since cholin is yielded as a decomposition product. The seeds experimented upon were those of *Phaseolus vulgaris*, *Gossypium*, and *Lea Mays*; and germination was stopped at certain stages of development, not at certain periods, as is usual.

In the first named the increase of lecithin was 15·9 per cent. at the end of the first stage. In *Gossypium* the amount rose and fell again, showing that some was again decomposed, as the plant further developed. From these results the author concludes that new lecithins were formed from the inorganic phosphorus compounds, but it is not clear that the whole of the amount discovered was reorganised. In fact the question as to what happens to the original lecithins in the mature seed must be solved hereafter.

— L. de K.

The Quantitative Estimation of Penta-glucoses in Plants. G. de Chalmot and B. Tollens. Ber. **24**, 694—695.

The authors have modified Günther and Tollens' method (this Journal, 1890, 903) of estimating penta-glucoses, in so far that they precipitate the furfurol produced by the distillation of certain carbohydrates with hydrochloric acid, as furfurol hydrazone. Precipitation is effected in presence of acetic acid by means of a solution of phenylhydrazine acetate. The precipitate is collected in an asbestos filtering tube and dried by suction at 50—60° C. A correction is applied to the weight of furfurol found to allow for the slight solubility of the precipitate in the liquid. The average yield of furfurol obtained by the distillation of various sugars with hydrochloric acid is as follows:—

	Per Cent.
Arabinose	48·72 of furfurol.
Xylose	56·25 of furfurol.
Penta-glucoses	52·5 of furfurol.

A number of carbohydrate substances were analysed by the above process, the furfurol found being calculated into the corresponding amount of arabinose or xylose. The results obtained are given below:—

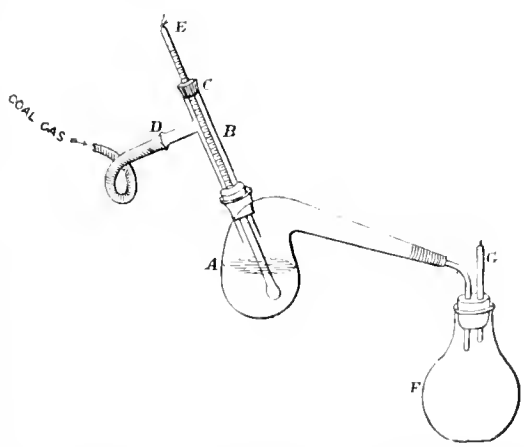
	Per Cent.
Cherry gum (new, of good quality)	15—16 of arabinose.
Wheaten straw	24·9 of xylose.
Oat straw	22·6 of xylose.
Beech wood	19·7 of xylose.
Pine wood	7·8 of xylose.

(See also this Journal, 1891, 473.)—H. T. P.

Determination of Turpentine in Paints and Varnishes. H. J. Phillips. Chem. News 1891, **63**, 275.

When paints or varnishes are distilled in air, it is known that oxidation-products are formed giving a low result for turpentine, while the residue of linseed oil, &c. is rendered useless for further examination owing to the formation of the inert linoxyn, &c. In ordinary cases the distillation may be conveniently carried on in a gentle current of coal-gas.

The figure represents the apparatus used by the writer. B is a three-way tube fitted into the tubulure of the retort A, through a cork, the end of the tube being about half an inch



from the surface of the sample; into the part B a thermometer, E, is fitted, supported by a rubber plug at C. D is connected with a supply of coal-gas. F is a tared receiver,

which is to be kept in a basin containing cold water. G is a small tube for allowing the gas to escape. About 150 grms. of the sample are weighed into the retort, and connected to the tared receiver as in sketch. The retort is now suspended in a glass air-bath (a beaker with its bottom cut out is convenient) over wire-gauze on a tripod-stand. Before proceeding with the distillation a gentle current of coal-gas is made to pass through the apparatus, and when all the air has been driven out the issuing gas is lighted at G, and the gas turned down until the flame is about the size of a pea. A rush of gas must be avoided, or there would be a loss of turps. A small flame is now placed under the retort, and the distillation proceeded with gently. The turpentine should drop into the receiver without affecting the gas issuing at G. The temperature necessary for the complete expulsion of turps may be about 220° C. When all the turpentine has come over, detach F and plug the end of the retort with a cork, leaving the gas still turned on until it be required to examine the residuum, which is thus kept free from oxidation.

The Volumetric Determination of Hydrocarbon Vapours. W. Hempel and L. M. Dennis. Ber. **24**, 1162—1164.

The authors have compared Bunsen's and E. St. Claire Deville's (this Journal, 1889, 972—973) methods for the determination of the hydrocarbon vapours (benzene and naphthalene) in coal-gas with the result that they find the former gives considerably higher results than the latter. Bunsen's method consists in passing a large volume of the gas through a long wide tube and a wash-bottle filled with alcohol, the hydrocarbons being then separated from the alcohol by which they have been dissolved by the addition of a saturated aqueous solution of sodium chloride. In Deville's method the gas is cooled to − 22° C., whereby the suspended vapours are deposited. 15·4 cc. of liquid hydrocarbons containing 3·5 cc. of benzene and 13 cc. of liquid hydrocarbons containing 5 cc. of benzene were obtained respectively by the above two methods from 1,497 cc. of Dresden gas. The low result in the latter case is traced to the difficulty of keeping a constant temperature of − 22° C. for several days as is required for the experiment. With the view of making the method both handier and more accurate, the following plan has been devised. The coal-gas is measured in an ordinary Hempel burette over water saturated with the gas, which is then connected with a gas pipette, having the form of the Hempel explosion pipette, by means of a capillary tube, in the usual manner. The pipette contains 1 cc. of absolute alcohol enclosed by means of mercury; this quantity of alcohol can be readily introduced by siphoning it in from a gas burette. The alcohol should first be saturated with coal-gas so as to prevent its absorbing any constituents other than the hydrocarbon vapours. The coal-gas having been siphoned into the pipette it is agitated with the alcohol for 3 minutes, then siphoned back and passed into a similar pipette containing 1 cc. of water instead of alcohol, which effects the absorption of the alcohol vapours. The water in this second pipette must also be saturated with the coal-gas before use. In passing the gas into the alcohol-pipette care must be taken not to allow any of the water in the burette to pass beyond the capillary tube connecting the burette with the pipette.

The whole process can be carried out in 20 minutes, and only 100 cc. of coal-gas are required for the experiment. A further advantage is found in the fact that the results may be expressed directly as percentage by volume, which is not the case with the methods referred to above.

Dresden gas analysed in this way gave in two experiments 0·74 and 0·70 per cent. of hydrocarbon vapours, employing burettes filled with mercury; using water in the burettes the results varied from 0·50—0·63 per cent. An artificial sample of gas prepared by passing coal-gas through benzene gave the following results:—

1. 90 cc. of gas passed through benzene increased in volume to 93·1 cc. After absorption as above, 89·4 cc. were left.

2. 90 cc. of gas after passing through benzene increased to 93·0 cc. After absorption 89·4 cc. were left.

In these cases only 1 cc. of alcohol was employed, which is therefore sufficient to absorb 3 cc. of hydrocarbon vapours.

Since these vapours are dissolved to a considerable extent by caustic soda it is desirable to determine them before proceeding to the determination of the carbon dioxide in the gas.—C. A. K.

Purity of Benzene. C. Liebermann and A. Seyewetz. Ber. **24**, 788—790.

The authors find that so-called pure benzene of commerce frequently gives a comparatively abundant white crystalline precipitate with phenylhydrazine. This they traced to carbon bisulphide, the amount of which they estimate at 0·2 to 0·3 per cent., giving a precipitate equal to 0·8 per cent. of the benzene. Phenylhydrazine is accordingly recommended as a test for carbon bisulphide; three or four drops are added to about 10 cc. benzene; the mixture is frequently shaken and allowed to stand for 1 to 1½ hours. In this way it is possible to detect carbon bisulphide when present to the extent of only 0·03 per cent.

Benzene purified by crystallisation rarely contains carbon bisulphide.—A. K. M.

ANALYTICAL AND SCIENTIFIC NOTES.

Oxy-pyruvic Acid, a New Product of the Decomposition of Cellulose. W. Will. Ber. **24**, 400—407.

When collodion is treated with 10 per cent. soda in the cold and the alkaline solution after standing two hours is neutralised by acetic or sulphuric acid, a slimy precipitate falls out with the simultaneous evolution of carbon dioxide and oxide of nitrogen. The precipitate is insoluble in water but easily soluble in alcohol and alkalis; it contains nitrogen, and has been called cellulose dinitrate, as it does not yield cellulose when treated with ferrous chloride. This name is hardly correct; it appears rather to be the oxime of a ketone.

If the alkaline solution of collodion be allowed to stand for 20—30 hours, acids no longer precipitate the solution. The solution reduces alkaline copper solution and ammoniacal silver nitrate, and contains a body which yields a yellow hydrazine. This body is oxypyruvic acid, the osazone has a composition corresponding to the formula $COOH.C(N_2H.C_6H_5).CH(N_2H.C_6H_5)$. The free acid may be obtained direct from the alkaline solution of collodion. Analyses of its salts and the determination of its molecular weight by Raoult's method leave no doubt as to the correctness of the above formula. Its constitution might be aldehydic or ketonic, but the action of oxidising agents on it show that it is expressed by $COOH.CO.CH_2OH$.

—A. L. S.

PATENT.

Improvement in the Means of Determining Acidity or Alkalinity in Milk or other Substances. A. W. Stokes, London. Eng. Pat. 8551, June 3, 1890. 4*d*.

Pellets are made containing a definite quantity of some acid or alkali together with a suitable indicator, and these are added one by one to a measured quantity of the liquid to be tested, until the indicator shows that the acid or alkali has been completely neutralised. The quantity of free acid or alkali present is ascertained from the number of pellets required.

In the case of milk 10 cc. of the liquid is taken and the pellets contain 0·212 grm. of anhydrous sodium carbonate moistened with an alcoholic solution of phenolphthalein. The number of pellets required to produce a permanent pink colouration gives at once the quantity of lactic acid in tenths of a per cent.—C. H. B.

New Books.

Chemisch-Technisches Repertorium. Uebersichtlich geordnete Mittheilungen der neuesten Erfindungen, Fortschritte und Verbesserungen auf dem Gebiete der Technischen und Industriellen Chemie. Mit Hinweis auf Maschiwen, Apparate und Literatur. Herausgegeben von Dr. Emil Jacobsen. 1890. Erstes Halbjahr. Erste Hälfte. Berlin: R. Gaertner's Verlagsbuchhandlung, Hermann Heyfelder. Schönebergerstrasse 26, S.W. London: H. Grevel and Co., 33, King Street, Covent Garden.

The first issue for the first half year of 1890. It contains 144 pages of subject-matter, copiously illustrated with wood engravings. In the text the following subjects are treated of:—Building Materials, Cements and Artificial Stone. Colouring Matters, Dyeing and Calico Printing. Fats, Oils, Illuminating and Heating Materials. Fermented Liquors, Tanning, Leather and Glue Manufacture. Textiles. Glass and Earthenware. Wood and Horn. India-rubber. Cements, Plasters and Artificial Stone. Lakes, Varnishes and Paints. Metals.

The Pocket-Book of Mensuration and Gauging, &c., for Revenue Officers, Brewers, Spirit Merchants, &c. By J. B. Mant. Second Edition, Revised. 1891. London: Crosby Lockwood & Son, 7, Stationers' Hall Court, Ludgate Hill.

Small oblong pocket-book size, with india-rubber band. Commences with 16 lined blank pages. Then follows title-page; Dedication to W. H. Johnston, Esq., Collector of Inland Revenue, &c.; Preface to first and second editions, and 249 pages of Formulæ, Numerical and other data and Tabulated figures, data, &c. The Alphabetical Index is at the beginning and takes the place generally occupied by the Table of Contents.

Water Analysis, A Practical Treatise on the Examination of Potable Water. By J. Alfred Wanklyn and Ernest Theophron Chapman. Eighth Edition. By J. Alfred Wanklyn, M.R.C.S. London: Kegan Paul, Trench, Trübner & Co., Lim., 1891.

Crown octavo volume, bound in black cloth, containing with slight modification and addition the same matter as the last, the seventh edition. The addition is contained in an explicit statement of directions for preparing the solutions necessary for the Moist Combustion process, and will be found on page 54. These directions it will be remembered formed the subject of a patent by the author, taken out years ago. That patent has now run out, as the directions it contained now appear in the book, *loc. cit.* (see this Journal, 1889, 140).

Trade Report.

(From Board of Trade and other Journals.)

TARIFF CHANGES AND CUSTOMS REGULATIONS.

Russia.

Customs Decision.

The *Bulletin du Musée Commercial* says that by a circular dated the 10th April last the Russian Customs Department announces that all explosive materials sent from abroad in packets without mention of the fact being made in the declarations relative to these packets, will be confiscated on entry into Russia, as articles introduced clandestinely.

United States.

Customs Decisions.

The following decisions respecting the construction to be given to Acts of Congress relating to the classification of articles in the Customs tariff and the application of the Customs laws of the United States, have recently been given by the Customs authorities in that country:—

White lead, ochre, and umber, all in oil, and put up in small metal tubes such as are used by artists, are dutiable at 25 per cent., under the provision of paragraph 61, for "artists' colours, in tubes or otherwise."

Wool grease or dregas is dutiable at one-half of one cent. per pound under paragraph 599.

Chemical wood pulp, bleached, is dutiable at 6 dollars per ton.

Articles known as plateaus, used as ornamental dishes for the centre of tables, and for holding fruit, and for flower stands, and also for salvers, consisting of "dises of plate glass, silvered, from 6 to 16 in. in diameter, and set into a metal case with feet," are classified under paragraph 143 of the Tariff Act of 3rd March 1882, which provides a rate of 45 per cent. duty *ad valorem* on "porcelain and Bohemian glass, chemical glassware, painted glassware, stained glass, and all other manufactures of glass, or of which glass shall be the component material of chief value, not specially enumerated or provided for in this Act."

Copper, in pyrites ore, is admitted free of duty.

Candle tar, a by-product obtained in the manufacture of candles from animal grease, commercially known as "candle tar," and having a distinctive use as a waterproof lining for barrels and a waterproof covering for roofs, is dutiable as a non-enumerated manufactured article at 20 per cent.

Dead oil, a distillate of coal tar, is dutiable at the rate of 25 per cent. *ad valorem* as a distilled oil, under paragraph 76, N.T.

Straw intended for the manufacture of paper is dutiable at 30 per cent., under paragraph 289, N.T.

Regulus of antimony is dutiable, under paragraph 187 of the new Tariff Act of 1st October 1890, at three-fourths of 1 per cent. per pound.

Chili.

Customs Legislation.

Mr. Lewis Joel, Her Majesty's Consul-General at Valparaiso, in a report to the Foreign Office, dated the 11th April, transmits copy and translation of a decree of the Chilian Government which came into force on the 15th April, making obligatory the despatch and payment of duties at the Custom houses of the Republic of the articles therein enumerated. The translation is as follows:—

It is declared obligatory the despatch of the following articles:—

1st. Acids, oils, effervescing and mineral waters, asbestos, in whatever form, sugar, sulphur, washing blue, weighing scales, varnish, empty bottles, pasteboard, cement, beer,

raw sugar, chloride of lime, concrete sugar, soda crystals or soda ash, floor cloth, phosphorus, Bengal lights, tallow and grease, black lead, common soap, sweetened juices, looking-glasses (silvered or not), lard, wrapping-paper, kite-paper, petroleum, turpentine, common salt, caustic soda, sulphate of copper, colouring earths, chalk, candles, common glass, and packages having straw in sight. Large packages which cannot conveniently be stored, packages exceeding 100 kilos. weight and goods in bulk, considering as such those without exterior packing. Goods free of duty, all those which are not sufficiently packed to prevent loss of contents or those that are inadequate for storing in the ordinary manner.

2nd. These goods may be reshipped for foreign countries always provided that the interested party prove its identity to the satisfaction of the respective Custom houses, in which case the duties will be refunded.

The New French Tariff on Soaps.

Common and toilet soaps are among the articles upon which the Customs Commission of the French Chamber of Deputies proposes to increase the duties very considerably. At present common soaps pay 6 frs. per 100 kilos. It is proposed to increase this tax to 13 frs. for the minimum, and 17 frs. for the general tariff. The minimum tariff on perfumery soaps is to be raised from 8 frs. to 20 frs., and the general tariff from 12 frs. to 26 frs. The Commission justify their recommendations upon the ground that the internal taxes upon many of the ingredients used in soap-making have increased considerably since the fixing of the last tariff. Transparent soaps are to be placed in a separate category and taxed at 60 frs. to 70 frs. per 100 kilos., because, the Commission argues, it is impossible to ascertain by chemical means whether alcohol has or has not been used in their manufacture, while foreign manufacturers, usually by simply declaring that no alcohol has been used, contrive to pass them at the ordinary duty upon common soaps. On the other hand, if alcohol has been used, then the foreign alcoholic transparent soap has an enormous advantage over the home made, as the French manufacturer pays an excise of 1·56 frs. per litre on alcohols, equal to from 17 frs. to 156 frs. per 100 kilos. of soap, upon which no drawback is allowed.

The French Tariff on Chemicals.

The Paris Chamber of Commerce has submitted to the French Legislature its report on the modifications which it considers desirable in the new Customs tariff. So far as chemicals are concerned, the Chamber is generally in favour of a reduction of the present duties. It is pointed out that whereas 15 years ago France imported 12,000 tons of soda a year, now her industry has grown so large that she actually exports over 20,000 tons annually. The Chamber, therefore, suggests that the following duties will be sufficiently high: caustic soda, 1 frs. per 100 kilos., or 10 per cent. *ad val.*; carbonate of soda, 2 frs. per 100 kilos., or 10 per cent. *ad val.*; chloride of lime, 30 frs., or 12 per cent *ad val.* With respect to fine chemicals the Chamber supports the continuation of the present tariff for all but the following: Bromine to be placed on the free list (present duty 1 fr. per kilo.); all bromides to be taxed 5 per cent. *ad val.*, or 25 frs. per 100 kilos. The tax on iodine, now 4 frs. per kilo., or about 20 per cent. *ad val.*, to be maintained in the interests of the kelp industry, but that on iodides (now about 5 per cent. *ad val.*) to be raised to 4 frs. per kilo., or about 20 per cent., thus placing the manufactured product on a level with the raw. The late commercial war with Italy led to the placing of a heavy duty on concentrated lemon and bergamot juices, which the report wishes to abolish entirely. It would also free citrate of lime, and reduce the duty on crystallised citric acid from 50 frs. to 25 frs., or about 5 per cent. The report further asks that citrates may be made dutiable at 50 frs. per 100 kilos., instead of *ad valorem*, as at present. The oxalic acid manufacture is so strong and well organised in France that it is considered safe to place it on the free list, or at any rate to reduce the duty to 5 per cent.—*Chemical Trade Journal*

EXTRACTS FROM DIPLOMATIC AND CONSULAR REPORTS.

France.

The Merchandise Marks Act.

There is no change to report in connection with British trade at Havre, nor, with the prospect of a higher tariff on all manufactured articles, is there any chance of England doing a larger business after 1891. The Merchandise Marks Act continues to be applied with severity by the English Customs to goods sent to England in transit for foreign countries, especially with those going to the United States, and Britain is accused of wanting to monopolise the English language. Among other cases brought forward is one of 67 casks of earthenware tiles, manufactured at Creil, for a firm at New York, and bearing the words, burnt in, "Universal Wall Tiles Company." They were sent to Southampton for transhipment by one of the National Line steamers, and were stopped by the Customs, who imposed a fine of 10*l.*, and required the removal of the words—which was impossible—before releasing the goods. Finally, the casks were allowed to be forwarded and the fine was remitted, but permission for future transhipments of the same kind was refused. The result is that the goods, instead of being sent in British, are carried in French and German, vessels.

Italy.

Trade with the United Kingdom.

The following figures show the trade between Italy and the United Kingdom in pharmaceutical articles during the last two years:—

Imports.		1890.	1889.
Acids	Cwt.	8,640	6,130
Potash and caustic soda	..	136,016	134,198
Alkaloids	Lb.	3,726	2,892
Oxides	Cwt.	17,340	19,310
Carbonates	..	59,766	92,770
Chlorides	..	76,182	71,240
Nitrates	..	10,554	20,711
Sulphates	..	258,112	126,910
Other chemicals	..	25,638	26,368
Bark	..	9,696	9,382
Gums and resins	..	21,144	29,018
Soap	..	9,514	8,842

Exports.		1890.	1889.
Olive oil	Cwt.	131,284	215,156
Orange essences	Lb.	229,754	249,196
Boracic acid	Cwt.	34,050	26,694
Alkaloids	Lb.	5,480	8,150
Tartar and lees of wine	Cwt.	101,782	88,086
Orange and lemon juices	..	42,386	42,952
Liquorice, aloes, &c.	..	12,884	9,810
Soap	..	19,018	25,606

Olive Oil.

Turning to the amount of olive oil, the small amount lately sent out of the country is principally due to the deficient harvests of 1889-90, as the export to France varied but little in the last two years. Olive oil entering France from Italy is now subject to a differential duty of 15 frs. per quintal; but, taking the average cost of production

at 100 frs., and at 140 frs. for the finest qualities, such a duty, although nearly quadrupling that imposed under the general tariff, can scarcely be considered prohibitive, as is the case with the duty on wine.

The export of olive oil to France, which in 1886 touched 30 per cent. of the whole amount exported, diminished in 1890 to 23 per cent.

The finer oils made in Liguria and Lucca still maintain their superiority, and, considering how much more extensively the olive is now cultivated in Turkey, Greece, the Ionian Islands, Tunis, &c., Italy may be fairly satisfied with her export—in good years averaging some 600,000 quintals.

GENERAL TRADE NOTES.

Industrial Progress of the Southern States of the American Union.

A review of the industrial and agricultural progress of the Southern States of the American Union in the last 10 years, based on census statistics, is contributed by Mr. Porter, Superintendent of the Census, to the *Manufacturers' Record*. Mr. Porter says:—"The mineral development and the increase in manufactures during this period has been of such magnitude and of such importance as to seriously attract the attention of the world. The South is to-day producing as much coal, iron ore, and pig iron as the entire United States produced in 1870. To my mind the progress of the Southern States in the manufacture of steel will be as great during the next 10 years as it has been in the production of coal and pig iron during the past decade. The class of labour attracted to these rich mineral regions will be of a higher character than of the past; that is to say, there will be artisans and mechanics who will command a much higher rate of wages, and hence increase the consuming power of the South." In 1860 the best estimates that can be obtained, according to the superintendent, show that the Southern States produced less than 1,000,000 tons of coal, and in 1870 about 2,000,000 tons. In the year 1880, as shown by official data, this production has increased to 5,676,160 tons. According to the eleventh census returns the production in 1890 was 17,772,945 tons. This gives an output in the coal-producing States of the South in 1890 of more than twice the entire output of bituminous coal in the United States in 1860, and nearly 2,000,000 more tons than the total production of the United States in 1870.

These same States, the writer says, show far greater progress in the production of pig iron. The only one of these States producing pig iron in 1860 and 1870 was Tennessee, which in 1860 produced 13,741 tons; in 1870, 28,688, jumping to 70,873 in 1880, and in 1888 producing 267,931 tons. The entire production of all these States, including Tennessee, in 1880 was 397,301 tons, which had in 1890 increased to nearly 2,000,000 tons. The production of iron ore in these Southern States now almost equals the total production of the United States in 1870. As illustrating the immense development of these States in the production of coal and iron, the following table is given:—

—	Production of the United States in 1870.	Production of the Central Southern States in 1890.
	Tons.	Tons.
Bituminous coal	15,000,000	17,772,945
Iron ore.....	3,163,839	2,917,529
Pig iron.....	1,860,000	1,780,309

Minerals in Canada.

The following is extracted from the Toronto *Monetary Times* for the 15th May last:—

There has been issued at Ottawa a preliminary summary of the production of metals and minerals in the Dominion for the year 1890. It is possibly subject to correction or addition, but the value placed upon the total is about the same as in 1889, viz., 19,000,000 dols., as compared with 15,000,000 dols. in 1888. The most notable feature in the statement here given is that the most valuable output among the metals appears to be that of nickel. At any rate, the quantity of nickel raised is put down at 1,640,240 lb., or 820 tons, the value of which, at 75 cents per pound, would be 1,230,180 dols. This result, however, we must regard as an approximation, since the companies producing nickel are chary of giving information to Government about their doings. We give the figures as we find them.

Production of Metals, 1890.—Gold, 65,011 oz., value 1,166,227 dols.; copper, 6,454,913 lb., value 968,241 dols.; nickel, 1,640,240 lb., value 1,230,180 dols.; silver, 400,687 oz., value 120,662 dols.; iron ore, 76,511 tons, value 155,380 dols.; iron pig, 24,772 tons, value 331,688 dols.; lead, 113,000 lb., value 5,085 dols.

If reliance is to be placed upon these figures, we showed a considerable falling off during the year in the production of iron. But there will be an improved tale to tell of 1891 in this respect, for New Glasgow, Londonderry, and Three Rivers will all have additions to make to the manufactured iron returns. The figures for the principal non-metallic minerals are as follows:—

Asbestos, 8,000 tons, value 1,039,651 dols.; bricks, 208,587 thousands, value 1,247,607 dols.; building stone, 360,001 cub. yds., value 936,168 dols.; coal, 3,117,661 tons, value 6,396,910 dols.; glass, value 537,150 dols.; petroleum, 765,029 barrels, value 902,734 dols.

Total non-metallic, 13,928,417 dols.; total metallic, 3,722,565 dols.; estimated value of mineral products not returned, principally structural materials, 1,349,018 dols. Total, 19,000,000 dols.

Production of Olive Oil in Spain.

The following information respecting the production of oils in Spain is taken from the *Gaceta Mercantil*:—

The yield each year amounts to about 300,000,000 kilos. of oil, of which nearly half, or 147,600,000 kilos., represents the production of the provinces of Andalusia, Cordova, Seville, and Jaen.

Of the 49 Spanish provinces, including the adjacent islands, only 17 do not cultivate the olive. These are Alava, Burgos, the Canaries, Corunna, Guipuzcoa, Leon, Lugo, Orense, Oviedo, Palencia, Pontevedra, Santander, Segovia, Soria, Valladolid, Vizcaya, and Zamora. Further 14 provinces produce only the oil necessary for the consumption of their inhabitants; these are Alicante, Almeria, Avila, the Balearic Islands, Barcelona, Cadiz, Cuenca, Grenada, Guadalajara, Huesca, Logrono, Madrid, Navarre, and Salamanca. The latter produces the least oil, 137,000 kilos.

The province of Cordova produces the most, 55,200,000 kilos. The province of Seville produces 4,945,000 kilos., and Jaen 3,588,000 kilos.

There are consumed about 138,000,000 kilos. of oil in Spain, there only remains consequently an excess of 162,000,000 kilos. for exportation. The latter goes to South America, the Antilles, England, France, and Portugal. —*Board of Trade Journal.*

Coal Discovery in Asiatic Turkey.

The *Journal de la Chambre de Commerce de Constantinople* says that some coal mines have just been discovered at different places in the vilayet of Erzeroum. The mining engineer of the vilayet of Trebizond has been requested to go to Erzeroum, to examine these mines and to make a report.

Lavoisier's Medal.

The Société d'Encouragement pour l'Industrie Nationale has awarded its gold medal to M. Solvay for his share in the development of the ammonia-soda industry. This medal is only awarded in each sixth year, Ste. Claire Deville, Weldon, and Michel Perret being former recipients. The distinction is the greater as Schloesing, who is usually regarded by the French as the discoverer of this process, is himself a member of the committee.—*Industries.*

Production of Manganese Ores in the United States since 1880.

The production of manganese from 1880 to 1889, inclusive, has been as follows:—

States.	1880.	1881.	1882.	1883.	1884.
Virginia	2,761	3,295	2,082	5,355	8,980
Arkansas	..	100	175	400	800
Georgia	1,800	1,200	1,000	..	..
Other States	300	500	375	400	400
Total	7,761	4,895	4,332	6,155	10,180

States.	1885.	1886.	1887.	1888.	1889.
Virginia	18,715	29,567	19,835	17,446	14,616
Arkansas	1,487	3,316	5,651	4,312	2,528
Georgia	2,580	6,041	9,024	5,568	5,208
Other States	450	269	14	1,072	1,575
Total	23,258	39,193	34,524	29,398	23,927

This table shows the production of what may be strictly regarded as manganese ores in the classification above given. It has been impossible in some cases to separate the manganese and manganiferous ores which are the product of a given mine, but where the total production of State or mine averages more than 44·252 per cent. of metallic manganese its production is regarded as manganese ores.—*Eng. and Min. Journal.*

Mineral Production of Russia in 1889.

To the courtesy of Mr. W. A. Abeg, of St. Petersburg, we are indebted for the following statistical table of the mineral production of Russia in 1889, together with that of 1888:—

	1888.	1889.
	Pounds.*	Pounds.
Gold (Siberia and Lapland)	2,448	2,272
Platinum (Ural)	166	68
Silver (Altai, Baikal, Caucasus)	924	847
Lead (Altai, Baikal, Caucasus)	49,000	35,314
Tin (Zaylon)	1,200	721
Spelter (Poland)	230,000	149,318
Copper (Ural, Siberia, Poland, Caucasus, and Finland	281,000	377,571
Manganese ore (Caucasus and Siberia)	1,200,000	1,713,701
Pig-iron (Ural, Siberia, Finland)	10,715,000	15,535,412
Forged iron (Ural, Siberia, Finland)	22,356,000	26,307,279
Steel (Ural, Siberia, Finland)	13,540,000	16,100,059
Coal (Don, Ural, Turkestan, Caucasus, Poland, Sakhalin)	246,502,000	378,989,892
Salt (Astrakhan, Tauris, Perm, Ekaterinoslaff, Turgai)		†84,980,813
Naphtha (Tauris, Crimea, Caucasus)	191,447,000	198,970,242
Quicksilver	4,746 flasks‡	4,822 flasks.
Sulphur (Digestan, Ferghana)	..	5,791
Glauber's salt (Caucasus, Altai, Turgai)	..	622,055

* One pound = 16·38 kilogrammes. † Including 1888.
‡ One flask = 34·65 kilogrammes.
—*Eng. and Min. Journal.*

The Spanish Drug Trade.

The declared value of the imports of drugs and chemical products into Spain during the first four months of 1891 was 19,191,032 ptas., against 19,039,215 ptas. and 15,095,080 ptas. respectively in the corresponding periods of 1890 and 1889. The exports of some of the principal Spanish products of pharmaceutical interest have been as follows:—

	January—April.		
	1889.	1890.	1891.
	Kilos.	Kilos.	Kilos.
Quicksilver	1,266,745	659,347	1,206,025
Liquorice, in pipe	637,361	625,754	547,371
Liquorice, in paste	162,082	278,102	249,045
Cream of tartar	151,571	129,322	180,053
Anise	212,336	205,576	249,976
Olive oil	12,210,094	5,696,487	4,543,187
Saffron	9,859	12,157	14,930

—*Chemist and Druggist.*

The German Alkali Industry.

The managing director of the German alkali works, "Rhenania," in an article in a recent German chemical journal, gives an interesting account of the German alkali industry since 1873. In that year the duties on soda salts were considerably reduced, and immediately the prosperity of the German alkali industry began to decline. This decay continued until 1879, when the tariff was revised in a protective sense. The effects of the increased duties made themselves felt almost at once. In 1878 the German soda production amounted to about 42,500 tons, while about 27,500 tons were imported from abroad. Since 1878, however, the total production has risen to 195,000 tons, of which 28,150 were exported. Germany now exports more than she imports of all the principal soda salts, except bicarbonate of soda. In 1884, five years after the adoption of protective legislation, soda ash was the first article to show an excess of exports over imports; soda crystals followed in 1886, and caustic soda in 1890.—*Ibid.*

The Stassfurt Potash Salts Industry during the Year 1889.

G. Borsche. Chem. Ind. **13**, 492—493.

Another works, viz., the Deutschen Solvay-Werke at Bernburg, has been added to those works belonging to the Syndicate, making the total number of these works, eight. During the coming year still another potash works (at Thiede) will come into operation.

The general state of the industry during 1889 had remained unchanged.

During that year were produced for working up into concentrated potash salts:—

7,699,500 meter-centners of carnallite.
1,275,000 meter-centners of kainit, including shonite and sylvinite.

The output of potash salts was—

1,237,500 meter-centners of potassium chloride of 80 per cent.
161,000 meter-centners of sulphate salts (potassium sulphate and potassium-magnesium sulphate).
22,000 meter-centners of potash manure salts, containing 20 per cent. and upwards of potash.

Up to this year the United States has been the chief market for potassium-magnesium sulphate, because potassium sulphate was charged with an *ad valorem* duty of 20 per cent. But during 1889, owing to the coming into force of the new Customs tariff, and the remission of the duty on potassium sulphate, the export of the latter to the States has largely exceeded that of potassium-magnesium sulphate.

Prices have remained unaltered.

The yield of kainit for agricultural purposes in 1889 was 2,632,800 meter-centners of which—

	Meter-centners.
Germany took	1,501,700
America	716,700
Other countries	414,400

There was also worked for agricultural purposes—

268,000 meter-centners of carnallite.
91,500 meter-centners of kieserite.

The sale of kieserite in lumps (magnesium sulphate) is a monopoly held by the Syndicate. The output of this was 318,200 meter-centners. The output and price of magnesium chloride, magnesium sulphate (Epsom salts), Glauber salts, and bromine are also regulated by the combination.

The recovery of chlorine and hydrochloric acid from magnesium chloride is still confined to the two works that have heretofore worked these processes. A further patent for the direct recovery of chlorine from magnesium chloride has been worked out by de Wilde of Brussels.

The proposed ammonia-magnesium method for making potash, has, on a large scale, been temporarily discontinued owing to technical difficulties, which necessitate further experiment.

Engel's patent for making potash by means of magnesia has passed into the hands of the Salzbergwerks Neu-Stassfurt, which has obtained a concession of a site for erecting works for carrying out the process on a commercial scale.—H. S. P.

The German Ultramarine Industry.

Dr. Kraushaar. Chem. Ind. **13**, 512.

The low prices of ultramarine which have held for more than 10 years have led to the formation of a limited liability company, which has taken over nearly all the ultramarine works of Germany. Arrangements have been made with the few works that have not joined this company, by which either the whole of their make is sold to the company, or some other device has been agreed upon, which gives a guarantee that the operations of the new company will not be interfered with. A consequence of this combination has been a considerable rise in the price of ultramarine.

—H. S. P.

The Present State of the Soda Industry, especially of the Leblanc Process.

Chem. Zeit. **15**, 73—74.

During the last five years the English as well as the German soda industry has suffered from over-production caused by the enormously increased quantities manufactured by the ammonia process. A number of establishments working the Leblanc process have consequently had to limit or even to stop the manufacture, until at last the English Leblanc manufacturers have recognised the necessity of preventing a further reduction of prices. Germany's export during the last few years has greatly increased. Last year it amounted to 21 per cent. of the total production of German soda. Such was the state of affairs when the United Alkali Company, Limited, was founded last year, and it may be expected that the organisation of this great enterprise will permanently improve the English soda industry. The Austrian soda manufacturers have likewise succeeded in forming a syndicate, and it is expected that this will be of considerable advantage to the trade. In order to minimise German competition, the prices charged near the German frontier are lower, and this, together with the high Austrian import duty, will prevent large sales of German soda there. In face of these facts the author recommends the formation of a German syndicate, in order to derive the full benefit from the present position of the industry. In would in this case of course be necessary to limit production to a certain extent if prices are to be improved. A central office for sales like that in Vienna is strongly recommended, such as was tried, unsuccessfully, four years ago by the German Solvay works at Bernburg. In Germany the prices of calcined and crystallised, as well as of caustic soda generally, rose towards the end of last year, and it is expected that at the end of the current year a further rise will take place. On the other hand, the prices of bleaching powder went down in spite of the convention, and a further fall is expected. As regards the different bleaching powder processes, the magnesium chloride and the electrolytic methods have not been worked long enough for a conclusion to be formed of their commercial value. But it is proved beyond doubt that the Deacon process—which has been introduced into Germany at Rheinau in conjunction with the Hargreaves process—is a successs, the bleaching powder manufactured in this way being considerably cheaper than that obtained by the Weldon process. The author is of opinion that if the Leblanc manufacturers succeed in recovering the sulphur by the Chance process they will be able to compete with ammonia soda; and the manufacture of bleaching powder by the Deacon process, as just described, will be a further advantage. The magnesium chloride process for the manufacture of bleaching powder, which has been introduced at Stassfurt, seems to require an expensive plant, as the costs of the latter are stated to be double those of the Weldon plant, and it is said that there are difficulties connected with the manufacture in hot weather. The electrolytic system has been introduced at Griesheim, but nothing is as yet known of the results. It is said, however, that the plant of this system also is much more expensive than that of the Weldon process. In spite of the increased manufacture of bleaching powder in Germany during the last year, a good quantity has been imported; and it seems that there is greater over-production of it in England than in Germany. The direct consequence of the new processes was that less bleaching powder was manufactured by the Weldon process and less hydrochloric acid used, the price of which went down in consequence, notwithstanding the convention. The author draws the general conclusion that the prospects of the German Leblanc soda manufacture can be satisfactory only if conventions, comprising all articles concerned, are formed.

How to Pack Drugs and Chemicals for Export.

C. Monheim. Chem. Zeit. **15**, 41—42.

The following suggestions will be found of practical value:—

1. Salts should be put in stoppered glass bottles or packed in casks, if sent in large quantities. Casks used for hygroscopic salts should be lined with oil cloth or parchment paper. Salts should never be packed in tin boxes or in paper only.

2. The glass stoppers of all bottles containing either liquids or dry substances should be greased with a little vaseline in order to avoid any difficulty in removing them.

3. Parts of plants, such as leaves, roots, &c., should be packed in sacks, and these again in cases; very delicate drugs in tin boxes. Vegetable powders should be packed in hermetically closed glass bottles or tin boxes. Drugs which occupy much space should be pressed as much as possible before being packed, especially if the shipping freight is calculated according to the bulk of the goods.

4. Boxes and cases should be lined with zinc, or where this is too expensive a strong and good oil cloth will usually be sufficient.

5. Although the utmost care is necessary in packing, yet packing materials such as hay, straw, &c., should be used as sparingly as possible, as duty has usually to be paid for the weight of these as well as for the goods themselves.

6. Cases should be secured by iron bands, and it is always desirable that the weight and volume of cases should be as small as possible.

7. Acids, caustic, or inflammable substances must be packed according to the regulations of the different railways by which they are transmitted prior to shipment. As a rule stone bottles are best for acids and ammonia, and glass or tin vessels for volatile substances. All these should be closed by corks saturated with paraffin, and then wrapped in sail cloth which, with the string securing it, should also be soaked in paraffin.

8. Acetic acid may be safely conveyed from place to place in carboys of 5 to 10 gallons capacity.

9. Liquor ammonia should never be put into iron vessels.

10. Vessels containing volatile substances should never be quite filled.

11. Acids and caustic and inflammable substances are conveyed on the decks of sailing vessels only, the cases containing them should be well closed, and the address, mark, number, &c., be such as will resist sea water.

12. Liquids should not be packed in the same case with dry substances.

13. Valuable or expensive chemicals, such as ethereal oils and essences, should be packed in strong tin vessels and closed with corks saturated with paraffin as before described.

14. The weights and measures of the country to which the goods are sent should always be used to avoid loss and inconvenience.

15. Besides observing these rules for packing, consigners of goods should be thoroughly acquainted with the Customs tariffs and regulations of the countries to which they are sending, as pecuniary loss and inconvenience may occur from ignorance of them. For instance, if a case contains various substance, the duties on which are different, it is usual in some tariffs to calculate the duty of the whole of the contents of the case or at least of the packing materials at the highest rate. The importance of packing together goods upon which the Customs tariffs are similar is self-evident from this.

16. In cases of urgency small quantities of any substance suitable for such transmission, *e.g.*, quinine, antipyrine, salicylic acid, &c., may be sent as patterns without value, and thus avoid the delay caused by the Customs office.

H. S.

Notes from Baku.

Chem. Zeit. 15, 228.

Ragosin's experiments for producing inflammable oils from heavy sorts and residues of naphtha, gave the following results. The specific gravities of the materials used were 0·920 to 0·935. The distilling apparatus was used without pressure, and 10 distillations could be made in 24 hours. The materials gave 55 per cent. of inflammable oils of a yellow colour, and better than ordinary kerosene, 22 per cent. of tar and 7 per cent. loss. The flashing points of the oils obtained were very high. Having obtained these favourable results, Ragosin intends to erect a factory for the working of his process. Silver ores have been discovered near Lugansk, containing 30 per cent. of silver. A company has been formed to exploit the mines. Although the Russian Government has declined to lay naphtha pipes from Baku to Batoum, yet it does not seem disinclined to support the idea of making Batoum the centre of the Caucasian kerosene trade, which would be considerably improved thereby. It is reported that foreign capital is to be invoked to lay the above-said naphtha pipes.—H. S.

Mineral Black.

A manufactory of mineral black and tripoli has been established at La Laye by M. Voiret, who produces annually some 100,000 kilos of the black, and about half the quantity of the tripoli. Mineral black is the residue of thorough incineration of schist (shale) in closed vessels. It is thus calcined for eight hours, and what remains is gathered in closed metal boxes, and then cooled without being exposed to the air. It is then carefully sorted and ground to fine powder. This substance, known as "Auvergne black" is said to be obtaining popular favour for ship painting, blacking, printing ink, varnish, and other purposes for which an intense black is required.—*Chemist and Druggist.*

GENERAL SUMMARY OF THE MINERAL PRODUCE OF THE UNITED KINGDOM.

Description of Mineral.		1889. Quantity.	1889. Value at the Mines and Open-works.	1890. Quantity.	1890. Value at the Mines and Open-works.
			£		£
Alum clay (bauxite)	Tons	9,150	5,490	11,527	5,763
Alum shale	,,	1,188	523	6,120	802
Antimony ore	,,	67	900	14	200
Arsenic	,,	4,758	35,260	7,276	60,727
Arsenical pyrites	,,	7,688	7,317	5,114	4,414
Barytes	,,	24,849	28,238	25,333	29,681
Bog ore	,,	14,002	7,001	14,512	7,256
Clays (excepting ordinary clays)	,,	3,036,253	828,174	3,308,214	899,166
Coal		176,916,724	56,175,126	181,614,288	74,953,997
Cobalt and nickel ore	,,	155	968	84	260
Copper ore	,,	9,029	26,584	12,136	27,801
Copper precipitate	,,	284	3,113	345	4,670
Fluorspar	,,	297	111	268	392
Gold ore	,,	6,226	10,746	575	434
Gypsum		132,357	53,849	140,293	57,991
Iron ore	,,	14,546,105	3,848,268	13,780,767	3,926,445
Iron pyrites	,,	17,719	8,111	16,018	7,066
Jet	Lb.	618	124	1,228	245
Lead ore	Tons	18,065	329,647	15,051	106,161
Lignite	,,	317	284	2,630	767
Manganese ore	,,	8,852	6,478	12,141	6,733
Ochre, umber, &c.	,,	10,491	15,532	19,068	17,375
Oil shale	,,	2,014,860	503,715	2,212,250	608,369
Petroleum	,,	30	45	35	52
Phosphate of lime	,,	20,000	38,250	18,000	29,500
Salt	,,	1,046,496	890,361	2,146,840	1,100,014
Slates and slabs	,,	178,436	1,048,143	431,352	1,027,235
Stone, &c.	,,	..	8,070,935	..	8,708,691
Sulphate of strontia	,,	5,976	2,988	10,276	5,138
Tin ore	,,	13,809	729,213	14,911	782,492
Uranium ore	,,	..	..	22	2,200
Wolfram	,,	4	8	101	1,848
Zinc ore	,,	23,202	96,925	22,031	109,890
Total values		..	73,476,000	..	92,793,481

Summary of the Metals obtainable from Ores produced in the United Kingdom.

Description of Metal.	1889. Metals obtainable by Smelting. Quantity.	1889. Value at the Average Market Price.	1890. Metals obtainable by Smelting. Quantity.	1890. Value at the Average Market Price.
		£		£
Aluminium..... Lb.	12,000	6,000	..	..
Sodium ..... ,,	63,726	9,145	..	..
Antimony..... Cwt.	666	1,998	154	565
Copper..... Tons	905	49,948	956	57,650
Gold..... Oz.	3,890	13,227	206	675
Iron..... Tons	5,181,733	12,695,246	4,818,748	11,808,884
Lead..... ,,	35,604	464,342	33,590	449,826
Silver..... Oz.	306,149	54,453	291,724	58,040
Tin..... Tons	8,802	860,342	9,602	937,760
Zinc..... ,,	9,392	192,145	8,582	203,358
Total values	..	14,346,846	..	16,516,758

Production of Minerals and certain Metals in the British Colonies and Possessions.

(Compiled from Official Reports.)

General Summary.

1888 and 1889.

Description of Mineral.	1888. Quantity.	1888. Value.	1889. Quantity.	1889. Value.
		£		£
Antimony..... Tons	876	9,922	220	3,344
Antimony ore.... ,,			634	6,961
Arsenic..... ,,	27	240	..	..
Asbestos..... ,,	3,932	51,001	5,458	85,314
Asphalt..... ,,	52,026	66,575	78,124	90,063
Barytes..... ,,	982	770	..	..
Bismuth..... ,,	18	3,911	94	20,129
Coal, including some coke ... ,,	8,156,204	3,362,689	9,116,680	3,708,950
Copper..... ,,	10,639	484,525	12,574	645,007
Copper ore and regulus ,,	58,966	1,281,495	58,815	832,115
Copper ore and regulus Packages	807	800	31	1,130
Crocidolite..... ,,	55,134	2,035	36,635	1,521
Diamonds ..... Carats	3,841,937	4,022,379	2,961,978	4,325,137
Gold..... Oz.	1,684,482	6,352,086	2,202,871	8,136,451
Gold ore ..... Tons	149	6,739	113	1,119
Gold ore ..... Packages	303	117	25	205
Gypsum ..... Tons	158,822	36,945	196,512	41,977
Iron, cast..... ,,	23,210	86,368	25,281	118,304
Iron ore ..... ,,	70,194	30,969	116,702	40,720
Kauri gum ..... ,,	8,482	380,933	7,519	329,590

Production of Minerals, &c.—*continued.*

Description of Mineral.	1888. Quantity.	1888. Value.	1889. Quantity.	1889. Value.
		£		£
Lead..... Tons	555	9,799	853	10,974
Lead ore..... ,,	710	7,940	270	2,520
Lignite ..... ,,	..	..	554	140
Manganese ore ... ,,	2,744	15,500	3,979	14,241
Mica..... Lb.	20,025	6,041	232,753	10,071
Mica..... Barrels	..		..	..
Ochre..... Tons	354	1,580	573	140
Oil shale..... ,,	34,869	73,612	4,561	77,667
Petroleum ..... Gallons	..	..	3,298,737	16,741
Petroleum ..... Barrels	733,564	151,114	639,991	122,420
Phosphate of lime Tons	27,511	70,751	33,137	83,176
Platinum..... Oz.	1,500	1,200	1,000	700
Plumbago..... Tons	11,163	153,503	28,529	392,277
Precious stones, other than diamonds .... Packages	26	1,194	..	22,755
Pyrites..... Tons	58,528	61,531	72,017	74,258
Salt..... ,,	1,086,727	618,035	1,063,443	158,832
Silver ..... Oz.	404,728	151,052	855,647	154,030
Silver-lead ..... Tons	31,051	1,120,752	36,178	71,414
Silver-lead ore ... ,,	117	5,838	47,293	1,301,529
Tin..... ,,	4,568	581	4,472	300,259
Tin ore ..... ,,	9,133	1,137,349	8,998	
Umber..... ,,	1,650	728	1,178	623
Zinc (spelter).... ,,	12	180	220	2,990
Zinc ore ..... ,,	6	35	..	..
Sundry mixed minerals, including bubbling stone, slate, flagging, limestone, &c.	..	780,098	..	1,007,846
Total value.....	..	20,583,472	..	23,709,619

BOARD OF TRADE RETURNS

Summary of Imports.

	Month ending 31st May 1890.	1891.
	£	£
Metals.....	1,888,375	1,818,667
Chemicals and dyestuffs.....	649,495	678,759
Oils.....	460,957	556,942
Raw materials for non-textile industries.	3,395,146	2,899,859
Total value of all imports	33,341,005	34,377,698

Summary of Exports.

	Month ending 31st May	
	1890.	1891.
	£	£
Metals (other than machinery)	1,278,321	3,770,025
Chemicals and medicines	828,279	742,054
Miscellaneous articles.....	3,102,198	2,616,065
Total value of all exports.....	22,904,779	19,744,473

Imports of Metals for Month ending 31st May.

Articles.	Quantities.		Values.	
	1890.	1891.	1890.	1891.
			£	£
Copper :—				
Ore ..... Tons	9,145	8,815	64,038	76,200
Regulus ..... ,,	9,153	11,153	248,070	319,802
Unwrought .... ,,	2,781	2,428	140,563	130,877
Iron :—				
Ore..... ,,	345,145	287,976	264,577	202,806
Bolt, bar, &c. ... ,,	6,946	5,530	81,924	54,221
Steel, unwrought.. ,,	1,191	576	8,610	7,122
Lead, pig and sheet ,,	14,608	14,913	185,673	187,617
Pyrites ..... ,,	57,853	59,027	103,090	110,549
Quicksilver..... Lb.	934,631	547,000	124,951	58,577
Tin ..... Cwt.	11,788	30,768	105,360	141,135
Zinc ..... Tons	2,710	3,050	60,197	137,562
Other articles ...Value £	..	..	103,722	391,861
Total value of metals	..	..	1,888,373	1,818,667

Imports of Chemicals and Dyestuffs for Month ending 31st May.

Articles.	Quantities.		Values.	
	1890.	1891.	1890.	1891.
			£	£
Alkali..... Cwt.	33,369	12,322	22,265	5,781
Bark (tanners, &c.) ,,	52,961	46,056	28,038	18,967
Brimstone..... ,,	34,003	17,276	7,005	7,610
Chemicals..... Value £	..	..	125,804	106,053
Cochineal ..... Cwt.	267	281	2,349	1,693
Cutch and gambier Tons	2,772	1,958	78,302	32,294
Dyes :—				
Aniline..... Value £	..	..	23,086	19,936
Alizarine ..... ,,	..	..	23,317	22,615
Other ..... ,,	..	..	3,614	1,956
Indigo ..... Cwt.	1,810	2,197	27,578	35,084
Madder ..... ,,	1,426	870	1,865	1,376
Nitrate of soda.... ,,	237,220	487,775	92,047	209,684
Nitrate of potash . ,,	26,127	26,366	23,140	22,041
Valonia ..... Tons	1,546	1,174	30,637	24,219
Other articles... Value £	..	..	178,671	168,791
Total value of chemicals	..	..	649,864	678,579

Imports of Oils for Month ending 31st May.

Articles.	Quantities.		Values.	
	1890.	1891.	1890.	1891.
			£	£
Cocoa-nut..... Cwt.	2,012	2,090	2,508	4,485
Olive ..... Tuns	1,204	1,056	56,248	69,715
Palm ..... Cwt.	57,520	78,003	59,330	94,443
Petroleum ..... Gall.	7,361,422	11,021,920	172,723	219,074
Seed ..... Tons	2,197	1,596	37,456	39,459
Train, &c..... Tuns	2,416	1,568	16,637	34,963
Turpentine ..... Cwt.	3,012	717	3,365	568
Other articles .. Value £	..	..	62,390	93,895
Total value of oils ...	..	..	410,057	550,942

Imports of Raw Materials for Non-Textile Industries for Month ending 31st May.

Articles.	Quantities.		Values.	
	1890.	1891.	1890.	1891.
			£	£
Bark, Peruvian .. Cwt.	8,830	8,801	19,917	17,953
Bristles..... Lb.	271,285	242,637	37,671	34,770
Caoutchouc..... Cwt.	18,338	22,171	211,742	280,312
Gum :—				
Arabic..... ,,	6,059	4,879	13,974	15,479
Lac, &c..... ,,	9,212	8,038	36,758	31,041
Gutta-percha .... ,,	6,605	6,084	67,513	85,424
Hides, raw :—				
Dry..... ,,	12,884	18,074	111,862	116,611
Wet ..... ,,	50,504	39,152	113,629	87,445
Ivory ..... ,,	960	541	51,895	29,075
Manure :—				
Guano ..... Tons	2,871	4,308	14,660	25,705
Bones..... ,,	6,311	6,913	33,081	33,856
Paraffin..... Cwt.	58,342	39,941	76,331	56,015
Linen rags..... Tons	3,610	2,260	37,915	19,899
Esparto..... ,,	19,467	17,313	90,062	82,611
Pulp of wood .... ,,	13,408	11,899	68,711	61,035
Rosin..... Cwt.	148,287	38,655	37,847	8,207
Tallow and stearin ,,	130,991	130,493	158,964	163,041
Tar ..... Barrels	8,329	5,140	4,794	3,170
Wood :—				
Hewn ..... Loads	208,583	184,221	476,905	361,992
Sawn ..... ,,	339,885	208,185	828,158	481,288
Staves ..... ,,	13,365	5,751	50,516	31,280
Mahogany ..... Tons	3,914	3,213	37,715	30,826
Other articles....Value £	..	..	813,306	826,715
Total value	..	..	3,305,146	2,859,859

Besides the above, drugs to the value of 67,111*l.* were imported, as against 97,306*l.* in May 1890.

EXPORTS OF METALS (OTHER THAN MACHINERY) FOR MONTH ENDING 31ST MAY.

Articles.	Quantities.		Values.	
	1890.	1891.	1890.	1891.
			£	£
Brass..... Cwt.	9,002	9,712	43,013	42,708
Copper:—				
Unwrought..... „	81,441	60,006	219,938	170,282
Wrought..... „	24,660	21,479	89,885	82,190
Mixed metal.... „	33,639	25,708	92,796	70,448
Hardware..... Value £	..	..	248,987	196,111
Implements..... „	..	..	124,250	102,517
Iron and steel..... Tons	422,080	321,452	3,131,533	2,796,438
Lead ..... „	6,700	6,278	93,231	85,769
Plated wares... Value £	..	..	30,099	28,046
Telegraph wires, &c. „	..	..	57,081	51,238
Tin ..... Cwt.	9,792	9,559	47,116	45,181
Zinc ..... „	20,969	14,861	19,241	14,783
Other articles .. Value £	..	..	90,151	84,514
Total value	..	..	4278,321	3,770,025

EXPORTS OF MISCELLANEOUS ARTICLES FOR MONTH ENDING 31ST MAY.

Articles.	Quantities.		Values.	
	1890.	1891.	1890.	1891.
			£	£
Gunpowder..... Lb.	860,500	1,287,800	18,029	29,731
Military stores.. Value £	..	..	122,080	93,363
Candles..... Lb.	1,178,900	1,285,000	21,894	25,365
Caoutchouc ..... Value £	..	..	100,611	101,698
Cement..... Tons	70,434	46,067	143,973	92,967
Products of coal Value £	..	..	128,052	146,808
Earthenware ... „	..	..	201,472	157,048
Stoneware ..... „	..	..	19,891	13,595
Glass:—				
Plate..... Sq. Ft.	346,917	198,768	23,298	11,282
Flint..... Cwt.	9,227	8,384	22,500	17,878
Bottles..... „	89,633	73,821	42,006	34,188
Other kinds.... „	21,354	13,301	20,126	11,890
Leather:—				
Unwrought.... „	13,315	12,376	123,808	110,593
Wrought ..... Value £	..	..	22,474	25,017
Seed oil..... Tons	5,855	5,778	138,790	132,030
Floorcloth ..... Sq. Yds.	1,536,800	1,495,300	73,122	63,202
Painters' materials Val. £	..	..	150,576	137,323
Paper ..... Cwt.	82,946	79,276	144,248	136,695
Rags..... Tons	5,364	3,814	38,838	23,760
Soap ..... Cwt.	52,217	43,347	52,499	44,679
Total value	..	..	3,102,198	2,616,065

EXPORTS OF DRUGS AND CHEMICALS FOR MONTH ENDING 31ST MAY.

Articles.	Quantities.		Values.	
	1890.	1891.	1890.	1891.
			£	£
Alkali..... Cwt.	547,211	469,861	181,193	194,241
Bleaching materials „	168,101	151,649	48,440	51,367
Chemical manures. Tons	21,223	21,971	168,028	179,649
Medicines..... Value £	..	..	87,017	82,749
Other articles ... „	..	..	343,601	234,048
Total value	..	..	828,279	742,054

Monthly Patent List.

* The dates given are the dates of the Official Journals in which acceptances of the Complete Specifications are advertised. Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the said dates.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

Applications.

8546. J. C. Mewburn.—From The Maschinenfabrik Grevenbroich, Germany. *See* Class XVI.

8547. W. H. Beck.—From G. Moreau, France. *See* Class II.

8551. J. H. Day. Improved apparatus and process for spreading viscous substances. Complete Specification. May 19.

8653. W. W. Horn.—From S. C. Thrall, United States. An improved apparatus for making extracts. May 20.

8697. L. Lobet. Improvements in carburetting apparatus. May 21.

8809. W. J. Mirrlees.—From H. T. Yaryan, United States. Improvements in evaporating and distilling apparatus. Complete Specification. May 23.

8823. A. McDougall. Improvements in covering lead surfaces to protect water and other liquids from contamination with the dissolved metal. May 25.

8863. H. H. Lake.—From Lacombe and Co., France. Improvements in rheostats. May 25.

8910. J. Tonssaint. A novel combination of ingredients for making crucibles, pots and other articles capable of resisting heat. May 26.

9147. A. W. Ellis. Improvements in filtering apparatus. June 1.

9181. J. Dawson and J. W. Hampson. An improved construction of refrigerator or cooling pan for chemical and other purposes. June 1.

9187. E. J. Mills and C. J. Ellis. An improved means and method of closure for the regulation of gaseous pressures. June 1.

9310. A. J. Boult.—From A. Klönne and F. Bredel, United States. Improvements in the setting and heating of retorts. June 2.

9311. W. P. Thompson.—From J. A. Bowden, United States. Improvements in filters. Complete Specification. June 2.

9311. W. P. Thompson.—From J. V. Bowden, United States. Improvements in filtering apparatus. Complete Specification. June 2.

9318. A. J. Boult.—From A. Klonne and F. Bredel, United States. Improvements in apparatus for charging retorts. June 2.

9354. J. Zubr. Improvements in retort furnaces. Complete Specification. June 2.

9378. F. J. Quéry. Improved filter bricks, or bricks which will allow of the flow of liquids of gases through structures formed of such bricks. June 3.

9431. J. Menzies. A new composition, and the process for manufacturing the same. June 3.

9573. G. L. J. Wells. Improvements in or appertaining to filtering apparatus, applicable for the treatment of ammoniated brine and other materials. June 5.

9596. J. J. Barlow. *See* Class VII.

9774. C. D. Martin. Improvements in valves for chemical liquids. June 9.

9879. D. Burr. Improved apparatus for mixing and effecting the circulation of liquids or pulverulent substances within vessels. June 10.

9922. W. Luzi. Improvements in the treatment or purification of graphite, to render it suitable for industrial purposes. June 11.

10,012. A. Liwentaal. Improvements in and relating to apparatus for producing steam by liquid fuel. June 12.

Complete Specifications Accepted.*

1890.

9548. J. Foster. Apparatus for evaporating solutions containing salts, and for other liquids. June 17.

9604. W. E. Smith. Apparatus for burning liquid fuel. June 17.

10,888. J. H. R. Dinsmore. Apparatus for drying granular substances. June 3.

11,529. A. Chapman and S. Vickers, jun. Evaporating apparatus specially adapted for the extraction of salt from brine. May 27.

12,004. L. Menetrel. Apparatus for washing, lixiviating, or extracting purposes. June 10.

1891.

3836. H. F. Newton.—From C. C. Worthington. Surface condensers. May 27.

3902. J. F. H. Gronwald and E. H. C. Oehlmann. Sterilising apparatus. May 27.

6374. J. Guenet. Ozonising apparatus. May 27.

6797. W. Weyrich. *See* Class VIII.

7205. The Gaseous and Liquid Fuel Supply Co., Lim., and B. H. Thwaite. Apparatus for inducing the flow of, and injecting and spraying, gaseous and liquid fluids. June 3.

8167. R. D. Gates. Concentrating apparatus. June 17.

II.—FUEL, GAS, AND LIGHT.

Applications.

8547. W. H. Beck.—From G. Moreau, France. Improvements in or connected with the production and drying of compressed air, and its application to useful purposes. Complete Specification. May 19.

8641. G. Chambaud. Improvements in the agglomeration of lignite. May 20.

8697. L. Lobet. Improvements in carburetting apparatus. May 21.

9104. E. W. Harvey and C. W. Alldred. Improvements in the manufacture of electric light carbons. May 29.

9171. E. Lahmann. Improvements in process of extraction of gases from fluids. Complete Specification. June 1.

9180. B. H. Thwaite. Improvements in methods of storing inflammable spirits or highly volatile hydrocarbons. June 1.

9366. B. Gibbons and W. P. Gibbons. Improvements in apparatus for charging inclined gas retorts. June 3.

9398. P. van Gelder. Improvements in separating smoke or soot from air or other gases, and in utilising the air or gases so purified. June 3.

9457. J. H. Parkinson. Improvements in obtaining or separating oxygen from atmospheric air, and in apparatus therefor. June 4.

9716. J. F. Allen. Improvements in the manufacture of illuminating gas. Complete Specification. June 9.

9729. M. Pickford. The manufacture of a slow combustion fire-lighter. June 9.

9781. L. Labois. Improvements relating to the treatment of sulphur ores, crude sulphur, ozokerites, heavy oils of petroleum, and other materials for extracting, purifying, or refining purposes, and to apparatus for use therein. June 9.

9796. H. H. Lake.—From The Standard Coal and Fuel Co., United States. An improved compound for treating fuel. Complete Specification. June 9.

Complete Specifications Accepted.

1890.

8373. E. W. Walker. Method and apparatus for manufacturing gas. June 3.

9651. W. Loe and C. Gumbart. Treating peat for production of fuel and by-products. May 27.

10,831. L. van Vestrant. Means and apparatus for charging inclined gas retorts. June 10.

11,195. W. W. Staveley. Treatment of crude blast-furnace or coke-oven oils, and application of the products. June 3.

11,581. F. J. Rowan and H. Armour. Retorts for distilling shale or other oil-yielding minerals. June 10.

11,757. J. Laing. Apparatus for destructive distillation of mineral oils. May 27.

1891.

2159. J. A. Soetjè and J. C. A. Kahl. Manufacture of peat briquettes, peat coke, and peat coke briquettes. June 3.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

Application.

9052. W. P. Thompson.—From P. Kuntze, Germany. Improvements in the manufacture of ammonia and tar from nitrogenous organic substances, and in apparatus relating thereto. May 28.

Complete Specifications Accepted.

1890.

10,976. T. H. Davis and A. H. Davis. *See* Class XIII.

11,757. J. Laing. *See* Class II.

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* *See* Note * on previous page.

IV.—COLOURING MATTERS AND DYES.

Applications.

8702. B. Willcox.—From The Farbenfabriken vormals F. Bayer and Co., Germany. The manufacture and production of colouring matters derived from anthraquinone and alizarine blue. May 21.

9280. J. Frost and E. C. Kayser. Improvements in the manufacture of azo-colouring matters, and in their application for dyeing and printing. June 2.

9636. B. Willcox.—From The Farbenfabriken vormals F. Bayer and Co., Germany. Improvements in the production of black azo-colours upon fibres. June 6.

9943. O. Imray.—From The Farbwerke vormals Meister, Lucius, and Brüning, Germany. Production of blue colouring matter. June 11.

Complete Specifications Accepted.

1890.

10,448. Brooke, Simpson, and Spiller, Limited, and A. G. Green. Production of new azo-colouring matters. May 27.

10,802. O. Imray.—From The Farbwerke vormals Meister, Lucius, and Brüning. Production of novel colouring matters for wool-dyeing and printing. May 27.

12,356. J. Y. Johnson.—From The Badische Anilin and Soda Fabrik. Manufacture of colouring matters from dihydroxybenzoic acid. June 10.

12,386. J. Y. Johnson.—From The Badische Anilin and Soda Fabrik. Production of new materials for the preparation of dyestuffs. June 10.

14,416. J. Y. Johnson.—From The Badische Anilin and Soda Fabrik. Production of new amido-azo compounds and azo-dyes therefrom. June 10.

V.—TEXTILES, COTTON, WOOL, SILK, Etc.

Applications.

8644. C. Stephens. Improved means for damping, drying, dyeing, starching, or chemically treating paper, silk, felts, and other like fabrics. May 20.

8776. F. V. M. Raabe. Improvements in the treatment of vegetable textile fibres for the manufacture of yarns and fabrics. May 23.

9696. W. Whitaker and G. E. Donisthorpe. Improvements in the treatment, preparation, and application of certain fibrous materials suitable for spinning yarns for the manufacture of woven, felted, and other textile fabrics; applicable also to other useful purposes. June 8.

10,017. F. J. H. Sampson. Improvements in the treatment of rhea to obtain fibre therefrom, and in apparatus to be used in such treatment. June 12.

Complete Specifications Accepted.

1890.

2827. A. J. Boult. Manufacture or treatment of textile fabrics. May 27.

12,576. J. Sutcliffe and J. Greenwood. Treatment of yarn for weaving. June 3.

1891.

6663. A. George. Cleansing wool and similar substances. May 27.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

Applications.

8538. J. W. Selanders and W. Turnbull. An improvement in dyeing fabrics. May 19.

9228. E. A. Marchand. A process of bleaching vegetable and animal fibres and tissues by means of alkaline permanganates; and the economical production of such permanganates. June 1.

9413. C. F. Cross, E. J. Bevan, and C. Beadle. Improvements in dyeing jute and other vegetable fibres. June 3.

9470. R. Lanham and D. Gulland. An improved method of and apparatus for embossing, colouring, and printing upon paper or other suitable material. June 4.

9554. J. Horrocks. Improvements in bleaching raw cotton, and in machinery or apparatus to be used in parts of the process. June 5.

9995. J. Frost and E. C. Kayser. Improvements in the production of dyes on textile fibres and other like materials. June 12.

Complete Specification Accepted.

1890.

6612. R. T. West. Expediting and improving the process of bleaching linen, cotton, and other yarns in the hank. June 10.

VII.—ACIDS, ALKALIS, AND SALTS.

Applications.

8530. G. H. Hedley. The manufacture of sulphate of soda, hydrochloric acid, and red oxide of iron. May 19.

8571. A. Vogt. Improvements in the manufacture of carbonate of soda and carbonate of potash. May 19.

8692. F. M. Lyte. Improvements in the production of caustic alkalis, alkalines, carbonates and other products. May 21.

8810. M. Netto. Improvements relating to the separation of the so-called fished salts obtained in the manufacture of caustic soda. May 23.

8814. A. E. M. L. Paillard. A method of manufacturing and regenerating salts of peroxide of iron. May 25.

9332. Comte T. S. de Dienheim Brochocki. Improvements in the manufacture or production of chlorine compounds for bleaching. June 2.

9458. J. H. Parkinson. Improved process of treating a permanganate of potash or soda to produce a spongy porous mass. June 4.

9561. W. Walker. An improved method of recovering carbonic acid gas from lime-kilns and furnaces, and apparatus in connexion therewith. June 5.

9575. D. Rylands. Improved process or arrangements for the manufacture of carbonic acid gas. June 5.

9596. J. J. Barlow. Improvements relating to the recovery and utilisation of waste heat from black ash, soda ash, salt cake, and other solid and highly heated substances produced in alkali and chemical works, and of apparatus therefor. June 6.

9646. E. Luhmann. Improvements in process for production of carbonic acid. Complete Specification. June 6.

9732. D. Rylands. Improvements in the manufacture of carbonic acid gas, and in tubes for containing the same. June 9.

9781. L. Labois. *See* Class D.

9785. W. Walker. Improvements in apparatus for obtaining silicates for making glass, and for the production of hydrochloric acid. June 9.

9786. W. Walker. An improved method of recovering carbonic acid gas from lime-kilns and furnaces, and apparatus in connection therewith. June 9.

9947. A. T. Hall. Improvement in the treatment of waste liquors from metallurgical processes to obtain sulphurous or sulphuric acid and zinc. June 11.

9948. A. T. Hall. Improvements in the treatment of waste liquors from metallurgical processes to obtain sulphurous or sulphuric acid and oxide of iron. June 11.

Complete Specifications Accepted.

1890.

3087. J. G. Lawrence.—From S. Peck. Apparatus for evaporating liquors containing salts, and for separating such salts when rendered insoluble by evaporation of the liquors. June 3.

9198. W. L. Wise.—From The Chemische Fabrik Buckau Actiengesellschaft. Treatment of impure or waste potassium salts for the manufacture therefrom of soda, potash, hydrochloric acid, magnesia, calcium sulphate, and sulphur or sulphuric acid. June 10.

11,296. A. G. Haddock and J. Leith. Manufacture of alkaline carbonates and by-products, and arrangement of plant therefor. May 27.

11,529. A. Chapman and S. Vickers. *See* Class I.

11,545. F. M. Lyte and J. G. Tatters. Conversion of hard-burnt into soft-burnt magnesia. June 3.

11,638. T. Elliot. Producing sulphate of calcium. June 3.

11,979. W. B. Giles, F. G. A. Roberts, and A. Boake. Production of acid sulphates. June 10.

12,661. R. Dempster and J. Dempster. Apparatus connected with the manufacture of sulphate of ammonia. June 17.

18,990. J. Greenwood. Production of chlorine and caustic soda, and apparatus therefor. May 27.

1891.

2134. J. Greenwood. Manufacture of caustic soda. May 27.

2343. T. G. Webb. Apparatus for concentrating sulphuric acid. June 10.

5749. M. W. Bayliss, C. J. Everett, and C. A. Collins. A new alkaline magnesian compound. June 17.

7362. C. Kellner. Apparatus for recovering sulphurous acid used in the manufacture of paper pulp from wood. June 3.

7757. C. H. Lish. Furnaces for burning sulphur. June 10.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

Applications.

8528. D. Rylands. Improvements in furnaces for glass melting and for similar purposes. May 19.

8848. C. W. Fox, I. Robinson, and W. H. Gratton. Improvements in or appertaining to the manufacture of glass. May 25.

9220. H. Godwin and W. Hewitt. Improvements in or applicable to fender, hearth, wall, and other tiles. Complete Specification. June 1.

9377. F. J. Query. Improvements to be employed in the manufacture of certain kinds of earthenware articles. June 3.

9412. W. James. An improved method of ornamenting glass. Complete Specification. June 3.

9745. L. Lederer. Process for the production of coloured designs and coloured writing on mirrors. Complete Specification. June 9.

9785. W. Walker. *See* Class VII.

9960. D. Rylands. Improvements in furnaces for glass melting and for similar purposes. June 12.

Complete Specifications Accepted.

1890.

11,651. D. Rylands and A. Husselbee. Manufacture of glass tubing. May 27.

12,506. T. Webster, sen., and T. Webster, jun. Manufacture of earthenware pots, jars, &c., whole or in section. June 17.

1891.

6797. G. Weigelin. Methods and appliances for drying moist material (bricks, pipes, flags, &c.) by artificial heat. May 27.

7908. J. E. Bousfield.—From F. Schultz. Manufacture of stove tiles, mouldings, rosettes, &c., and apparatus therefor. June 17.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

Applications.

8567. O. Imray.—From W. Schlening, Germany. Improvements in the manufacture of artificial stone. May 19.

8875. J. J. Mead. An improved lime-grinding mill. Complete Specification. May 26.

9189. W. Corbould. Improvements in manufactured whiting. June 1.

9319. W. P. Thompson.—From J. Petrus von Balgooy, Holland. *See* Class XIII.

9561. W. Walker. *See* Class VII.

10,080. V. Schofer. Improved apparatus for drying cement, clay, and other materials for burning or calcining. Complete Specification. June 13.

Complete Specifications Accepted.

1890.

5108. F. Sang. Concrete for construction of vaults, roofs, arches, &c. May 27.

10,918. N. W. Curtis and A. E. Carey. Apparatus for crushing and mixing material for the manufacture of cement. June 10.

11,245. S. McDougall. Blocks, tiles, &c. for pavements, floors, and steps. May 27.

12,610. F. F. von Ainbach. Production of stony polychrome decorations. June 17.

17,153. M. Hirsch and H. Reinisch. Macadam pavement. June 17.

1891.

4719. A. J. Boult. From L. Grote. Artificial stone. June 17.

6389. R. A. Cheesebrough. Preservation of wood and iron imbedded in the earth. June 10.

X.—METALLURGY, MINING, Etc.

Applications.

8529. D. C. Bateman. Improvements in the method of and apparatus for hardening and tempering steel wire. May 19.

8688. C. T. J. Vautin. Improvements in the method of and means for extracting gold from ores, or from materials containing it. May 21.

8689. C. T. J. Vautin. An improved amalgamator. May 21.

8818. D. Rennie. Improvements in furnaces for melting iron, steel, and other metals. May 25.

8819. W. Bevan. An annealing apparatus to be applied to heating furnaces for iron, steel, or metal sheets and plates. May 25.

8837. The Rovello Syndicate, Lim., and J. C. Howell. Improvements in apparatus for use in obtaining copper. May 25.

8881. F. J. Page and H. A. Anderson. Improvements in the art of soldering aluminium. Complete Specification. May 26.

8904. G. G. M. Hardingham.—From G. Ashcroft, Australia. Improved means applicable for use in the treatment of ores and other compounds for the extraction of the precious metals by amalgamation. May 26.

9013. A. M. Clark.—From The Deutsche Gold und Silber Scheide-Anstalt, vormals Roessler, through Wirth and Co., Germany. An improved process for desilverising argentiferous lead. May 27.

9061. R. R. Gubbins. Improvements in cleaning scrap iron. May 28.

9143. A. Torkington.—From N. K. Morris, United States. Improved apparatus for use in the manufacture of lead fibre. Complete Specification. May 29.

9219. H. Niewerth. Improvements in obtaining metals, half-metallic elements, and other minerals. June 1.

9341. J. H. Rogers. Improvements in apparatus used in the manufacture of tin and terne plates. June 2.

9342. J. H. Rogers. Improvements in the manufacture of tin and terne plates. June 2.

9417. J. O. Day. Improvements in alloys and compositions for use in covering or coating surfaces of iron and steel, and the surfaces of other materials, in order to prevent corrosion and fouling thereof when submerged. June 3.

9468. J. G. H. Batchelor and C. T. Batchelor. Improvements in the means of separation and recovery of tin and iron from tin scrap, hard-head, and other tin refuse. June 4.

9686. A. Longsdon.—From F. Asthower, Germany. Improvements in compound armour plates. Complete Specification. June 8.

9708. C. J. Fauvel. An improved furnace for the treatment of refractory ores. June 8.

9757. R. Heathfield. Improvements in the process of coating or cleaning metals. June 9.

9784. W. Noad, C. Minns, and P. H. Stevens. An improved process of or means for extracting or recovering metals from their ores or other metal-bearing bodies. June 9.

9923. H. J. Allison.—From A. Burnstine, United States. An improved process for treating the products of zinc ores. June 11.

Complete Specifications Accepted.

1890.

8759. J. von Langer. Manufacture of iron and steel. June 3.

9123. A. Danber. Making pig iron, wrought iron, cast steel, and rough steel. June 10.

11,649. A. Jepson. Manufacture of iron and steel castings. June 3.

11,690. P. U. Askham and W. Wilson. Electro-magnetic separators for extracting metal from slag and the like. June 10.

12,200. W. Beatson. Method and apparatus for recovering tin from waste tinned iron or steel. June 17.

12,621. A. M. Clark.—From W. G. Horgan. Fluxes or solutions for coating metals with lead. June 10.

12,626. L. Mond. Manufacture of nickel. June 17.

12,666. W. Brazell. Annealing tin and terne plates. June 17.

13,474. W. L. Wise.—From L. Benchmans. Process for roasting ores and metallic compounds. June 10.

18,508. J. Johnson.—From J. W. Langley. Aluminium alloys and manufacture thereof. June 3.

18,546. F. H. Molesworth. Construction of rotary furnaces for the calcination of sulphide and other ores. June 3.

1891.

3348. B. C. Tilghman and R. A. Tilghman. Manufacture of chilled iron globules. June 10.

4695. W. A. Baldwin. Process and apparatus for alloying metals. June 10.

7777. W. P. Thompson.—From F. J. Clamer. Coating certain metals or metal articles with other metals or alloys. June 17.

8127. W. G. Richards. Process and moulds for making castings. June 17.

XI.—ELECTRO-CHEMISTRY and ELECTRO-METALLURGY

Applications.

8573. J. Y. Johnson.—From J. Weir, United States. The manufacture and production of hydrocarbon products or compositions for use for insulating or other purposes. Complete Specification. May 19.

8648. E. Bazin. Improvements connected with the use of compressed air for producing electric light and cold. Complete Specification. May 20.

8735. E. W. Berdoe and G. M. Shum. Improvements in electrical storage batteries or accumulators. May 22.

8808. W. J. Green. Improvements in and relating to electrical batteries. May 23.

8845. R. Haddan.—From I. Cabanyes, France. Improvements in galvanic batteries. May 25.

8872. J. F. Bennett and E. P. Hides. Improvements in galvanic batteries. May 26.

8941. A. J. Boult.—From E. E. Ries, United States. Improvements in method and apparatus for electrical hardening and tempering. Complete Specification. May 26.

9079. C. Hoepfner. Improvements relating to the electrolytic extraction of metals and to the electrolysis of other substances. May 28.

9627. C. D. Abel.—From R. J. Gulcher and the Firm of J. Pintsch, Germany. Improvements in thermo-electric batteries. Complete Specification. June 6.

9628. D. G. FitzGerald. Improvements in or connected with negative elements (positive electrodes in charging secondary cells) of voltaic batteries. June 6.

9629. D. G. FitzGerald. Improvements in or relating to the negative elements (positive electrodes in charging secondary cells) of voltaic batteries. June 6.

9652. A. Watt. Improvements in the production of copper tubes by electrolysis. June 8.

9683. T. J. D. Rawlins and A. Walker. Improvements in electric primary batteries. June 8.

9689. V. Jeanty. Apparatus for supplying depolarising or other liquids to a series of electric batteries. June 8.

9734. W. Aldred. Improvements in dynamic-electric machines. June 9.

9762. S. C. C. Currie. Improvements in secondary or storage batteries. Complete Specification. June 9.

9791. J. Greenwood. Improvements relating to carbon electrodes for electrolytic and other purposes. June 9.

9803. W. J. Engledue. An improvement in galvanic batteries. June 9.

9928. G. A. Schoth. Improvements in galvanic batteries. Complete Specification. June 11.

9938. The London Metallurgical Co., Lim., and S. O. Cowper Coles. Improved apparatus for consolidating metals during the process of being deposited from an electrolyte. June 11.

10,082. P. Jablochkoff. An improvement in voltaic batteries. June 13.

10,090. L. Grabau. An improved process for the electrolytic production of aluminium. June 13.

Complete Specifications Accepted.

1890.

13,853. C. A. Faure. Production of electricity, and means therefor. June 3.

19,942A. W. P. Thompson.—From F. Marx. Electro-chemical formation of chlorine and chlorine compounds. May 20.

1891.

5637. R. W. Barker.—From M. G. Farmer. Electric converters. June 10.

7168. G. Wester. Voltaic cells. June 3.

7715. G. A. Washburn. Storage batteries. June 10.

XII.—FATS, OILS, and SOAP MANUFACTURE.

Applications.

9131. H. H. Lake.—From La Societe Anonyme des Parfums Naturels de Cannes, France. Improvements relating to the purification of fatty substances. June 3.

9991. A. Siebels. Improvements in the manufacture of iodine soaps. Complete Specification. June 12.

Complete Specifications Accepted.

1890.

9176. H. H. Lake.—From F. de la Croix. Apparatus for desiccating and sterilising waste animal substances, and extracting fat therefrom. June 3.

12,000. J. Walton. Oxidising and drying vegetable oils. June 10.

12,373. J. Ross. Manufacture of saponifiable matter from wool fat. May 27.

13,634. C. A. Feuerlein and J. C. Lahusen. Production of odourless wool grease. May 27.

XIII.—PAINTS, PIGMENTS, VARNISHES, and RESINS.

Applications.

8510. H. Pennington. Improved process of manufacturing lead sulphate from metallic lead. Complete Specification. May 19.

8610. A. Gutensohn. An improved method of producing lead dust, and of converting the same into white lead. May 20.

8713. T. Simmons. A washable and varnishable substitute for oil paints and distempers. May 22.

9193. R. Jacks.—From G. Sharp, Peru. A new or improved composition for coating ships' plates and the like. June 4.

9231. R. Haddan.—From A. Grammont, France. A method of and apparatus for the purifying of gutta-percha. Complete Specification. June 1.

9267. W. B. Lawson and H. Schofield. An improvement in the manufacture of black-lead blocks. June 2.

9319. W. P. Thompson.—From J. Petrus van Balgooy, Holland. Improved process and compositions for coating walls and similar surfaces to prevent the penetration of damp. June 2.

9526. L. Labois. Improvements relating to the manufacture of white lead, and to apparatus for use therein. June 5.

9589. R. D. Burn. A new and improved paint or composition named "Litholine," for preserving the surface of iron and steel ships and other structures. June 6.

9747. H. Beck.—From E. Schaal, Germany. Improved manufacture of hard neutral resins as substitutes for natural resins, such as copal, amber, and the like. Complete Specification. June 9.

9851. C. Boothy and W. Mackeay. The manufacture of chromate of lead. June 10.

9932. W. C. Hayne. Improvements in the manufacture of fire-proof paint. June 11.

10,036. C. Calot. A new or improved varnish. June 12.

Complete Specifications Accepted.

1890.

10,976. T. H. Davis and A. H. Davis. Purifying coal tar, to render same a suitable paint or coating for iron or steel. June 17.

11,602. G. Bischof. Manufacture of white lead. June 3.

11,780. J. A. Maynard. Manufacture of oil paint in sheets. May 27.

12,085. J. J. Lee. Application of certain waste materials for the production of "mineral white," and process of making same. May 27.

15,903. N. K. Morris. Manufacture of carbonate of lead, and apparatus therefor. May 27.

16,684. J. S. Fairfax.—From F. Crane. Improvements in varnishes or coatings. June 10.

1891.

6916. T. Maxwell. Liquid preparation for protection of bright metallic surfaces, applicable as an anti-fouling and anti corrosive composition. May 27.

XIV.—TANNING, LEATHER, GLUE, and SIZE.

Applications.

8796. B. Wright and D. Wright. Improvements in or relating to machinery or apparatus for staking, softening, and perching leather. May 23.

9064. J. Hundhausen. *See* Class XVI.

9624. W. Crowther and J. Crowther. Preserving a solution of tannin and keeping it from fermenting or changing into gallic acid. June 6.

Complete Specification Accepted.

1891.

6852. F. Drew. Substitute for leather. May 27.

XV.—AGRICULTURE AND MANURES.

Application.

9348. C. Glaser. Improvements in and relating to a process for the treatment of phosphorites or other phosphatic materials. Complete Specification. June 2.

Complete Specification Accepted.

1891.

5111. O. Jachne. Superphosphatic manure. May 27.

XVI.—SUGARS, STARCHES, GUMS, Etc.

Applications.

8545. J. C. Mewburn.—From The Maschinenfabrik Grevenbroich, Germany. Improvements in the crystallisation of saccharine and other solutions. May 19.

8546. J. C. Mewburn.—From The Maschinenfabrik Grevenbroich, Germany. Improvements in the treatment of solutions which have been boiled to the granular state. May 19.

8893. A. Parks. *See* Class XVII.

9064. J. Hundhausen. Improvements in or connected with the manufacture of gluten and vegetable albuminous extracts. May 28.

9115. J. C. Firth. Improvements in cleaning Kauri gum. Complete Specification. May 29.

9168. E. Pechnik and S. Stein. Improvements in the manufacture of sugar. June 1.

9665. E. Ruescher. A process for separating impure sugar masses in one operation into crystallised sugar and molasses, avoiding all other products. Complete Specification. June 8.

Complete Specification Accepted.

1890.

10,449. W. R. Hutton. Saccharate of lime. May 27.

XVII.—BREWING, WINES, SPIRITS, Etc.

Applications.

8512. C. Funk. Improved method in fermenting mash, dough, wort, and the like. Complete Specification. May 19.

8518. J. Candwell. Improvements in the ingredients employed, and the method of their preparation, for the manufacture of brandy or cognac. May 19.

8893. A. Parks. Process of utilising the waste of distilleries, glucose, and starch works, &c. Complete Specification. May 26.

9004. R. H. Leaker and C. R. Bonne. Improved apparatus for drying brewers' grains and other materials. May 27.

9308. H. W. Joyce. Reek dissipator for improving malt kilns. June 2.

9763. W. P. Thompson.—From J. F. Theurer, United States. Improvements in the process of and apparatus for effecting the extraction of hops, with the simultaneous production of a fine extract. June 9.

Complete Specifications Accepted.

1890.

11,226. E. Craddock. Apparatus for treatment of grain for production of malt. May 27.

11,613. T. Reade. Preparation for fining or frothing beer and other fermented beverages. June 3.

11,672. C. O. Gridley and A. Bishop. Apparatus for the manufacture of finings and analogous materials. June 3.

16,942. F. T. Simson and J. Cox. Kola, or caffeine, or theine malt liquors, fermented wines and spirits. June 3.

1891.

7140. S. Mason, jun. Method and apparatus for purifying and refining alcoholic liquors and other fluids. June 3.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

Applications.

A.—Chemistry of Foods.

8894. T. E. Brain. An improved process in the manufacture of artifical butter. May 26.

9239. L. E. Mouline. Improved kinds of bread termed "Rational breads,' and improved processes of preparing the same. June 1.

9790. V. H. Vincent. An improved process for the manufacture of oxygenated water, and apparatus therefor. June 9.

B.—Sanitary Chemistry.

9398. P. van Gelder. *See* Class II.

9482. W. E. Rowlands. Improvements in and connected with drying or desiccating animal matters. June 4.

9670. The Sewage Purification Co., Lim., and H. B. Jagger. Improvements in the means employed for carbonising refuse and other substances. June 8.

10,028. W. Ambler. Improvements in or applicable to apparatus for purifying smoke. June 12.

10,092. F. Livet. Improved apparatus for cremating house-dust and like refuse on new sanitary principles. June 13.

C.—Disinfectants.

8629. W. H. Spencer. Improvements in apparatus for vaporising oils and other liquids for medicinal and disinfecting purposes. May 20.

8827. R. Armstrong. Improvements in the manufacture of detergent powder. May 25.

9083. C. Scott. Improvements in the method of vaporising carbolic and other disinfectants, and in apparatus therefor. May 29.

9491. T. H. Williams. The improved manufacture of disinfecting powder. June 4.

9492. T. H. Williams. The improved manufacture of disinfecting powder. June 4.

Complete Specifications Accepted.

A.—Chemistry of Foods.

1890.

10,961. N. Etienne and A. Delhaye. Preparing peptonised soluble meat and peptone. June 3.

20,640. W. Budenberg. Sterilising milk and other substances. June 17.

21,068. E. G. N. Salenius. Manufacture of butter, and apparatus therefor. June 3.

1891.

7335. W. P. Thompson.—From F. Lanhoff. Preparation or treatment of rice or other cereals. June 3.

7485. H. Warry. Food preservation. June 3.

B.—Sanitary Chemistry.

1890.

16,836. J. Lowe. Precipitating and filtering sewage. June 10.

XIX.—PAPER, PASTEBOARD, Etc.

Applications.

8857. E. Edwards.—From J. H. Schnitz, Germany. An improved process of treating the leaves of the dwarf palm for use in the manufacture of paper. May 25.

8968. A. Johnston. Improvements in the manufacture of paper and in mechanism connected therewith. May 26.

9139. A. J. Boult.—From E. Rocca, Italy. Improvements in or relating to cellulose manufacture. May 29.

9852. J. L. Geddes, P. Culter, and J. W. Johnston. Improvements in and relating to the manufacture of parchment paper. June 10.

Complete Specification Accepted.

1890.

7971. F. W. Crowther. Metallic foil coated air-tight and grease-proof paper. May 27.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES, AND EXTRACTS.

Applications.

8541. P. A. Newton.—From the American Eucalyptus Co., United States. Improvements in the manufacture of medical extracts. May 19.

8584. L. F. Riedel. Manufacture of an iodine derivative of phenacetin. May 19.

9024. W. Smith and W. Elmore. A new and more economical method for the production of nitrous oxide. May 27.

9431. H. H. Lake.—From La Société Anonyme des Parfums Naturels de Cannes, France. *See* Class XII.

9439. H. H. Lake.—From La Société Anonyme des Parfums Naturels de Cannes, France. An improved method of and apparatus for collecting the vapours of solvents. June 3.

9450. J. Y. Johnson.—From F. von Heyden (Nachfolger), Germany. Improvements in the manufacture of iso-eugenol and poly-iso-eugenol. June 4.

9763. W. P. Thompson.—From J. F. Theurer, United States. *See* Class XVII.

Complete Specifications Accepted.

1890.

10,432. K. Luttke, L. Scholvien, and L. F. Riedel. Manufacture of salicylicate of phenyldimethylpyrazoline. May 27.

11,802. L. Scholvien and L. F. Riedel. Manufacture of phenyldimethylpyrazoline. June 3.

11,189. W. R. Lake.—From Kalle & Co. Preparation of hydrochlorides, hydrobromides, and hydriodides of peptone. May 27.

11,196. G. D. Bowie. Phosphated salt:—"Sal. phosph." June 3.

12,993. J. Y. Johnson.—From F. von Heyden. Manufacture of oxyphthalic acids (phenol dicarbonic acids). June 10.

1891.

5981. J. Le Roy Webber. Manufacture of pepsine. June 17.

XXI.—PHOTOGRAPHIC PROCESSES AND MATERIALS.

Applications.

8557. A. J. Boult.—From J. North, United States. Improvements in photography. Complete Specification. May 19.

8834. F. Sternberg. A process for producing photographs. May 25.

9984. J. Gray. A new permanent photographic printing process. June 12.

Complete Specifications Accepted.

1890.

9893. J. W. Swan and J. Leslie. Manufacture of transparent films for photographic and other purposes. June 3.

11,945. B. J. Edwards. Manufacture of flexible films for photographic and other purposes, and apparatus therefor. June 3.

XXII.—EXPLOSIVES, MATCHES, Etc.

Applications.

9196. J. B. Scarlett. Improvements in the manufacture of lucifer and other matches made of wood and cotton and other combustible or suitable material. June 1.

9485. T. Holmes. Safety-fuse igniting to be used in conducting blasting operations in mines, quarries, and the like. June 4.

9503. H. T. Ashton. Improvements in percussion fuses. June 4.

Complete Specifications Accepted.

1890.

11,720. R. J. Jones and G. Worrall (on behalf of Wood house and Rawson). Electrical fuses. June 10.

12,094. R. Morris. Electric fuse.

1891.

5843. A. Moschek and A. Brunner. Smokeless blasting compound and cartridges made therefrom. June 10.

7193. J. Y. Johnson.—From J. A. C. de Latouche. Military and sporting ammunition. June 3.

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THE JOURNAL

OF THE

Society of Chemical Industry:

A MONTHLY RECORD

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Johnson, Edmund E., Warren Hill House, Loughton, Essex, chemical student.

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Quincke, Dr. Friedrich, 25, Alma Square, London, N.W., chemist.

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Haslam, Dr. Arthur R., 64, Carysfort Avenue, Blackrock, co. Dublin, analytical chemist.

Jackson, Robt., 18, Harrington Street, Dublin, analytical chemist.

Kortright, F. L., 1,609, W. Genesee Street, Syracuse, N.Y., U.S.A., technical chemist.

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PROCEEDINGS

OF THE

TENTH ANNUAL MEETING.

The Annual General Meeting of the Society was held on Wednesday, the 8th July, in the Examination Hall of Trinity College, Dublin.

The President, Mr. E. Rider Cook, took the chair at 11 o'clock. The proceedings were opened by—

The Rev. Dr. Haughton, who said that he was instructed by the governing body of the University to appear there that day in conjunction with Dr. Emerson Reynolds, the Professor of Chemistry, to bid the Society a hearty welcome within the walls of Trinity College, Dublin. It was not on altogether unselfish grounds that they did so. They had reasons of their own for welcoming on its first appearance among them the largest society in existence connected directly with the promotion of chemical industries. He was aware that there was another chemical society, having more scientific objects, whose membership was larger; but he understood that this was the largest society in the world having for its object the promotion of such a large group of pursuits as must be embraced in the title of the chemical industries. They were rather backward in Ireland in that department of industry. It was not their own fault that they were so, and he dared not say that it was the fault of Providence; but whoever had given England, Scotland, and Wales, such a large quantity of coal had acted the part of an old stepmother to Ireland, to whom she had given none. He did not believe, and he hoped that the visitors would not believe, that Irishmen were naturally inferior to Englishmen, Scotchmen, or even to the men of gallant little Wales. He believed that if they only had coal, they would lead the van in chemical industry; but as they had not, they welcomed the Society, in the hope that by mutual contact between guests and hosts the visitors might take away pleasant impressions of Ireland, of its people and their ways, and in return communicate some stimulus to those chemical industries which were possible among them. He would say no more himself, but would ask Professor Reynolds, as the representative of the Irish School of Chemistry, to add some words on the objects of the meeting.

Professor J. Emerson Reynolds, F.R.S., thought that he would best consult the pleasure of the meeting by saying very little. They were all "industrious chemists," and were anxious to get to business. But as Dr. Haughton had given him the opportunity, he wished on behalf of the professoriate of the University, as Dr. Haughton had already done on the part of the governing body, to give the members of the Society a hearty welcome to Dublin. It would be superfluous on his part to say anything about the objects of the Society, since they were well known to all present. All that they, the hosts, could do was to help the visitors to see Dublin and to enjoy their short stay there as thoroughly as possible. Antiquity had its disadvantages as well as its advantages; and in a 300 year old University some of the halls were not equipped as they would be in a modern college. They were, however, conscious of their disadvantages, and had taken whatever steps were possible for the comfort of their guests.

The President, in reply, said that he believed there would be an opportunity later on of formally expressing the gratitude of the visitors for the kind and hearty welcome they had received in Dublin. But he could not allow one moment to pass without saying on behalf of the Society that they accepted the hospitality which had been so generously offered with heartiness, because they knew that it was offered with the greatest possible sincerity. He re-echoed the hope expressed by Dr. Haughton, that while

they would undoubtedly be indebted to their Irish friends in the matter of hospitality, they might be able to repay that debt to some slight extent by awakening an interest in some of the manufactures of the country.

The GENERAL SECRETARY then read the Minutes of the last Annual General Meeting, held in Nottingham on the 9th July 1891; and these having been confirmed—

Professor C. R. C. TICHBORNE and Mr. C. C. HUTCHINSON were appointed scrutators of the ballot for the election of Council for the ensuing year.

The PRESIDENT then called upon the Secretary to read—

THE REPORT OF THE COUNCIL.

"We have the honour to report that the number of members on the register is 2,697, as compared with 2,595 at the last Annual Meeting. During the year 260 new members have been elected, and 158 have been removed by death, resignation, and other causes, showing a net gain of 102.

Among those who have died are Prof. T. Carnelley of the University of Aberdeen, Mr. C. H. Gimingham, at one time assistant to Mr. Crookes, and latterly manager of the Swan Light Works, Mr. J. Chambers Nicholson of the late firm of Simpson, Maule, and Nicholson, Mr. W. Lant Carpenter, an indefatigable member of Publication Committee; Mr. Chas. Marvin, the Russian traveller; Dr. M. Bechler of the Manbré Saccharine Co.; Mr. C. H. Grundtvig, killed by an accident in Greece; Mr. F. C. Blake of Pittsburgh; and Mr. Geo. Dyson of Hurworth-on-Tees.

During the past session 77 papers have appeared in the Journal, as against 87 the year before.

Ten years having now passed since the foundation of the Society, a few statistics are presented showing the progress of the Journal and membership during that period. In 1882 each number of the Journal averaged 43 pages of matter; in 1884, 56; in 1886, 61; in 1888, 79; and in 1890, 101. In 1882 the membership was 1,140; in 1884, 1,869; in 1886, 2,271; in 1888, 2,395; in 1890, 2,595. The invested funds of the Society amount to 3,880*l.* 3*s.* 3*d.*, as against 3,688*l.* 15*s.* 9*d.* last year. The revenue last year, as will be seen from the Treasurer's report, exceeded the expenditure only by 107*l.* 7*s.* 11*d.*, as against 607*l.* in 1889, the increased size of the Journal being responsible for the whole outlay. If the rate of increase of the Journal is to be maintained, it is most desirable that we should have larger accessions of members.

In November last a Committee was appointed to consider certain proposals of the Manchester Chamber of Commerce to amend the law of patents. Upon the report of that committee, the Council resolved to support the Chamber in endeavouring to limit the period during which inventors can rod their patents of rash and inconvenient claims, to two years after filing their original application. Should this alteration of the law receive the sanction of Parliament, the speculative patentee will no longer hamper the chemical industries.

In May last a Yorkshire Section of the Society was formed with Sir James Kitson as its first Chairman. This makes the seventh, and the cordiality of your welcome induces a hope of the early formation of an eighth.

It will be remembered that we had intended to meet in Birmingham this year, but it became clear last autumn that the meeting could not be arranged. The Council, however, received a hearty invitation from a reception committee in Dublin, with the result that the Society is holding its Annual Meeting for 1891 within the walls of Trinity College."

The adoption of the report was moved by the PRESIDENT, seconded by Mr. HENRY BESSEMER, and carried unanimously.

The Hon. Treasurer (Mr. I. Rice Cooke) presented the accounts for the year, printed on page 599, and in doing so said that it would be unnecessary for him to do more than briefly state that the revenue for the year 1890 from all sources, exclusive of Life Composition Fees, amounted to 4,013*l.* Of this sum, annual subscriptions accounted for 3,053*l.*; interest, 135*l.*; advertisements, 536*l.*, and sales of the Journal outside the membership, 291*l.* The expenditure might be roughly stated to be, upon the Journal, 3,031*l.*; Sectional expenses and Annual Meeting, 297*l.*; salary, 250*l.*, and other small items, bringing the total expenses up to 3,908*l.* 5*s.* 11*d.*, and leaving a balance of revenue over expenditure of 107*l.* 7*s.* 11*d.* The Treasurer's cash account showed that at the end of the year he had a balance in hand of about 370*l.* In addition to this the sum of 3,880*l.* 3*s.* 3*d.* had been invested in Metropolitan 3 per cent. Consolidated Stock, in the names of Mr. David Howard and himself.

The next item on the programme was the President's Address, but before proceeding to this the President said that he wished to draw attention to the fact that the annual meetings of the Society had hitherto been held in places where Local Sections of the Society had been formed. Dublin, however, without having a Local Section, had sent them a cordial invitation to hold the meeting there this year. He therefore wished his first words to be an expression of the sense of gratitude felt by the Society in accepting that invitation. He would also say that although Ireland did not possess a Section of the Society at present, he hoped that it would not be long before Irishmen would feel that it would be desirable to form an Irish Section, having its head-quarters in Dublin, and that the next invitation would come from the Chairman of that Section. Dr. Haughton had said that Ireland was behind England, Scotland, and Wales in manufacturing industries mainly because Providence had acted a sort of step-motherly part towards that country in not giving her coals. He thought that it was only due to the courtesy which one always expected from an Irish gentleman that Dr. Haughton had so limited the causes of Ireland's backwardness. Their Society was not a political one in any sense; at the same time in speaking of Ireland it was difficult to altogether avoid touching upon politics. But there was one thing upon which every Englishmen who had read history, whatever his political opinions might be, was agreed, and that was that England as well as Providence had been a sort of step-mother to Ireland in respect of manufactures, and that there were acts of the English nation during the last century which had been deliberately planned in order to favour English industries at the expense of Irish. As he had said that every reading Englishman knew this, he would also say that every thinking Englishman regretted it, and was willing and anxious in every possible way to try to make amends for the wrongs which had been done to Ireland in those darker times. He hoped that the Society of Chemical Industry might be able in some small way to lend a hand to make up for the wrong done in those days. There was plenty of room in Ireland for the work of the Society of Chemical Industry. The main object of the Society was to teach manufacturers to do better what they were already doing. Substances and forces were altogether different from men. In social and political questions one had to deal with the imperfect individual atoms which went to make up societies, communities and nations. But in the case of substances and forces one had to deal with things which if they were properly used were certain in their operations. If one did right by them they would do right in return. Hence, chemistry came to the help of the manufacturer, not only in teaching him better methods of working than he was already pursuing, but in teaching him absolutely the right methods. The exact work of the analytical laboratory was brought to bear upon the rough work of the factory, and by degrees the results were brought nearer, not only to practical correctness, but to an absolute standard of perfection. Then the Society tried to teach manufacturers not only to improve on what they were already doing, but to do a great deal that they were not doing at all, especially in the utilisation of what had been called waste. There were many things in Ireland which were capable of being submitted to these two processes. Sir Robert Kane had shown that Ireland was rich in mineral wealth, and he could not believe that Nature had been so unkind to Ireland as not to supply her with the means of developing that wealth if the proper ways of doing so were found. The arrangements of Nature were generally perfect, and he had no doubt that if they only brought knowledge and care to bear upon the natural resources of Ireland, a great deal of its wealth might be developed. They had in Dublin an illustration in the great

STATEMENT OF REVENUE AND EXPENDITURE FOR THE YEAR 1890.

REVENUE.

	£ s. d.	£ s. d.
Annual Subscriptions for 1890:—		
1 subscription received in 1888	1 5 0	
65 subscriptions received in 1889	81 5 0	
2,366 subscriptions received in 1890 (less 4s. short paid).	2,957 6 0	
11 subscriptions received in 1891	13 15 0	
2,443		3,053 11 0
11 Life Composition Fees	165 0 0	
Interest on Deposit Account		27 6 1
Interest on Metropolitan Stock		107 18 0
Journal:—		
Advertisements	536 0 0	
Sales	290 18 9	
		826 18 9
		£4,015 13 10

EXPENDITURE.

	£ s. d.	£ s. d.
Journal Expenses:—		
Publishing	1,791 13 2	
Editorial:—		
Editor's Salary	500 6 0	
„ Expenses	36 18 6	
Abstractors	473 11 6	
Portion of Secretary's Salary	100 0 0	
Patent Lists	73 8 7	
Indexing Journal	42 8 0	
Foreign Translations	1 12 0	
Foreign Journals	8 17 6	
Sundry Journals	3 0 0	
	1,239 16 1	
		3,031 9 3
Sundries: Printing		46 8 6
Sectional Expenses	197 5 2	
Sectional Expenses, Nottingham, Annual Meeting	100 0 0	
		297 5 2
Secretary's Salary (Balance not included in Journal Editorial Expenses)		250 0 0
Hon. Treasurer's Assistant		42 0 0
Office Expenses		69 18 6
Stationery		38 4 3
Clerical Assistance to Secretary—issuing circulars, &c.		3 3 0
Auditors' Fee		10 10 0
Reporting Annual Meeting at Nottingham		11 10 8
Sundry Expenses connected with Annual Meeting		12 3 8
Honorarium to Mr. Jas. T. Brown (late Indexer)		30 0 0
Library—Sundry Purchases and Binding Books		6 15 2
Bank Charges		2 7 7
Treasurer's Petty Cash		15 13 11
Secretary's Petty Cash		40 16 3
Balance of Revenue over Expenditure		107 7 11
		£4,015 13 10

THE TREASURER—IN ACCOUNT WITH THE SOCIETY OF CHEMICAL INDUSTRY FOR THE YEAR 1890.

Dr.

	£ s. d.	£ s. d.
To Balance at Bank (1st January 1890)	98 17 8	
Balance in Treasurer's hands (1st January 1890)	10 0 0	
Balance in Secretary's hand (1st January 1890)	0 16 9	
		109 14 5
Annual Subscriptions:—		
5 subscriptions for the year 1888, at £1 5s.	6 5 0	
27 subscriptions for the year 1889, at £1 5s.	33 15 0	
1 part subscription for the year 1890, at £1	1 0 0	
1 part subscription for the year 1890, at £1 1s.	1 1 0	
2,364 subscriptions for the year 1890, at £1 5s.	2,955 0 0	
1 part subscription for the year 1891, at £1 1s.	1 1 0	
93 subscriptions for the year 1891, at £1 5s.	116 5 0	
2,492		
Sundry small excess payments	0 4 6	
Balance of subscription for 1889	0 4 0	
Amount received on account of 1891	0 10 0	
		3,115 5 6
Life Composition Fees		165 0 0
Interest on Deposit Account		27 6 1
Interest on Metropolitan Stock		107 18 0
Journal:—		
Advertisements	568 0 0	
Sales	305 0 5	
		873 0 5
		£4,398 4 5

Cr.

	£ s. d.	£ s. d.
By Journal Expenses:—		
Publishing	1,859 7 7	
Editorial	1,181 12 6	
Insurance of Stock	1 5 0	
		3,042 5 0
Sundries, Printing, &c.		89 3 0
Sectional Expenses:—		
Glasgow Section	33 4 9	
Liverpool Section	29 1 6	
London Section	64 7 3	
Manchester Section	56 0 6	
Newcastle Section	17 6 2	
Nottingham Section	7 2 0	
		197 5 2
Secretary's Salary (balance not included in Journal Expenses)		250 0 0
Office Expenses		69 18 6
Honorarium to Hon. Treasurer's assistant for work in 1889		42 0 0
Stationery		33 10 8
Issuing Circulars, &c.		3 3 0
Solicitors' Charges		15 14 0
Auditors' Fee		10 10 0
Purchase of £191 7s. 6d. 3% Metropolitan Stock		195 0 0
Reporting Annual Meeting (Nottingham)		11 10 8
Sundry Expenses connected with Annual Meeting		12 3 8
Honorarium to Mr. Jas. T. Brown (late Indexer)		30 0 0
Library		6 15 2
Bank Charges on Scotch and Irish Cheques, &c.		2 7 7
Treasurer's Petty Cash		15 13 11
Secretary's Petty Cash		40 16 3
Cash on Deposit (31st December, 1890)	150 0 0	
Balance at Bank ditto	211 6 7	
Balance in Treasurer's hands ditto	5 0 0	
Balance in Secretary's hands ditto	4 1 2	
		*370 7 9
		£4,398 4 5

* In addition to this there is an amount of £3,880 3s. 3d. Metropolitan 3% Consolidated Stock, invested in the names of Mr. David Howard and Mr. Edward Ruler Cook.

We have compared the above Statement with the Receipt Book Counterfoils, Vouchers, and Books of the Society, and certify it to be correct. We have also verified the amount of the Metropolitan 3% Consolidated Stock, £3,880 3s. 3d., by reference to the Books of the Bank of England.

23, St. Swithin's Lane, London, E.C.,
19th February 1891.

(Signed) THEOBALD BROS. & MIALL,
Chartered Accountants.

establishment of Messrs. Guinness of the very things which the Society of Chemical Industry was trying to teach manufacturers. They all knew that in the processes of brewing and distilling enormous quantities of carbonic acid gas were wasted. Messrs. Guinness had, however, been at work on the subject, and he believed that the members would have an opportunity of inspecting the machinery by which they were recovering from that waste product a large quantity—he was told something like 30 tons a day—of liquid carbonic acid. What would become of it he did not know; but past experience showed that a saving of this kind, which might be undertaken in the first instance with the idea only of effecting some small economy, generally formed the starting point of some great new industry. Ireland, moreover, and especially Dublin, was rich in the means for raising scientific chemists and men capable of superintending factories. They had in that magnificent institution under Professor Emerson Reynolds (President-elect of the Society) a school of chemistry quite equal to any school on the other side of St. George's Channel. They had in the Royal College of Science another admirable institution of the same kind. Dublin, therefore, could teach the men; and if the result of the meeting of the Society in Dublin should be that the capitalists of Ireland, or even some English capitalists, would put their capital and their plant under the superintendence of the men Dublin could produce in her scientific schools, then he believed that while they, the visitors, were debtors that day for the hospitality they had received, their hosts would be the first to acknowledge that they were indebted to the Society for having come there.

Mr. Rider Cook then proceeded to read

The President's Address.

In undertaking to give an address to the Annual Meeting of the Society of Chemical Industry, I feel sure I shall not be misunderstood in asking for your kind indulgence, following, as I do, so many distinguished men who have filled the Chair. Especially must I do so, because I cannot conceal from myself that I am indebted for the honour of the position which I now occupy to the fact that I have been able, since the formation of the Society, to render it some little service as its treasurer; whereas the distinction has usually been conferred on account of work done in the sphere of pure chemistry, or by reason of some great service to the commercial world in the region of applied chemistry.

It was only last year that Sir Lowthian Bell gave us a most interesting account of the result of his extended and laborious researches upon the chemistry of iron smelting, and in doing this, he was but following the custom of former Presidents, who have been able in their presidential addresses to give the results of original work. It has, doubtless, struck members of the Society that these presidential addresses have on several occasions dealt with the recovery and utilisation of waste products, and it might be expected, perhaps, that the first soap-maker who occupied this Chair would say something of the interesting recovery of glycerin from waste soap leys. But I am sorry to say that though my firm have benefited by the utilisation of this product which was formerly wasted, I am not able to give any information upon the subject which is not already well known.

It has occurred to me, however, that it might not be uninteresting or useless if, in the few remarks I shall venture to make, I take for my subject the Utilisation of Sewage, a question in which, as a member of the late Metropolitan Board of Works, I took a great interest for many years, and which I think will sooner or later have to be dealt with by the chemical engineer, to whom, I am satisfied, we must look to save the country from the enormous loss which at the present time is incurred by the want of scientific treatment of, perhaps, the most important waste product of our time.

At the Jubilee dinner of the Chemical Society, Lord Salisbury, in his exceedingly interesting and lucid speech, said:—"I am an agriculturist under the guidance of Dr. Gilbert and others, and we compass sea and land in order to bring manure to make our products grow. What is manure? Why it is an impure form of the carbon and nitrogen in which these products are bathed in circumambient air every day of their lives. I trust that the chemistry of the future will tell us why we have to go to Chili for these things and why we cannot take them from the air around us."

Now we all remember the interesting paper of Mr. Mond on the question of collecting the ammonia formed during the combustion of coal in furnaces, and I suppose the time will soon come when ammonia so obtained will be used for agricultural purposes.

We cannot tell what may be done in the future towards utilising the nitrogen of the atmosphere for the purpose of chemical manures, but it is a certain fact that if we can utilise the sewage of the country we shall be absolutely independent of Chili, and we ought to be able to save the 2,500,000*l.* per annum which we pay for imported phosphates and nitrates.

We ought, at any rate, to be able to save the expense of these fertilisers so far as they are used within the borders of our country, and are not exported, and also the cost of the sulphuric acid which enters so largely into the composition of artificial manures made from them.

I find the following figures in the Board of Trade returns, which show the money value of the imports of these articles for the last three years:—

	1888.		1889.		1890.
	Tons.	£	Tons.	Tons.	£
Nitrate.....	..	981,894	..	1,102,583	..	903,632
Guano.....	..	159,179	..	160,191	..	138,001
Phosphates..	258,000	544,919	305,000	703,704	343,500	849,452
Bones.....	66,000	310,983	63,000	310,263	70,000	372,048
		1,999,975		2,276,741		2,263,133
Acid (say)..	..	324,000	..	368,000	..	413,500
		2,323,975		2,644,741		2,676,633

Of course a considerable quantity of chemical manure is exported, but, as native coprolites and also large quantities of animal matter of various kinds are used in the manufacture of chemical manures; and as the value of the manure exported includes these, as well as considerable sums for labour, expenses, and profits, it is difficult to know what deduction should be made from the above figures; but I think it may not be unfair to assume that the cost to this country for artificial manures, of foreign origin, used here is not less than from 2,000,000*l.* to 2,500,000*l.* per annum.

Now, it may be said that this subject is hardly appropriate to our Society. I venture, however, to think that this is a mistake; for while it is quite true that hitherto it has been considered a subject confined to the province of engineers, and especially of sanitary engineers, it is also true that *chemistry* has been repeatedly called in to mitigate as far as possible the injurious effects of sewer gas upon the atmosphere, and to prevent the water supplied to us from being rendered wholly poisonous, a result which is sure to occur so long as the circular system of drinking from rivers which receive sewage from towns is continued. Sometimes these efforts have not been altogether wise: *e.g.*, in 1886, the Metropolitan Board of Works attempted to deodorise the sewage by pouring manganate of soda and sulphuric acid into the sewers. In 1886 the cost of this was 107,063*l.*, when only two grains of manganate to the gallon of sewage were used. It occurred to me that this expenditure was practically thrown away, and I therefore made some experiments from which I found that the average power possessed by a gallon of sewage in neutralising manganate of soda (20 per cent.) was as follows:—

In 1 minute.....	30 grains.
5 minutes.....	37 „
3 hours.....	67 „

that is to say, 287 tons of manganate would have been neutralised by 150 millions of gallons of sewage in one minute, while the quantity used by the Board was only 18·2 tons for that quantity. I not only reported these facts to the Board, but demonstrated them by experiments, with the result that the Board abandoned the idea of attempting to deodorise the sewage in the sewers, and in 1887 confined its operations to the effluent, after the sludge had been settled from it, and to sewage when it was actually being discharged into the Thames. The gain to the ratepayers was nearly 50,000*l.* in 1887, as the total cost of chemicals and labour that year was only 57,760*l.*, compared with 107,063*l.* in 1886.

I hope that even those who have doubts about the appropriateness of the subject will extend their indulgence to me, seeing that important as the pecuniary loss is to the country, the preservation of springs, streams, and rivers from pollution, and of our water supply from poisonous contamination, is of infinitely greater importance.

The magnitude of the evil resulting from the pollution of water sources is indicated by the fact that many of our large towns construct works to obtain their water supply from great distances, because the water upon which they naturally ought to rely has been polluted; *e.g.*, Glasgow from Loch Katrine, Liverpool from Lake Vyrnwy, Manchester from Thirlmere. It has even been proposed that London should get its supply from the Welsh mountains. The cost of these huge undertakings is enormous, and the result can hardly be considered satisfactory. In the event of war or domestic disturbance in the country the position of places thus supplied would be very critical. The destruction of a conduit as it passes, by a bridge, over a valley or, through a tunnel, under a hill would be most easy in these days of dynamite and gun-cotton, and the results to the population would be calamitous. And yet, as population continues to increase, unless the pollution of water sources is stopped, the number of large towns and cities which have to expend money in this way, and place themselves in this perilous position, will be constantly augmented.

I suppose there can be little doubt that, if properly utilised, the sewage of a country, together with the organic remains, such as the bones and the blood of animals which have been killed, should provide a fresh supply of food enough for the inhabitants of that country.

The food consumed by human beings and by animals may be said to be converted into—

(1.) Their bodies.

(2.) The substances associated with the air they give out from their lungs.

(3.) Their excreta.

Their bodies sooner or later return to the soil, the gases exhaled are dissolved by the rain and dew and restored to the earth. Now if, instead of sending the excreta into the water, they were returned to the soil, the whole of the matter taken from it to form food would have been restored, and be available for the new crops of food for man and beast. Thus, speaking in general terms, the food of one year would have been so returned to the earth as to enable it to produce the food of another. So far, then, as we run this resultant of food away into the sea, in just so much do we impoverish the soil and do we waste the resources of our country by buying substitutes from foreign countries.

I do not suppose for one moment, as a writer to the "Times" stated some time since, that this is a loss to the earth as a whole; fortunately for us, nature is ever repairing our blunders, and without attempting to trace the process, I have no doubt that in sea-weed, and in sea-life, is stored up the wealth which we so lavishly squander—wealth which is recovered from time to time in a small degree by our own country but largely by other nations of the globe.

Some idea of the extent to which our production of food falls short of the amount annually required, may be formed from the following figures:—

Taking only the articles wheat and flour.

In 1888, wheat was imported amounting in value to 21,971,337*l.*, but we exported 156,070*l.* worth, leaving the value for home consumption 21,815,267*l.*; in 1889 the home consumption was 22,387,050*l.*; and in 1890, 23,450,882*l.*, giving an average of 22½ millions of pounds.

In the same way, I find that the average value of flour imported for the last three years is 8,942,548*l.*, say 9,000,000*l.*, so that foreign wheat and flour consumed in England amount in value to 31,500,000*l.* annually.

Possibly some slight deduction should be made from this for exports of biscuits, cakes, and, other manufactured articles, but on the other hand, a much larger sum must be added for foreign vegetables, potatoes, &c., and a large amount certainly for oats, maize, &c., which are consumed by animals, so that we may safely say that the imports of foreign food for man and beast cannot be less in value than 35,000,000*l.* per annum, but probably considerably more.

To this must be added the cost per annum of dealing with sewage—including cost of sewers, sewage works, and pumps, of efforts for the deodorisation and disinfection of this unutilised waste product, so that the loss to the country—

(*a.*) By paying for foreign fertilisers;

(*b.*) By buying food which we ought to grow; and

(*c.*) By expenditure on works rendered necessary by the contamination of the water supplies which nature has placed close to our hands, but which we are compelled to abandon for more distant sources;

cannot be less than 10,000,000*l.* per annum.

Probably many may be disposed to say there is nothing new in all this, every one knows it. Unfortunately, however, the continuous crop of wild sewage schemes which are brought before the country shows us plainly that though the knowledge may be common, the practical results of it are by no means so. I want to ask those who think they know all about this important question, quietly to look at its present position, after the many years of failure, and after the destruction of so many hopes in connexion with it.

But we all know that the best means of attaining success is to learn the lessons which failure teaches, and I wish to point out one or two lessons which I think there can be little doubt, the experience of the last 20 or 25 years has taught. *And first*, in addition to the evils resulting from the pollution of our water supply owing to the water-carriage system of sewage. I think there can be little doubt that that system is responsible for a new and terrible evil by the production of sewer gas.

I know in raising any question in relation to the water-carriage system, I am running my head against a solid wall of popular prejudice, for certainly, as regards home comfort, that system has so many apparent advantages, that the great majority of people have settled down to it as if it were a finality.

A moment's consideration, however, will lead a thoughtful man to see that in attaining the comfort and cleanliness referred to, we have had to take associated with them some terrible evils. But for the system of water-carriage we should be ignorant of that subtle and insidious enemy sewer gas, which is no respecter of persons, and finds its victims in the houses of the wealthy, where bath-rooms and sanitary arrangements are most complete, quite as much as in the neglected dwellings of the poor; a gas which cannot be dealt with by any system of ventilation, but is liable to be ejected suddenly from the sewers by storm showers, or barometric changes, which we may meet with at any ventilator in the streets, and which may invade our homes at any time through a faulty pipe or a defective trap. In the sewers there exist all the conditions for the generation of this insidious and dangerous enemy, for the rise and fall of sewage has the effect of continually exposing organic matter upon an extended porous surface of brickwork to the influence of moisture and warmth in an atmosphere deficient in oxygen.

Secondly, the dilution of the sewage by water practically destroys its value as a fertiliser. There are many hills and moorlands in this country which contain thousands of pounds worth of silver and lead, but the cost of getting these metals is larger than the value of them when they have been obtained, and they remain unutilised, and for all intents and purposes worthless. And so with sewage; it contains matter which is of intrinsic value, but owing to dilution that

value is unavailable, as, in order to obtain a pound's worth of value, more than a sovereign has to be spent.

But, *thirdly*, the dilution in houses is followed necessarily by a further dilution in the sewers.

I know it has often been proposed that a system of double sewers might be arranged, one set for the purpose of sewage proper, the other set for the purpose of carrying away surface water.

Those who suggest this are ignorant of what all sewage engineers know, that when once sewage is turned into a sewer it is absolutely necessary to make use of the rainfall in order to flush the sewers and keep them in even a tolerable condition of wholesomeness.

The huge sewers in London, some of which are 11 and 12 ft. in diameter, have in some places, and for distances of several miles, a fall of only 1 ft. to the mile. The condition of these would be better imagined than described if they were not flushed by the rainfall.

The result of this second dilution is to render the volume of sewage simply appalling from its magnitude, and to reduce its actual value to a minimum.

The average daily flow of sewage dealt with by the Metropolitan Board was 150,000,000 gallons, and I suppose since 1888 that quantity has increased rather than decreased. This equals 670,000 tons per day. When settled and a comparatively clear effluent is run off, it leaves 3,000 tons of sludge, which when pressed in filter-presses can be reduced to 850 tons of cake of the following composition:—

	Per Cent.
Mineral matter	30·0
Organic matter	14·0
Water	56·0
Containing—	
Ammonia	0·01
Combined nitrogen	0·90
Phosphoric acid	0·50

An analysis of a gallon of the original sewage gives 3 grains of ammonia to a gallon, or 0·001 per cent.

Phosphoric acid, inappreciable.

(The above figures as to quantities were given me by the late Sir Joseph Bazalgette, the analyses by Mr. Dibdin.)

Now the ammonia is the only valuable constituent; and taking sulphate of ammonia, 25 per cent. ammonia, at 12*l.* 10*s.* per ton, a unit of ammonia in manure in a form suitable for putting on land is worth about 10*s.* per ton, so that the ammonia in a ton of London sewage is worth 0·001 of 10*s.*, which is nearly ½*d.*

What can be done with a ton of sewage for ½*d.*? It cannot be pumped, or settled, or pressed without expending far more than that sum, so that it may be said to be absolutely valueless, and the simple statement of this fact should convince speculators that by whatever process it is sought to recover this value, the working of such process must be ruinous in a pecuniary sense.

From this it will be seen that all hope of realising money value from the sewage, while the water-carriage system is continued, must be absolutely abandoned; that the country must be content to put up with the huge loss which it annually suffers; and that the question which local authorities have to decide is not how much they can obtain for what ought to be a valuable product, but how shall they get rid, at the lowest cost to the ratepayers, of that which, by our folly in ignoring the laws of nature, we have converted into a nuisance.

It must be borne in mind, however, that this water-carriage system which is so disastrous seems to be, after the experience of the last 20 or 30 years, the very best that the engineer and the sanitary engineer can do for us. Are we then to be content to let matters rest as they are? May we not hope that the *chemical engineer*, who has already turned into value so many waste products, primarily for the good of the manufacturer, but necessarily also for the good of the country, will find some means of saving this enormous annual loss?

In the East, and in comparatively uncivilised countries, the sewage, in ways more or less primitive, is placed on the soil, and even in over-populated countries like China the result of this is that the soil produces food for the population without imports. China is nearly as densely populated as England, as the following figures show:—The area of China, as given in the "Encyclopædia Britannica," is 1,399,609 square miles, population 370,323,545, or about 264 persons per square mile. Taking the area of the United Kingdom at 120,859 square miles, and population 37,075,000 (1887), it gives 306 persons per square mile, and yet, while Great Britain, as we have seen, imports vast quantities of food it is stated in the last edition of the "Encyclopædia Britannica" that "imports into China do not appear to include food stuffs."

In our own country, Mr. Moule by his earth-closet has achieved a certain amount of success, not by taking the sewage to the earth, but by bringing the earth to the sewage But the cost of the carriage of the earth, and afterwards of the mixture, is of such importance that his system is not applicable to large towns or cities.

At Warrington, at Nottingham, and other places, I am informed a certain amount of success is obtained by the adoption of the "pail system," the manure being much appreciated by neighbouring farmers, and realising a substantial sum, in mitigation of the cost of collection. The want, however, of efficient deodorisation causes the system to have considerable drawbacks from a nuisance point of view.

Is it beyond hope that some chemical engineer will find not only the chemicals, but some efficient and convenient mode of applying them, by the use of which the refuse of each house may be quickly desiccated and deodorised, and remain so for a sufficiently long time to enable collection to be made from house to house, even in large towns, and the product conveyed to the country without any nuisance being occasioned, there to be restored to the soil by the farmers?

The requirements of a successful solution of the problem seem to me to be—

(*a.*) The finding of a chemical or chemicals, the use of moderate quantities of which shall immediately deodorise excreta, and which shall arrest decomposition for some days.

(*b.*) The construction of an apparatus, with or without the means of separating the solid from the liquid excreta, for the application of these chemicals, which while quickly removing the contents to a receptacle, shall be simple and cleanly in its action.

(*c.*) The provision of a receptacle in each house which shall be readily accessible to the public authority, and which can be conveniently emptied.

Whether the problem will be solved or not remains to be seen, but the object I have in view will be answered if I succeed in convincing the members of our Society—

(1.) That there *is* a great unsolved problem, involving the health as well as the wealth of the country, worthy of their attention.

(2.) That no good will be done in the direction of sewage utilisation while the present water-carriage system continues; and

(3.) That if public opinion will not admit of any interference with that system it is useless to devote time and trouble to any question other than how to get rid of sewage at the least cost to the community, and in doing so, how to avoid spoiling the water supplies of our ever-growing population.

Professor Emerson Reynolds, in moving a vote of thanks to the President for his address, said that he wished the duty of doing so could have fallen into the hands of someone who was capable of discussing it in some detail. Under the circumstances, however, they must postpone a full consideration of it until they had the opportunity of seeing it in print; it being too full of information, and containing too many facts and figures of importance for its full significance to be realised at the moment. He thought that they might divide the President's remarks into two parts, it being essentially a double address. The first part he might venture to call the Dublin address, the second and larger part the general address, intended for the world in general, and which he was sure would be read with advantage in all parts of the world, but in Great Britain and Ireland in particular. He desired to thank the President for the very graceful allusions he had made to the very delicate subjects

connected with the relations of that country and the greater island on the other side of St George's Channel. He had skimmed delicately over very thin ice; and in a most interesting way had touched upon unpleasant episodes in the past, and brought into prominence the pleasanter possibilities of the present and the future. The President had said—though he (Professor Emerson Reynolds) had no intention of following him over that delicate ground—that he regretted the injustice of the past, and he had spoken kindly with reference to that injustice, which all who were acquainted with the history of the country would appreciate. But in mentioning the desire of their friends on the other side of the channel to help them now, he had forgotten one thing, he had omitted to mention that a return for a considerable portion of that debt of injustice to Ireland had already been made by his countrymen in giving their friends on the other side a very respectable amount of trouble. The President had referred to the utilisation of waste products in some of the manufactures which were of chief importance in that city. He referred to the great manufactures of the well-known liquid whisky and the equally well-known liquid porter. Those products were famous all the world over, and he believed that the members would have an opportunity of testing their properties in a full and interesting manner. They would also have at the great brewery of Messrs. Guinness an opportunity of seeing a most interesting novelty, the utilisation of the carbonic acid gas which was produced there in enormous quantities daily. It was, he thought, only a matter of common justice that the credit for that utilisation should be given in the right quarter. They had in Dublin, he was happy to say, a number of chemists of whom, perhaps, very little was heard, but who were nevertheless in the best and highest sense of the term industrial chemists; and he wished, therefore, to mention that the application of the utilisation of this important waste product, carbon dioxide, was mainly due to the efforts of a fellow-townsman, Professor Tichborne. It would be unreasonable to detain them with many observations respecting the second or general portion of the President's address. He had managed to treat a most unsavoury subject in a most interesting and valuable way, and had done great service to sanitary science by at once knocking on the head all the "promoters'" schemes of sewage utilisation proposed under the water-carriage system. He had clearly shown that the profitable utilisation of water-carried sewage was out of the question. If people were prepared to spend large sums of money for that purpose, sewage might be partially utilised; but the cost was so great as to render such schemes impracticable. Although the President's alternative proposals deserved and would receive much and careful consideration, he doubted whether it would be possible for the President, even with his great influence, to induce any public body to put aside the water-carriage system and go to the Chinese for examples of sewage treatment. He did not suppose that the President had really such an idea in his mind; but he had done a great service in showing so clearly that the profitable utilisation of sewage on the water-carriage system was almost out of the question. That system had many disadvantages, as they all knew; but the President had referred to one of them which his friend, the President of the College of Physicians, would appreciate, namely, the introduction of sewage gas into dwelling-houses. Efforts to prevent that danger had been many, and some of them had been partially successful, but none wholly so. Still he hoped that chemical engineers connected with that Society would turn their attention in that direction, and endeavour to remove that great source of danger to all communities in cities. Coming back to their own city once more, he might remind them that this question of the utilisation of sewage had been raised over and over again. They had often heard the expression "Dear and dirty Dublin;" they had had an opportunity of partially realising the meaning of that expression, and he feared that, if the elements should be unpropitious, they would realise it more fully later on, but he hoped not. One of their difficulties had been to deal with the surface cleansing of the streets and the disposal of the matter washed from them, combined of course with the primary difficulty of the treatment of the sewage. They were placed, as his friend Dr. Haughton had put it, in a mud valley, down which their river swept and from which drainage was difficult. The methods which had been proposed for Dublin was to carry the sewage out to sea; but if they did that they would be introducing the elements of another "Irish grievance" by taking from their own shores valuable materials and, as the President had said, distributing them for the benefit of the world. That was a course which they decidedly objected to take. He would not detain the meeting longer, but would conclude by formally moving a vote of thanks to the President not only for his valuable address, but for the charming way in which he had placed his statements before them.

Mr. JOHN SPILLER seconded the motion, and in doing so said that, as a colleague of their President from the time of the first formation of the Society, he desired to bear witness to the great value of his services. Whether in the capacity of treasurer (which position Mr. Rider Cook had held from the first) or in the special position of President which he had so ably filled during the past 12 months, he had always served the Society well. It was a pleasant duty to him therefore to second the motion so ably proposed by Professor Emerson Reynolds.

On the motion then being put by the Secretary, it was carried by acclamation.

The PRESIDENT said, in acknowledgment, that he was greatly obliged to the meeting for the vote which they had so kindly passed. He felt a happier man at that moment than he had felt at any time during the 12 months that had elapsed since he was elected President, for all that time the address had been hanging over his head. Feeling that he could not hope to bring forward anything that would compare with the addresses of previous Presidents, he had tried to find something to say which, if it did not give information, would at any rate do the next best thing—set his audience thinking. It was given to some to perform; to others to initiate, and if he had succeeded in starting somebody to work that day he would be amply rewarded for his trouble.

ELECTION OF AUDITORS.

Mr. S. H. JOHNSON moved that Messrs. Theobald Brothers and Miall be re appointed auditors for the coming year at a remuneration of 10 guineas. The motion was seconded by Mr. Alfred E. Fletcher, and carried unanimously.

Mr. T. TYRER, as Chairman of the London Section, then invited the Society to hold its next Annual Meeting in London. London, he said, had already had some experience in entertaining the Society, and that experience, added to the invaluable lessons which it had learned from other local Sections, would, he hoped, enable it to keep up its reputation for hospitality. He had attended the meetings of the Society from the commencement, and had seen it received with uniform kindness and increasing hospitality. Each succeeding year had brought an aggregation of experience, and the novelty of one meeting served afterwards to make the next meeting a success. From what he had already seen, he was quite sure that Dublin would not be behind the other Sections in sustaining the reputation of the Society. He hoped that his Irish friends would come to London next year in as large a body as possible, so that the London Section might have an opportunity of repaying to some extent the generous and hearty hospitality of Dublin.

Mr. W. CROWDER seconded the motion, and in doing so re-echoed Mr. Tyrer's hope that the next meeting might be an exceptionally large one.

The motion that the invitation of the London Section be accepted was then put by the President, and was carried unanimously.

The President then read the report of the scrutators, which showed that 239 voting papers had been sent in, and that the following gentlemen had been elected to fill the four vacancies among the ordinary members of Council:—Mr. Wm. Thorp, Mr. Boverton Redwood, Mr Arthur Boake, and Dr. Charles Dreyfus.

The Council for 1891—92 is therefore composed as follows:—

President.

Prof. J. Emerson Reynolds, M.D., D.Sc., F.R.S.

Vice-Presidents.

Sir Lowthian Bell, Bart., F.R.S.	Ludwig Mond, F.R.S.
Wm. Crowder.	Dr. Hugo Müller, F.R.S.
James Duncan.	B. E. R. Newlands.
Dr. John Evans, F.R.S.	J. C. Stevenson, M.P.
David Howard.	A. Norman Tate.
S. H. Johnson.	Sir John Turney.

Ordinary Members of Council.

A. H. Allen.	E. K. Muspratt.
Arthur Baker.	T. L. Patterson.
Jno. Calderwood.	Boverton Redwood.
Dr. Charles Dreyfus.	Jno. Spiller.
H. Grimshaw.	F. W. Stuart.
Prof. R. Meldola, F.R.S.	William Thorp, B.Sc.

Honorary Treasurer.

E. Rider Cook.

Hon. Foreign Secretary.

Dr. F. Hurter.

Professor Emerson Reynolds said that he desired to return his hearty thanks for the honour which the members had done him in electing him President. His gratification was somewhat qualified by the fact that, according to his predecessor's experience, he must now turn his attention to the Presidential address for next year; he was glad, therefore, that so long a time had to elapse before presenting it. He should feel great pride in presiding over so important a body as the Society of Chemical Industry.

Mr. B. E. R. Newlands stated that under the Charter of the Imperial Institute the Society had the right of nominating a member of the governing body of that institution. He begged to propose that the outgoing President be appointed to that office. After the experience they had had of Mr. Cook that day, it needed no words on his part to press upon them the President's claims to their support in regard to this matter.

Mr. T. W. B. Mumford had great pleasure in seconding the proposal. Everyone who, like himself, had had the pleasure of working with Mr. Cook knew how thoroughly suited he was for such a position. He was sure, therefore, that if they elected him he would prove to be a thoroughly worthy representative of the Society in the Council of the Imperial Institute.

The motion was carried unanimously.

The President thanked the members for the confidence they had placed in him. There was, he said, one more resolution to put which he was sure the members would not regard as a merely formal matter. He referred to a vote of thanks to the authorities of Trinity College for so kindly placing their rooms at the disposal of the Society on that occasion. He had already expressed the gratitude they felt to the Reception Committee, and he was sure that their gratitude to the College authorities was no less. It was interesting to him, and he was sure it was no less interesting to every other member that the meeting should be held in that historic building the existence of which they had known ever since they knew anything at all, and the influence of which was not confined to Dublin or to Ireland, but was world-wide in its beneficence. He should look upon their meeting there as one of the red-letter days in the annals of the Society. He had therefore much pleasure in moving that the heartiest thanks of the members be accorded to the authorities of Trinity College for their kind invitation to the Society to use their Hall and Council Chamber on this occasion.

Mr. Norman Tate, in seconding the motion, said that he regarded the meeting in Dublin as a proof of the brotherly feeling that existed between the two countries. English chemists had come to Dublin to grasp in fellowship the hands of their fellow chemists in Ireland, and to unite in forming one strong brotherhood to work in the great field of chemical industry which could do so much for the benefit of both nations. The Trinity College authorities had greatly assisted that object by granting the use of their beautiful building, and he had therefore great pleasure in seconding the motion so ably proposed by the President.

The motion was put, and was carried unanimously.

Mr. W. G. Strype (Hon. Secretary of the Reception Committee) then made some announcements with respect to the arrangements for the excursions, &c., and this concluded the business of the meeting.

Several photographs of a large group of the members were then taken in the grounds of the College, after which at the invitation of the Reception Committee, a large party of the members partook of a substantial, and indeed sumptuous, luncheon in the "Antient Concert Room," Great Brunswick Street. In the unavoidable absence of the Lord Mayor, Sir Henry Cochrane, Deputy Lieutenant, presided, being supported by the President and Mrs. Rider Cook and Sir Charles Cameron, the City Analyst, on the right, and by Mr. Tyrer and Dr. Valentine Ball on the left. After justice had been done to the meal, the enjoyment of which was considerably enhanced by an artistic performance of Irish airs by Mr. John O'Donnell's orchestral band—

Mr. W. G. Strype gave some further information with respect to the excursions to be made that day in a humorous speech, which evoked frequent applause.

The President said that, notwithstanding Mr. Strype's efforts to prevent him, he did not intend to be deprived of the pleasure of proposing the health of the Reception Committee, coupled with the name of Sir Henry Cochrane, who had so kindly presided over the luncheon. He was sure that his friends would be disappointed if that toast were not given.

The toast was enthusiastically drunk with three times three, to which, at the invitation of Mr. Tyrer, hearty cheers were added for Mr. Strype, Mr. Boyd, and Mr. Wilson.

Sir Henry Cochrane briefly responded, and the company then separated to take part in—

The Excursions.

A portion of the members proceeded by steamer, in charge of Dr. Haughton and Mr. Wesley Wilson, to inspect the Bay of Dublin, while others, to the number of about 70, under the guidance of Mr. S. P. Boyd, left Westland Row by special train for Dalkey, and thence proceeded by car to the Victoria Park, Killiney. Unfortunately, the weather was not propitious, as there was more than a suspicion of rain, with a dull leaden sky. Under these circumstances, the view, which includes the lovely Bay of Killiney, was not seen to its best advantage. The party then walked to Ilerton, Killiney, the seat of Mr. Samuel Boyd, J.P., who had most kindly invited the members to pass through his grounds. After examining the rare sub-tropical shrubs and ferns with which the gardens abound, among which were to be found palms and tree ferns rarely seen growing in the open air in this country, the visitors partook of tea and other refreshments, and returned to Dublin by the train from Killiney at 5.35.

The Conversazione.

In the evening the members attended a conversazione given, by permission of the Lords of the Committee of Council on Education, in the rooms of the Science and Art Museum, Kildare Street. A large number of ladies and gentlemen attended, and were received by the Lord Mayor and Lady Mayoress, Miss Meade, and Dr. Valentine Ball, the Director of the Science and Art Museum. Among those present were the President of the Society and Mrs. Cook, Professor J. Emerson Reynolds, the Rev. Dr. Haughton, Sir Robert Ball (the Astronomer Royal), Mr. Claude Guinness, Mr. Reginald Guinness, Professor Tichborne, Mr. Norman Tate, Mr. T. Tyrer, Mr. B. E. R. Newlands, Mr. John Spiller, Sir Nath. Staples, Bart., Dr. W. L. Dudley, Sir Chas. Cameron, and representatives of the rank and fashion of Dublin and the vicinity.

The Central Hall, the Rotunda, and the various rooms containing the art treasures of the Institution were brilliantly lighted by electricity; and the visitors, aided by programmes indicating the disposition of the various collections of relics, models, statuary, &c., &c., found no difficulty in passing a thoroughly pleasant evening. By the kind permission of Lieut.-Col. Courtenay and the officers, the band of the Royal Sussex Regiment was in attendance in the gallery of the central court, and gave an admirable performance of both instrumental and vocal music. The comfort of the guests was amply provided for in every way, seats and lounges being distributed throughout the building, and light refreshments being provided. The whole of the arrangements for the evening's entertainment were admirably carried out by Mr. W. G. Strype and Mr. S. P. Boyd, the honorary secretaries of the Reception Committee, and by Mr. E. A. Werner, F.C.S. The company broke up about 11 o'clock, the general opinion being that the reception had been one of the most enjoyable that they had experienced in connection with the meetings of the Society.

SECOND DAY.

Visit to the Inchicore Railway Works.

On Thursday morning a party visited the extensive workshops of the Great Southern and Western Railway at Inchicore.

These works have been in operation since the early part of 1846 previous to the line being opened for traffic on 4th August of that year. They have since been steadily increasing in size, until they now cover an area of 52 acres, upon which stand about eight acres of shop buildings. In 1847 the number of men employed was 259; there are now between 1,200 and 1,300. All the rolling-stock has for a considerable time been entirely constructed and repaired at these works; and in addition the various articles, such as lamps, barrows, &c., required for traffic and other purposes of the railway, are made and kept in repair. The rolling-stock consists of 178 engines, 530 passenger vehicles, and 3,820 waggons. In the boiler shop steel is used for the manufacture of locomotive boilers, and hydraulic riveting is employed as far as possible.

There are two erecting shops, one 286 ft. long and 50 ft. wide, with 16 pits; the other is 326 ft. long and 50 ft. wide, with 19 pits. The shops are provided with rope-driven gantries, and are divided by a traverser serving all roads in both shops; the traverser is driven by wire rope. On one side of the newest portion of the erecting shop, built in 1883, are the coppersmiths' shop and testing room; and at right angles to the erecting shops is the machine and fitting shop, about 324 ft. long by 50 wide.

By the courtesy of Mr. H. A. Ivatt, locomotive engineer of the Company, a splendid saloon carriage was placed at the service of the visitors, who at 10.30 left the Kingsbridge terminus, and shortly afterwards reached Inchicore. The party, on arriving at the works, were first conducted through the paint shop, where carriages, engines, and tenders were being painted. They next visited the trimming shop, where the carriages were upholstered. The foundry, which supplies all the iron and brass castings required in the shops, as well as castings for signal and other work for the permanent-way, was a very interesting section, and there locomotive cylinders were cast double, and axle-boxes, buffer-sockets, slide-valves, &c., were machine moulded. The locomotive smithy is 282 ft. long and 50 ft. wide, and contains 37 fires. Much of the work is done by stamping and welding under the steam hammer. Adjoining is the forge, which contains two Siemens gas furnaces and a 50-cwt. hammer. The boiler shop, the saw mill and joinery, the carriage and waggon, and other shops were all visited, and the inspection of the work carried on in them was regarded with the greatest interest. In one department a small bogie tank-engine, about 32 tons in weight, was lifted off the rails, and raised a height of 10 or 12 ft. This was done by a travelling crane. The lifting and moving of such an enormous weight afforded evidence of the power employed in those great workshops. The travelling crane was invented by Mr. Ramsbottom, on whom a few years ago Trinity College conferred the honorary degree of Master of Engineering. Mr. Ramsbottom was succeeded at Crewe by another eminent engineer, Mr. Frank Webb, under whom Mr. Ivatt completed his education as an engineer, and qualified himself to become head of one of the greatest engineering establishments in the United Kingdom. Mr. Ivatt conducted the visitors to the erecting shops, and also showed them the fire engine department, which was a model of order and neatness. The Rev. Dr. Haughton observed with respect to it, "The perfection of a thing like this is to have everything right, though the misfortune of having to use it may never occur." The visitors were greatly pleased at having been afforded the opportunity of seeing the splendid and interesting work carried on in those great shops, and, after thanking Mr. Ivatt for his courtesy, returned to Kingsbridge in the saloon carriage in which they proceeded to Inchicore.

Messrs. John Power and Son.

Another party went to Messrs. John Power and Son's distillery in John's Lane, where they were received by Mr. J. Talbot Power, who, assisted by several members of the staff, conducted the visitors over the establishment. Unfortunately the "long vacation," common to distilleries in the summer months, had already commenced, but Mr. Power and his able coadjutors did their utmost to render the visit as instructive as possible by giving the fullest information on all points of interest. The first and most striking feature was the perfect cleanliness, brightness, and good order prevailing in every department, and at first sight almost conveying the impression that the various apparatus had not yet been put into practical operation. This was actually the case, we believe, as regards the first department entered, a handsome and roomy structure designed for use as a smithy, fitting, turning, and carpentering shops. Passing on, the corn stores, cleansing machines, new horizontal engines, and the malt kilns were severally inspected, and then the attention of the visitors was directed to the mill-room, in which were seen the huge stones and rollers employed for crushing and grinding the corn, and capable of so treating a quantity of grain equivalent to 1,500 barrels per day. Considerable interest was shown in the gearing for distributing engine power to the various pairs of stones and rollers, and the use of ropes in lieu of driving belts, every department being able to signal power on or off by means of electric bells. Crossing to another portion of the distillery, the party was conducted to a perforated iron floor above the brewhouse, from which they obtained a bird's-eye view of the two gigantic mash-tuns, each 33 ft. in diameter and 7½ ft. deep, and which, working alternately night and day, are capable of mashing 1,000 barrels per diem. Passing on, and noting *en route* the metal underbacks for receiving the wort from the mashing tuns, the powerful compound condensing steel beam engine, the 37 ft. steel boilers, the four coppers for boiling water and wort, and the system of refrigerators, the visitors arrived at the still-house, a building containing six of the largest pot stills in existence. From there an ascent was made to the gangway, from which a view could be obtained of three immense wrought-iron "worm tubs" fitted with copper coils of continuously diminishing section. From there the course lay through the sampling and filling rooms, and by means of a hydraulic lift worked by waste hot water from the worm tubs, to the bonded stores below. Passing again into daylight, and after admiring the small but beautifully fitted stables, the cooperage, the fire brigade shed, and last, but not least, the horses paraded with drivers and trollies, the visitors were received by Mr. Power in the counting house, where the finished product of the firm was submitted for approval. Here the President thanked Mr. Power for his kind and courteous reception of the members, and Mr. Power briefly replied.

Messrs. Guinness, Son, and Co., Limited.

The visit to Messrs. Guinness's great brewery was arranged and carried out in the most effective manner. On arriving at the establishment at St. James's Gate, the visitors were received by Mr. Claude Guinness. Each one

then received a tastefully bound description of the brewery, a card giving a general idea of the course to be followed during the visit, and a second card with a number corresponding to that borne by the guide of the party to which he was for the time attached. Some 10 or 12 gentlemen, each intimately acquainted with the establishment and its operations, acted as guides, and the visitors were apportioned among them in parties of from 10 to 15, the whole of the arrangements, however, being under the personal supervision of Mr. W. W Wilson. Passing through the general offices into and across the space between the old and new breweries, the visitors were soon in a position to form a rough idea of the vast proportions of this historic concern. A map was supplied to enable one to grasp the general plan of the works, the tunnel connecting the higher with the lower portion of the premises, and the miniature trains rapidly conveying men and material from one part to another, all tending to produce the impression that one was passing through a busy town rather than the premises of a private firm. As affording some indication of the gigantic business of the Company, it was mentioned that the works cover an area of about 40 acres, afford constant employment to about 3,000 men and 150 horses, besides a great many more hired from outside contractors. The average brewing is about 3,000 barrels per day, and the Excise duty amounts to over 40,000*l.* per month.

Passing through the engine room and malt-receiving room the visitors halted in the mill room and inspected the apparatus for taking out foreign matter from the malt and automatically feeding it in exactly proper weight to the respective mashing tuns, through crushing rollers. They then followed as far as possible the course of the malt and wort through the various processes, the next room visited being that devoted to a series of enormous mashing tuns. The brewery contains 16 of these, eight in each half of the establishment, capable of dealing with over 1,600 quarters of grain per day. Having watched for a time the operations of mashing and sparging, the party passed on to the coppers in which the wort is boiled with the proper complement of hops. Here it was incidentally mentioned that a larger proportion than usual of Californian hops are being used this season in consequence of the crop from that country being of exceptionally good quality. Leaving these huge coppers, each of which has a capacity of about 600 barrels, the visitors' course lay by way of the hop backs or cleansers to the refrigerating department, where the system of cooling the wort by Lawrence's patent refrigerators was much admired. Twelve sets of these were at work, the heated water being afterwards employed for washing returned casks. In this connection it was stated that about 1,000 hogsheads of boiling water are produced and used daily without the employment of fuel directly for that purpose. Passing then through the rooms in which the operations of fermenting and skimming were proceeding in various stages, the visitors inspected the processes of pressing and drying the yeast. In this department about 80 tons of dried yeast are produced per day, the whole of which is either sold to Irish distilleries or used in future operations in the brewery. Leaving this department and inspecting the gigantic fermenting tuns passed en route, the visitors arrived at what was for the majority of them the scene of the most interesting operation of the day, namely, the room in which is carried out the process of recovering and storing the waste carbonic acid referred to by several speakers at the Annual Meeting. It is impossible to predict to what proportions this industry may grow. The idea is quite new at present, and Messrs. Guinness's operations are therefore limited to producing sufficient carbonic acid to supply the requirements of their own establishment, and such demand as has already arisen in connection with the mineral water manufacture. The carbonic acid gas is collected from the fermenting tuns by means of parachutes from which it is drawn through pipes to this department, where, after passing through scrubbers to remove suspended impurities, it is liquefied and stored in the ordinary steel cylinders. From here the party went to the freezing machines. The Company employs both the ether and the ammonia process of freezing, but only the former was in operation at the time, the object being to reduce a solution of calcium chloride to a low temperature, and pump this through pipes traversing the various departments in which it is required. It is intended to replace the ether by liquid carbonic acid. After inspecting a few of the enormous oak vats in the storing department, of which there are about 150, some of them of 1,700 barrel capacity, the visitors passed from the new brewery by way of the stables to the malt stores. This is a gigantic building beside the canal, capable of storing a million bushels of malt. It is about 120 ft. high, and is divided into a series of bins, into which the malt, after being screened, is conveyed by bands worked by two engines of each 100 h.p., and consuming only 10 to 12 cwt. of coal per day. From the bins the malt is discharged as required into little railway waggons for conveyance by the railway mentioned above to the brewery. We were informed that the arrangements in this department are so admirably economical that two men can work about 1,500 qrs. of malt per day. Messrs Guinness themselves produce about 4,200 qrs. of malt, and in addition take the production of eight commission houses. Some of the visitors proceeded by train to the maltings, a large and handsome building of five floors supported on innumerable iron columns, the three lower floors being devoted to malt and the two upper ones to barley. Others went to see the grain drying. Three machines are used—the Passburg, Millburn, and Hacking; each machine dries about one ton per 24 hours at a cost of 18*s.* 6*d.* per ton of dried grains. The product finds no market in this country, but is eagerly bought up for export to Germany. Thence a visit was made to the cooperage, the interesting operation of cleansing the casks by means of steam and hot air being inspected on the way. In the cooperage the visitors were much interested in watching the rapid manufacture, repairing, and numbering of barrels and hogsheads, every operation except that of drilling being performed by hand labour. Passing on through the saw mill, by the huge stores of timber and the forwarding department, the filling shed was arrived at, and here was seen in full swing the interesting and economical method by which the casks are rapidly filled to the bung-hole without the waste of a spoonful of liquor. It consists in employing an india-rubber tube for filling, a smaller pipe containing a glass tube being let into this near the bung-hole. The overflow passes back through this smaller pipe, and consists at first of air and "fog" or froth, and of black beer as soon as the cask is full. When this latter appears at the glass tube the supply pipe is transferred to another cask. It was stated that so expeditious is the operation that one man can fill 100 barrels per hour.

This completed the tour of the premises, and the visitors were next conducted to a room in which an excellent luncheon had been prepared for them. Here they were regaled with both solid and liquid refreshment, the renowned "double" and "treble" stout of the firm of course coming in for the lion's share of attention, but the mineral waters produced on the premises by the utilisation of recovered carbonic acid also received a considerable amount of favour. Congratulatory speeches having been made by the President and other leaders of the Society, and responded to by Mr. Guinness and Mr. Wilson, the members took their leave highly gratified with their visit.

Messrs. John Jameson and Son.

A few members availed themselves of the kind invitation of Mr. John Jameson to inspect his famous distillery. Arrived at Bow Street, they were gratified to find that working operations were going on, though, as the distilling season is practically over, only two stills were running. The party were conducted over the building by the Manager, and every facility was afforded for seeing every detail of the operations in this the most famous distillery in Ireland, or indeed in the world.

The tour of the premises completed, the visitors were invited to the offices, where samples of the famous "seven years old" were tested. The Manager apologised for the unavoidable absence of Mr. Jameson, who, he said, would have been delighted to have welcomed the members of the Society in person, and Mr. Newlands briefly returned thanks on the part of the visitors.

The Garden Party.

A somewhat larger number on leaving Messrs. Guinness's attended the garden party in the Zoological Gardens, which were kindly placed at the disposal of the Reception Committee by the Royal Zoological Society. The attendance, though fashionable, was not so large as should have been attracted to a gathering of this kind. The visitors were received by the Committee, and at once proceeded on a tour of inspection of the gardens, under the excellent guidance of Dr. Valentine Ball, Secretary of the Royal Zoological Society. No better opportunity of inspection could have been selected, as the grounds are at present all that could be desired in regard to tidiness and order, and the pleasant change in the weather contributed to no small extent to the favourable appearance of the gardens. The band of the 1st Gloucester Regiment played a choice programme during the afternoon. Considerable interest was manifested in the various occupants of the cages—birds, beasts, and fish alike calling forth expressions of warm admiration. The guests were warm in their eulogies of the *carnivora*, especially those born and reared in the gardens. Refreshments were then served, and the members went away expressing themselves well pleased with their visit.

The Annual Dinner.

The Annual Dinner of the Society was celebrated on Thursday evening, 9th July, in the Town Hall, Kingstown, which had been tastefully decorated for the occasion by the proprietor of the Marine Hotel, in whose hands the arrangements for the banquet were placed. About 150 members and friends sat down. The President, Mr. E. Rider Cook, presided at the high table, being supported on the right by the Right Hon. the Lord Mayor of Dublin, Professor Fitzgerald, Sir Nathaniel Staples, Mr. Hugh Moore, Dr. Carte, Mr. J. Talbot Power, and Sir Charles Cameron, and on the left by Professor Emerson Reynolds, Sir Henry Coehrane, Dr. Finney, President of the Royal College of Physicians, Mr. H. Gray Croly, President of the Royal College of Surgeons, Mr. S Boyd, Mr. J. M'Sheehy, and Mr. W. Anderson. The spur tables were presided over by Mr. T. Tyrer, Mr. S. H. Johnson, and Mr. Vereker.

Dinner having been partaken of:

The President proposed the first toast—"The Queen"—in a few felicitous words. This having been honoured with three times three—

The President proposed "The Reception Committee and Honorary Officers." This toast, he said, caused him considerable difficulty, not because there was nothing to be said in the way of commendation, but because there was so much to be said that he felt incapable of adequately performing the duty. As he had already stated, the Society was present in Dublin for the first time, not in the ordinary way by the invitation of one of its local Sections, but by the invitation of a Reception Committee consisting largely of gentlemen outside their own body, who had gathered themselves together for the purpose, had sent the invitation, and had backed up that invitation in a way which it was impossible to describe other than by saying that it was the best possible way in which it could have been done. He hoped therefore that this particular toast would be drunk, not in a formal manner, but with the Irish enthusiasm befitting such a toast on that hospitable Irish soil. He had had the opportunity during the day of talking to a great many members of the Society, and he had met with but one opinion, and that was that the hospitality which had been offered to them in the city of Dublin was almost unexampled. If they could put themselves in the position of one body instead of being a number of separate individuals, they might imagine themselves to be the German Emperor come over to visit the country, for they had certainly met with a right royal reception. Without wishing to make any comparison between the way they had been received there and at other places, all he could say was that if that was the way in which Irishmen were in the habit of receiving societies, he hoped that it would not be long before another invitation came, say from Cork, Belfast, or some other Irish city. With regard to the second part of the toast, the Honorary Officers, he wished to point out that such perfect organisation as they had seen during the meeting was not attained by hazard or chance. It was the result of sheer hard work, and that hard work had been done by gentlemen who had given their time and labour voluntarily. Even hard work would not have been sufficient by itself; behind it there must have been hearty enthusiasm to have enabled them to carry out every detail of the arrangements in so perfect a manner. They had had perfect organisation and prodigious labour on the part of the honorary officers, and in addition—if he might judge of the members' feelings by his own—there had been an amount of personal geniality on every occasion which had made them feel that they were regarded as old friends. Personally, he could only hope that an opportunity would be afforded him next year of returning some of the kindness he had experienced from those gentlemen. He was sure that the whole of the visitors would join with him upstanding to drink with all enthusiasm the toast he had the honour to propose, coupled with the names of the Right Hon. the Lord Mayor, Messrs. S. P. Boyd, W. G. Strype, and W. W. Wilson.

The toast having been enthusiastically drunk with musical honours—

The Rt. Hon. The Lord Mayor said that he had much pleasure in thanking the members on the part of the Reception Committee for the very kind way in which the President had spoken of their puny efforts to entertain the Society. They had felt that they had very little indeed to show the members of such a Society, representing the vast chemical industries of England and Scotland. But they felt that there were some industries in their little city of Dublin which, although they could not strictly be called chemical, were nevertheless industries with which chemistry had a great deal to do, and which were regarded by Irishmen with considerable pride. The members of the Society had visited that day some establishments which Dublin was proud of. He referred firstly to Messrs. Guinness's brewery, and he was sure that those gentlemen who had visited that place must have been gratified by the way in which it was organised and carried on, and especially by the application of means for reducing labour and by the introduction of the latest discoveries in science connected with the industry there pursued. They had also seen the distillery of his friend Mr. Talbot Power, and he felt sure that those who had been through that establishment would admit that it was an example of an Irish manufactory, the machinery, appliances, and order of which was deserving of nothing but admiration. The members had probably seen larger works in England or Scotland, and he only pointed to these as instances of what could be done in a small country. He hoped, too, that the visitors had found some things to interest them in the city itself; at any rate, he thought they would admit that an attempt had been made to amuse them. On the part of the city of Dublin he could assure the Society of a hearty welcome on any future occasion.

Mr. S. P. Boyd said that he considered it one of the greatest privileges that had fallen to his lot to be permitted to take part in the work of the Reception Committee. The visitors had already seen some of the natural beauties of the place, and he hoped that they would see more on the morrow. But he wanted them to do something in return for the small amount of hospitality which it had been their privilege to extend to the Society. He wanted them to do their utmost to help Ireland through her greatest difficulty—the development of the natural resources of the country and the employment of the people. It might be the opinion in England that capital could not be safely invested in Ireland; but that opinion was not well-founded, and it was a matter which he hoped gentlemen who were largely interested in industries would take into consideration. Ireland was a splendid field for the development of industries. It possessed great natural resources, and all that was wanted was capital and enterprise to develop them. Irishmen were divided on many points, but they were united on one; they loved their native country. They believed that their country had a great future before it, and he hoped that gentlemen then present would assist

them in some measure in attaining that future. English capitalists were disposed to send their savings to Africa and other far-off districts instead of looking, as he thought they should do, nearer home; and of the fields for enterprise near home Ireland best deserved their attention.

Mr. W. G. Strype (who was unfortunately at times inaudible) thanked the President for the very kind way in which he had spoken of the work of the Reception Committee. That committee was not only mixed in character but large in number, consisting of about 120 members. Fortunately they had only one chairman, but then they had 15 vice-chairmen, two secretaries, and a treasurer. Mr. Strype then proceeded to give a most amusing description of the proceedings of the committee, showing how it had found itself unable to get on with business as a whole, with the 15 vice-chairmen all anxious to take the place of the chairman; how it had then divided itself into sub-committees, how the Paper Committee had thought it absolutely necessary to provide black-bordered paper and envelopes for the use of the visitors; how the Weather Committee had appointed the Rev. Dr. Haughton its chairman, as being the highest authority in Ireland on that subject, and the only man likely to have any influence with the Clerk of the Weather; how a little delay had occurred in making the preliminary arrangements, in consequence of which it was found that a rainfall of ·0097 had been fixed for the day of the annual meeting; how the Clerk of the Weather insisted on having that amount of moisture down somehow; and how Dr. Haughton, by skilful diplomacy, had managed to make the rainfall occur at the time when the one excursion party was safe down in the cabin sampling the supplies of the Cigar Committee, and the other party was well under the protection of Mr. Boyd.

In the absence of Mr. W. W. Wilson, the treasurer of the Reception Committee, the President called upon Sir Charles Cameron to respond on his behalf.

Sir Charles Cameron said that he need hardly explain to an audience of gentlemen, all of whom possessed more or less scientific knowledge, how necessary it was to the comfort and happiness of any one who had just eaten a good dinner accompanied by good wine, that the whole stream of nervous energy should be allowed to run steadily and uninterruptedly in the channels of digestion and absorption. He had been in that happy position that evening, until he was suddenly informed by his friend Mr. Strype, the autocrat of all their arrangements, that Mr. Wilson was unable to be present, and that he would have to take his place. That announcement had seriously interfered with the process of the conversion of peptones into parapeptones which had been going on so nicely before; and he therefore appeared before them an imperfectly nourished man, utterly incapable of making such a speech as he would have made if his friend had not deferred to the last moment his decision not to come. Sir Charles then proceed to discuss in a humorous manner the probable causes of Mr. Wilson's absence; and concluded by saying that while all the members of the Reception Committee had worked hard, none had done more or better work than their Honorary Treasurer, Mr. Wilson. He was sure that all the members would join with him in deeply regretting that their friend was not able to be present, and in thanking the President and the guests for the very kind way in which his name had been received.

The toast having been pledged with great enthusiasm—

Professor J. Emerson Reynolds proposed "The Society." In doing so, he said that there had been so many humorous speeches that anyone who had to follow with a more serious set of observations was placed in a great difficulty, one of his disadvantages being that he must not even attempt to be amusing if he could; while he personally was on the other horn of the dilemma, that he could not be funny if he would. Sir Charles Cameron had provided him with one observation by describing the effects on his digestion of being called upon to address that great meeting within a few minutes. He would ask them, then, to endeavour to imagine the condition of any person who, like himself, had known for at least three hours that he was required to perform a similar function. The toast which was entrusted to him was being given for the first time in that noble land of theirs; but he hoped it was not the last time it would be proposed. That toast was the continued prosperity of the Society of Chemical Industry. The history of that Society illustrated in a most exceptional way the truth of the old statement that "Unity is strength." He did not refer to that lower kind of unity—very real, nevertheless—which arose out of self-interest, but to that higher class of unity which was based on the desire of men to associate together for the promotion of the general welfare. Still he might refer to that form of unity of which he had spoken in the first instance, and which he had ventured to call a lower class of unity, as it really was from a theoretical standpoint. He might speak of that Society as including all the interests represented by that great chemical union which dealt with the enormous capital of eight millions that had been so freely subscribed in these countries. He might speak of that greater union represented by the Society, which was outside the alkali union and whose interests amounted to many times eight millions. He would perhaps not be exceeding his duty if he referred to that higher union still which existed in that Society between the men whose aim in life was simply to extend the bounds of human knowledge and those who sought to apply such knowledge for the benefit of the race. He would be unworthy even at a distance to follow in the footsteps of his excellent friend, the present President, if he did not recognise that the members of that Society required the stimulus which those who were engaged in the pursuit of pure science could give them in the development of the important industries with which they were connected; and that further they who were engaged in the pursuit of pure science received from those who applied their researches the most important stimuli to further exertions. This was a tempting theme on which to enlarge, but he dare not pursue it, as he was oppressed by the knowledge that an express train would shortly be in waiting for them. However, nothing could prevent that meeting, and especially the Irish portion of it, from wishing to the Society the highest and most prolonged prosperity, and an extension of its present membership of 2,700 to one many times that number. He therefore confidently asked the company to join him in drinking to the prosperity of the Society, and, if he might be permitted to add it, to the prosperity of those who had been concerned in developing its greatness.

The toast having been duly honoured—

The President said, in response, that he rose to discharge the duty of a moribund president in returning thanks for the kind way in which the toast had been proposed and received. A great deal had been said about digestion, and he would ask them to imagine his condition after abstaining from beer for ten years when he told them that he had been induced that day to imbibe some of Guinness's stout. What the ultimate result might be he knew not; but at present he was bound to confess that he found nothing seriously wrong. He thanked Dr. Reynolds heartily for the way in which he had proposed the toast. He did not intend to be modest on behalf of the Society, for he believed that it deserved all their good wishes. In returning thanks, he wished to explain that the Society was not the Chemical Society. That Society was intended for the advancement of the abstract science of chemistry, and great and glorious work had it done. The Society of Chemical Industry did not grant letters for people to use; that was done by the Institute of Chemistry, which body he hoped would soon be recognised throughout the length and breadth of the land as the Society which was to give weight and authority to scientific evidence given in courts of law. He did not believe in people putting S.C.I. after their names in order to get something out of it. The Society aimed at combining those who possessed a knowledge of abstract science with those who had the quite distinct power of applying scientific principles on a manufacturing scale. Therefore they wanted to number amongst their members not only chemists but manufacturers who applied chemistry to their manufactures. They did not want any test or qualification; all they required was that a man should recognise that chemistry was a great

help to the manufacturer. In the great contest that was going on between the nations of the world, those manufacturers who availed themselves of the principles of chemistry and physics would necessarily be the better able to hold their own against competitors. Just as by means of railways, telegraphs, and telephones countries were being brought closer and closer together and the markets of the world concentrated into one huge one, so they wanted to see the manufacturers of the United Kingdom in possession of every advantage that would enable them to hold their own in friendly if not in bitter competition with other nations. Therefore he asked everybody in Dublin and in Ireland whose interests were such that chemistry could help him, to join the Society, and he should be very much surprised if when they had read three copies of the Journal through they did not find that they had received five guineas' worth of value for their 25s.

Mr. W. G. Strype then made some announcements with respect to the excursions to take place on Friday, and—

The President stated that Mr. E. C. C. Stanford, whose name was down to propose the next toast, was compelled to remain in London to give some further evidence before a Committee of the House of Lords, and that his place would be taken by Mr. T. Tyrer, the Chairman of the London Section.

Mr. Tyrer said that the duty which had devolved upon him was one which happily needed but few words. Had Mr. Stanford been present he would have been able to continue the humorous vein of which they had had several excellent examples. He, however, did not profess to be a past master in that art. Professor Emerson Reynolds had reminded them of the admirable manner in which the President had fulfilled his duties, and they had all had evidence that night of the hearty way in which he could perform the functions of his office; but the London members who had worked with him on the Council knew him better still, and those who like himself had known and worked with him ever since the foundation of the Society 10 years ago had found him always the same genial, hearty, thorough man of business which they had seen him that night. Speaking in the presence of those who knew every detail of his connexion with the Society, he could honestly say that that Society owed to no member, however able, diplomatic, energetic, or wise, more than it owed to that gentleman who would on the morrow cease to be its President. When in the early days of the Society he, Mr. Tyrer, became Secretary of the Metropolitan Section, he had found Mr. Rider Cook in the office of treasurer, and treasurer he had remained ever since; and those who knew the amount of work which such a position involved in a Society such as theirs, and the business capacity required to manage the finances so as to be able to produce yearly such a balance sheet as they had seen the day before, would appreciate the advantage that the Society had enjoyed in securing the services of such a treasurer. He could not pretend to speak of Mr. Rider Cook's services as eloquently as they deserved, but he did wish to emphasise the fact that those services were not altogether included in his year's work as President; they extended back for 10 years, and he hoped would extend forward for many years to come. Presidents might come and Presidents might go, like the river, but he was glad to say that as treasurer Mr. Rider Cook would remain with them, and he hoped that he would "go on for ever." He was quite sure that directed by such a treasurer the Society could not fail to "flow on" in the right direction. He therefore asked the company to drink in the most cordial manner the health of "The President."

The President, in responding, said that he had already taken up so much time that he would limit his reply to thanking them sincerely for the cordial way in which they had received Mr. Tyrer's kind words about himself. He wished, however, to avail himself of the opportunity to supply an omission which he had made in proposing the toast of "The Reception Committee and Honorary Officers." In addition to those gentlemen, the Society owed a deep debt of gratitude to the owners, and the representatives of the owners, of the works which they had visited. Amongst those gentlemen were Mr. Geoghegan, who had so efficiently shown many of them round Messrs. Guinness's place; and Mr. Power, with respect to whom those who had had the pleasure of being conducted round the distillery by him felt that he not only had an interesting work to show, but that he showed it with a genuine courtesy such as could not be excelled. Those were the two places which he had visited himself, and with respect to which he was entitled to speak, but he had no doubt that those gentlemen who had visited the railway works and Messrs. Jameson's distillery had met with an equally kind reception. It would therefore be an omission on their part if they allowed that evening to go by without publicly stating how much they were indebted to those gentlemen for their kindness. He therefore begged them to accept his assurance that the members of the Society were sincerely grateful to them for the marvellous exhibitions of manufacturing industry and the development of machinery which they had had the pleasure of seeing in those works.

The toast having been cordially drunk—

Mr. H. S. Johnson, in proposing "Our Guests," admitted that he was somewhat uncertain as to whom the title referred to, seeing that, in the first place, the Society was in Dublin as the guests of the Reception Committee; secondly, the Reception Committee were there as the guests of the Society; and in the third place, a number of gentlemen were present as the guests of both the Society and the Reception Committee. The President had, however, saved him much trouble by his eloquent reference to those gentlemen who had received them so nobly and so well. But there were other gentlemen present who had not been alluded to. They had the honour of the presence of several gentlemen of the highest eminence representing certain learned societies: the President of the College of Surgeons, and other gentlemen of great distinction from other societies. Nor must they omit Mr. Samuel Boyd, who had received them with so much kindness and courtesy on the previous day. He would conclude by saying that after drinking the healths of the guests he had specially mentioned, he would propose that they should all drink each others healths in their respective capacities as the guests of each other. That, he thought, would be an admirable system to adopt when in Ireland.

Mr. Hugh Moore, who responded in the absence of Mr. J. Talbot Power, briefly thanked the Society for the cordial manner in which the toast had been received.

Dr. H. Gray Croly, President of the Royal College of Surgeons, also responded on behalf of that body.

THIRD DAY.

On Friday the members divided themselves into three parties, and proceeded on excursions into the county of Wicklow. A special train left Harcourt Street station at 10.15 a.m., and conducted a large number to Bray and Rathdrum stations. Two sections of the party alighted at Bray. One proceeded on cars to Roundwood, *viâ* the Glen of the Downs, and the other to Enniskerry and Powerscourt. A party of about 60, under the superintendence of Messrs. W. G. Strype and S. P. Boyd, and accompanied by Mr. John L. Robinson, a well known archæologist, drove from Rathdrum station to Glendalough and the Seven Churches. The "haunted holy ground" of Glendalough, the gloomy lake, and dark and broken hills, deeply impressed the visitors, who inspected the principal ruins of the district with the greatest interest. A larger party went to Enniskerry, Dargle, and Waterfall, in Powerscourt demesne, through which they were conducted by Professor Emerson Reynolds, President-elect of the Society. The dark, wooded glen of the Dargle and the thickly-wooded hills were viewed from the most favourable points. Powerscourt demesne and Waterfall, and the richly-clothed wood in the vicinity, was the attractive centre of the day. The party which selected Roundwood went by Hollybrook, driving through the beautiful grounds of Sir Richard Hodson and Kilmacanogue, returning by Carrowhill and Rocky Valley. At Roundwood they were

conducted over the city waterworks by Sir Charles Cameron, Mr. Spencer Harty, C.E., and Mr. Andrews, assistant engineer. The entire party returned to town before 9 o'clock, highly pleased with the day's outing, and expressed to the Reception Committee the pleasure which their visit to Dublin afforded. Throughout the day the weather was very fine. This concluded the programme, and the members for the most part returned to England on Saturday morning.

During the meeting the Councils of the Chamber of Commerce and Royal Dublin Society placed their rooms at the disposal of members, and the Whisky Distillery Co., United Alkali Co., Messrs. Pim, Messrs. Johnson, Mooney, and O'Brien, Messrs. Thwaites & Co., Messrs. M. O'Brien & Co., Patent Pneumatic Tyre Cycle Co., Alliance Gas Co., Messrs. Cantrell and Cochrane, Messrs. J. Shanks & Co., and others opened their works for inspection.

London Section.

Chemical Society's Rooms, Burlington House.

Chairman: T. Tyrer.
Vice-Chairman: W. Crowder.
Committee:

C. F. Cross.	W. Kellner.
J. Dewar.	B. Redwood.
A. G. Green.	W. S. Squire.
S. Hall.	G. N. Stoker.
C. W. Heaton.	F. Napier Sutton.
J. Heron.	Wm. Thorp.
D. Howard.	T. E. Thorpe.

Hon. Local Sec. and Treasurer:
W. B. Mumford, 1, Glendale Villas, Sylvan Road, Wanstead, E.

Meeting held Monday, June 1st, 1891.

MR. THOMAS TYRER IN THE CHAIR.

GUM ARABIC AND ITS MODERN SUBSTITUTES.

BY DR. S. RIDEAL AND W. F. YOULE.

Since the closing of the Soudan to commerce consumers have found increasing difficulty in obtaining supplies of gum arabic, and now only small quantities find their way to Europe from the Red Sea littoral and fetch almost prohibitive prices. Consequently the attention of users of mucilaginous and adhesive liquids has been drawn to other sources of natural gums, and an increased stimulus has been given to the manufacturers of dextrin and other gum substitutes. Some notes relating to the appearance and properties of these various natural and artificial substitutes for gum arabic may therefore be of interest.

The various natural substitutes may be divided into two great classes, those which are exudations from the different species of acacia, and those which are not.

Of the former class, the principal are the other African gums from Senegal and the Cape and the different Australian wattle gums; whilst to the latter belong the Indian Ghatti gums.

The investigation of the commercial value of gums from various sources is naturally a problem of some difficulty, and some account of our experience in this direction, on the lines indicated by Liebermann and others, may be of service. Naturally the appearance and colour of the gums are of the first importance, and as they are generally bought and sold on an inspection of those physical qualities only, a brief description of the general characteristics of various classes of natural gum arabics is appended.

The finest gum arabic occurs in large white tears possessing a conchoidal fracture, even in size, and readily soluble in water, forming a viscid mucilage perfectly colourless and clear.

Samples of Aden gum arabic which nearly approaches the former in commercial value are in large white or yellowish white tears, mostly perfectly translucent and with the conchoidal fractures and fissures of genuine gum arabic. This gum generally contains a few fragments which are highly coloured and yields with water a viscid clear mucilage which is quite colourless and leaves no insoluble residue.

Cape gum occurs in irregular masses, not tear-shaped, and of an uniform brownish white colour. The fragments are smooth externally and not fissured. The gum is not so freely soluble as the true gum arabics, nor is the solution so viscid.

Indian gums other than Ghattis occur in irregular masses like Cape gum, but of a lighter colour, and contain many reddish lumps which, when broken, show an uniformly flat surface. It is freely soluble in water, but forms a weak solution and is not a good working gum.

Other samples of Oriental gums known in commerce as Eastern gum occur in tear-shaped masses of a whitish brown colour with conchoidal fracture. The gum is soluble in water, giving a fairly good mucilage.

Other African gums, of which the gum senegals are the most important, are found in fairly uniform fragments of a whitish brown colour and with a conchoidal fracture. They are soluble in water, forming a good mucilage.

All these gums are now met with in commerce and fetch varying prices.

These natural gums, as is well known, consist chiefly of arabic acid in combination with calcium, magnesium, and potassium, and a certain amount of moisture. A portion of the arabic acid, or arabin, may exist in the gum as metarabin, an insoluble modification of metarabin. Such gums leave an insoluble residue which swells up in water but does not dissolve.

As no process has been proposed for the accurate estimation of arabin directly, and as such a process, if available, could probably not give an index to the commercial quality of the gum, the analyst has to be guided by other considerations in the assay of gum.

From determinations of the ash of the sample, its viscosity in solution, which is a measure of its mucilaginous and adhesive power, and the amount of water which the natural gum contains, a fair idea of its commercial value may be ascertained.

The ash of a genuine natural gum should be white in colour and consist chiefly of a mixture of calcium, magnesium, and potassium carbonates, with a trace of sodium chloride.

The following table summarises the results obtained from typical samples from different localities:—

No. of Sample.	Ash.	NaCl.	K_2CO_3	$CaCO_3$	$MgCO_3$	Total.
1. Aden.....	3·29	0·29	17·2	53·90	29·48	100·86
2. Cape.....	3·05	1·11	15·40	57·90	28·89	103·33
3. Indian	2·03	0·37	12·6	58·50	29·82	101·29
4. Eastern ...	2·98	0·24	26·8	53·50	..	..
5. (a)	3·19	0·21	18·01	41·70	34·30	97·22
6. Senegal ...	3·03	0·11	21·5	54·90	15·96	92·50
7. (a)	2·11	0·11	24·9	53·10	..	..
8. Senegal ...	3·38	0·11	17·14	50·32	..	..
9. (b)	3·18	2·00	13·65	59·39	..	..
10. (c)	3·06	0·21	15·8	54·50	30·07	100·58
11. (c)	2·76	0·24	17·10	49·04	29·94	96·32
12. Fine Australian	3·01	0·34	21·2	57·25	..	..
13. Good "	3·15	2·30	29·9	46·23	..	..
14. Cape.....	2·61	2·20	12·2	52·73	..	..

It is commonly stated that gum arabic yields from 2 to 3 per cent. of ash, but we have not been able to find any record of analyses of the mineral constituents.

We tried most of the established tests used by pharmacists for the detection of gum arabic on all the gums which we have had an opportunity of examining. The aqueous solution of a natural gum invariably gives a white precipitate with alcohol, with ammonium oxalate solution, and with subacetate of lead. They do not appreciably reduce Fehling's solution when boiled with it, most samples being without any reaction; some however gave a slight reduction. Iodine in potassium iodide gave no reddish or blue colour. As dextrin and starch are almost invariably present in the artificial gums, this last reaction is of great value in the preliminary examination of a gum. Häger's reagent, which consists of a saturated solution of potassium ferricyanide, with an equal volume of dialysed iron, and some dilute hydrochloric acid, was also tried; but its only value appears to be in discriminating dextrin from natural gums. With the former it strikes a deep blue colour on allowing the mixture to stand. The reaction of course depends upon the reducing power of the dextrin producing Turnbull's blue, no body having such a property being present in natural gums. The test is therefore of no use in discriminating between natural gums. Copper acetate and a few drops of acetic acid when boiled with the gum solutions gives no reduction, showing the absence of glucoses. Liebermann recommends the use of dilute potash and copper sulphate solution to effect the assay of gum arabic and gum senegal whether adulterated or not with dextrin. He adds first the alkali and then the copper sulphate solution to the cold aqueous solution of the gum under examination, filters off the flocculent blue precipitate of copper arabinate after warming, and boils the filtrate, when dextrin, if present, causes a reduction of the copper sulphate. The precipitate on the filter is washed with warm water, dissolved in dilute hydrochloric acid and the free arabic acid (pure gum) precipitated by the addition of a large excess of alcohol. From the reaction of the gum acid thus obtained, he decided whether it has been derived from a true gum arabic or from gum senegal. It is evident that the distinguishing tests which he proposes depend for their success on the presence of accidental impurities, and not on any difference in the behaviour of the arabic acid, which is the chief constituent of both gums. The test which Liebermann most relies on is the formation of a colour on boiling with dilute potash. He remarks that gum arabics give an amber yellow colour, whilst senegal is scarcely affected. Our own experience does not bear out these results. We determined the potash absorptions of several samples of gum and also noticed the colour given by each:—

Gum.	Weight of KOH absorbed.	Colour produced.
1. Aden gum arabic	7·87	Yellow.
2. Cape gum	7·47	Yellow.
3. Indian gum	6·82	Green
4. Eastern gum	9·04	Yellow.
5. Source unknown	5·48	Yellow.
6. African Senegal	2·48	Yellow.
7. Source unknown	2·39	Yellow.
8. Source unknown	6·16	Yellow.
11. Source unknown	2·08	Yellow.
12. Finest gum arabic.....	2·57	Green.
13. Good gum arabic.....	1·92	Green.
14. Cape gum	4·87	Yellowish brown.

From these results one would infer that the colour produced on boiling with potash is no indication of the source of a gum, as sample No. 1, a good gum arabic of ascertained purity, gives a yellow colour, whilst samples 12 and 13, also genuine gum arabics, give a green colour when similarly treated. On the other hand, the majority of samples of gum from very different sources give a similar yellow colour on boiling with the KOH. It is possible that the tint produced is due to a slight decomposition of the arabin by the action of heat and potash. As will be noted further on, Ghatti gums from India react strikingly with potash, producing a characteristic pink colour. On the whole, so far as our experience goes, the methods of determining the source of any exudation from the acacia, chemically, are very unsatisfactory, and the chemist, like the gum consumer, has to rely chiefly upon the physical appearance and properties of the gum.

The determination of the moisture present in natural gums has established the fact that the loss on heating to 100° C. varies from about 10 per cent. to 15 per cent. of the total weight, but no attempt can be made apparently to classify gums according to the percentage of water they contain. Samples of gum of good quality lose more water often than inferior specimens, whilst the time of year in which the gum is collected has a considerable influence on the result. A marked difference is shown in the different losses of moisture undergone by dextrins and other artificial gums compared with natural gums. The dextrins at 100° C. appear not to lose more than 4 or 5 per cent., whilst no gum arabics which we have examined give such a low percentage. Liebermann states that the losses undergone by gums arabic and senegal respectively are 13·39 per cent. and 14·56 per cent. at 103° C. On the other hand, he found that the dried Senegal gum absorbed more water exposed to a warm damp atmosphere for 24 hours than the dry gum arabic, the respective increases being 6·15 per cent. and 2·24 per cent. It is of course obvious that the more water is expelled from a gum by heat, the more it will be prone to take up when re-exposed to moist air. All the samples of gum with which we have had to deal, have universally taken up more water when exposed upon glass slides over water in a bell jar. If the conditions are changed, however, they will lose this excess of moisture with a rapidity depending upon the nature of the gum. By experiments of this sort conducted in a specially constructed apparatus it is possible to obtain a fairly accurate idea of the behaviour of the gums used in envelope gumming, &c., when exposed to a tropical climate. This is a point of some practical importance, as it has been found that gums which work very well in the temperate zone are altogether useless when used for goods intended for India, &c., as in such climates a hygroscopic gum is valueless for stamps, envelopes, &c.

The determination of the viscosity of a gum solution is of great importance in forming an estimate of its commercial value. The usual method of doing this is to note the time taken by 50 cc. of a 10 per cent. solution to run out from a burette fitted with a fine jet, as compared with the time taken by water under the same conditions. The longer the time the more viscous the gum; but it is evident that the numbers obtained are not strictly proportional to the true viscosity, and at the best only relative numbers are obtainable. The qualitative results obtained in this way are of little value in fixing the true viscosity of any gum solution. The burette method informs the operator of the bare fact that one gum is better than another, but the results do not carry any quantitative significance, and he is left quite in the dark as to the extent of the superiority of the better gum. The figures obtained also vary so much with slight differences of temperature that very serious errors may arise if the operator, working on two different days, does not use for the purposes of comparison all the standard gums he had previously employed. A rapid and simple process for estimating viscosity which shall be free from the more serious errors of the burette method is evidently a desideratum, and we have found no difficulty in working with an apparatus which gives absolute results, and suggest that some uniform system might be adopted by those engaged in these determinations.

The adhesiveness of a gum is of course of great importance; and although we have made attempts to adapt the methods used for testing the strength of paper, glue,

belting, &c., for obtaining numerical values for this property, we find that a qualitative trial of the gum on paper gives practically all the information that is needed.

We found that with the above data a very fair estimate of the commercial value of a gum for any particular class of work may be formed.

The second class of natural gums now in the market are those of which Ghatti gum may be taken as a type. These gums apparently contain much more metarabin than the acacia gums, and consequently are not so readily nor so completely soluble in water. The fact that a considerable residue was left on treating the gums with water at first misled buyers, as the superior viscosity of the soluble portion was not immediately recognised. At the present time a considerable quantity of these gums are employed, partly as adulterants for the gums which are completely soluble in water, and partly by those manufacturers who find that the mucilages obtained from them answer their special purpose.

Ghatti gum generally appears in rough irregular fragments of a brownish colour and somewhat dirty, containing fragments of bark, straw, &c. It is much harder than gum arabic and not so brittle, so that it is a matter of some difficulty to reduce it to fine powder in a porcelain mortar. Most samples contain a considerable proportion of vermicelli-shaped tears of a yellowish white colour, which are almost insoluble in water and apparently consist of nearly pure metarabin.

The chemical examination of these gums is conducted on practically the same lines as for a gum arabic. The ash varies from 2 to 3 per cent., and consists of the same constituents as a gum arabic ash, viz., calcium, magnesium, and potassium carbonates, and sodium chloride, with the addition of alumina and a little calcium phosphate.

The loss of water on drying at 100° C. is not so high as for a gum arabic, being from 4 per cent. up to 7 per cent. The general hygrometric quality of this class of gums is good, and they are on the whole well suited for tropical work.

The viscosity of Ghatti samples, as compared with those of gum arabics is the most remarkable property of these gums. On first commencing work upon them, we found it necessary to employ a viscosity solution weaker than 10 per cent., as solutions of that strength would scarcely flow and were tedious to manipulate. We have therefore since employed universally 5 per cent. solutions in the determinations of their viscosity. A comparison of the figures obtained with them and with good gum arabics in the same burette shows the remarkable viscosity of the former:—

Sample.	Strength.	Burette time in seconds.
	Per Cent.	
1. Gum arabic	10	80
2. Gum arabic	10	70
1. Ghatti	10	117
Ditto	5	89·7
2. Ghatti	5	117
Ditto	10	147

Thus the Ghatti No. 1 is distinctly superior to gum arabic No. 1, which is the best Aden gum; whilst the other sample is considerably better than even Ghatti No. 1. As a matter of fact, none of the specimens of Ghatti gum which we have since examined have fallen below No. 1 in viscosity, so it is evident that this superior viscosity is one of the characteristics of this gum.

In two or three of the samples we have roughly estimated the amount of insoluble matter left on making the viscosity solutions, and have found it vary from 5 per cent. to 15 per cent. The gums are certainly markedly less soluble than the acacia gums, but the prolonged action of water appears to slowly dissolve the metarabin, probably by converting it first into arabin. The action of boiling water is much more efficacious, and far better solutions are obtained from gums containing much metarabin by boiling the powdered gum with water. A cold water solution, however, has other advantages for some kinds of work.

Reference has already been made to the action of potash upon Ghatti gums. As a class they take up less potash per unit weight of gum than the gum arabics, although they differ considerably.

Sample.	Amount of KOH absorbed.	Colours of Liquid.
	Per Cent.	
1. Ghatti gum	3·39	Pink.
2. Ghatti gum	3·97	Pink.
3. Ghatti gum	0·23	Pink.
4. Ghatti gum	3·68	Pink.
5. Ghatti gum	0·225	Pink.

The pink colour of the solutions after boiling with KOH seems characteristic of the Ghatti gums, none of the others we have examined giving such a colour reaction.

Among the gums introduced into the market there are others which in physical appearance, &c. are markedly different to the rest. Among these the most important are the Amrad and wattle gums.

Amrad gum comes from the highlands of Abyssinia, and is an exudation from the *Acacia abaica*. It occurs in commerce in dark brown or yellow tears with a smooth surface and fairly regular in size. It possesses a remarkable aromatic odour. The gum is soluble in water, leaving no residue, and giving a moderately viscid solution equal to the second class gum arabics. The ash is about 2·24 per cent., perfectly white and of similar composition to the ash of the other gums, being free from the alumina and phosphate which appear characteristic of the Ghatti gums. Its price is prohibitive at present of its superseding the second rate gum arabics and the Ghatti gums for commercial purposes.

A better prospect appears to be open for the Australian gums, which under the generic name of Wattle gum have been of late years introduced into the English market. All these gums which are classed together as wattle are exudations from numerous species of acacia. They are apparently divisible into two classes, the coast gums which contain much metarabin and swell up in water, and the gums from the interior which are freely soluble. In general appearance wattle somewhat resembles the commoner kinds of Cape gum, being usually of a dark brown or amber colour with a glassy even fracture, and dirty in appearance, owing to its being admixed with bark, &c. The higher grades are probably equal to the second class of gum arabics, but many samples do not attain this excellence. The ash is somewhat variable but usually lies between 2 and 4 per cent., not greatly exceeding the latter. The moisture is a trifle higher than for gum arabics, being 16 to 17 per cent. The gums yield a tolerably viscid mucilage which is said to be very adhesive. Unfortunately the best samples of this class of gum seem hard to get hold of, and are not apparently yielded in large quantities by the gum-bearing trees.

At present the gums are not exported in very large quantities, but there is certainly an opening for them if prices do not rule too high.

An exhaustive examination of the wattle gum-bearing trees and of the composition of the exuded gums has been made by J. Maiden, who divides them into three groups according to their solubilities in water, which, of course, depends upon the varying amounts of metarabin present (v. Maiden, Pharm. J. xx. 869, 980) [111].

Of the bodies which are artificially prepared and used as gum substitutes, the most important is dextrin. This has a widely extended use for cheap gumming work, and being easily "reduced," is in great favour. The commercial dextrins used for this work always contain more or less unaltered starch. They are therefore "reduced" with hot water or steam, and the starch thus gelatinised

materially affects the viscosity of the solution. Up to a certain limit, therefore, the presence of starch in a dextrin increases its commercial value for this class of work.

To distinguish between a dextrin and a natural gum is no difficult matter. Besides the iodine test there is the reducing action which commercial dextrins have upon Fehling's solution, and the absence of a precipitate with alcohol in dilute solutions.

Dextrins are readily distinguished from gums quantitatively by the low ash which they yield on incineration. Among the samples examined by us none exceeded ·3 per cent. mineral matter, and some were much lower, just over ·1 per cent. The ash appears to be of similar qualitative composition to that of natural gums, though alkaline carbonates are conspicuous by their absence; but the amount of chloride is considerably greater, and some samples contain phosphates and alumina.

The amount of water which dextrins yield on drying at 100° C. is smaller than for natural gums, but on raising the temperature to 110° C. they lose much more, as a general rule, as the following results show:—

Dextrin.	Loss Moisture at 100° C.	Loss at 110° C.
Sample 1	3·57	10·12
Sample 2	4·10	10·4

It is not advisable to subject gums to a temperature of 110° C. as they show a tendency to char and become slightly discoloured, so we have no reliable data as to the loss of water experienced by them at this temperature.

The viscosity of dextrins ordinarily is about equal to that of third rate gum arabics.

The behaviour of dextrins with potash is characteristic. They take up a large percentage of KOH and yield a deep red solution quite different to that given by gums arabic or Ghatti. Comparison with the previous figures will illustrate this:—

Sample.	Amount KOH taken up.	Colour of Solution.
	Per Cent.	
No. 1	25·4	Dark red.
No. 2	19·7	Almost black.

Both dextrin and gums give a precipitate on the addition of lead subacetate (Goulard). The filtrate is opalescent or milky with the gums, but is clear with a dextrin. This test has been recommended by Schloster for the detection of adulterants in gum, but while the iodine and Fehling tests are available, it seems somewhat superfluous and less easy of execution.

Of late years several varieties of dextrin made up somewhat to resemble gums have been put upon the market. To such belong Stead's patent dextrin, which is made by filtering ordinary dextrin solution through animal charcoal and evaporating with a little nitric acid, when a transparent mass is obtained, which is said to be free from any offensive taste. The adhesiveness is also said to be unimpaired by this treatment. A "starch" gum has also been prepared by an Alsatian firm by the action of sulphurous acid upon starch paste under pressure at a high temperature. The resulting liquid is evaporated in vacuo. This gum gives a blue colouration with iodine, showing presence of unaltered starch, and is used in confectionery. According to the patent specification the dextrin is free from odour and taste when the starch paste is boiled with half a per cent. of sulphurous acid until a trace of glucose can be detected. The resulting product is neutralised and filtered through animal charcoal, and then boiled down. The dextrin obtained is brilliantly white in colour. Schumann's non-fermentable cement is probably the same compound. This is made by mixing starch with water to a thin cream, adding acid and allowing to stand for 24 hours. The residual starch is washed free from acid and heated in a digester to 160° C. or 170° C. which converts all the starch into dextrin. The product is heated with a solution of albumen filtered through animal charcoal and evaporated to dryness. The resulting artificial gum is devoid of taste and smell and is similar in appearance to a natural gum.

Of a similar nature to dextrin and, from their consisting largely of it, almost identical with the former in chemical reactions, are the various artificial "gums." Numerous patents have been taken out for different methods of preparing these, but generally speaking they fall into three great classes, viz.:—

A.—Those containing only dextrin and gum.

B.—Those containing dextrin or other carbohydrates with nitrogenous bodies.

C.—Those consisting entirely of nitrogenous bodies, as liquid glue, fish glue, &c.

To the first class belong the patents of Rossi and Hellfrisch for preparing gum from starch by the action of sulphurous acid under pressure. The product consists of "gommaline," dextrin, and a trace of glucose, and is stated to be clear, non-hygroscopic, and to have an adhesive power nearly equal to gum arabic. This "gommaline," although a gummy matter, is not true gum. Little is known concerning it, but probably it is only a modified form of dextrin. If so the true place of this gum substitute would be under the real dextrins. An artificial gum was brought on the American market some two years ago, made by boiling down dextrin solution with gum arabic in vacuo. Several brands of "gum" made by this or a similar process are on the English market at the present time, and are used for many classes of work. Some consumers complain of them changing rapidly in consistency, especially in winter, and it has been recommended to boil the solid gums with 1½ times their weight of caustic lime, when it is stated the solutions retain their strength for weeks.

The general chemical characteristics of the first class of gum substitutes are low ash, indicating a high percentage of dextrin, loss of water on drying at 100° C., rather less than natural gum arabics, being about 10 per cent.; and moderate viscosity. None of the samples which have come under our notice have been above third rate gum arabics in this respect.

Among the second class of gum substitutes or mixtures of dextrin with nitrogenous compounds we may refer to the compound "arabol," which has been introduced into the market by an American firm. It contains dextrin admixed with some nitrogenous body, such as albumen or casein, and is put on the market as a brown sticky mass containing upwards of 35 per cent. moisture and yielding a light coloured solution which is not very viscid, about equal to that of a good dextrin. When boiled with aqueous KOH it assumes an almost black colour and absorbs 40·6 per cent. calculated on the dry material, pointing to a high percentage of dextrin as we have previously observed. The "Arabol" Company claim that the product works well both for envelope and label-gumming and lithographers' work, also for various general purposes as a substitute for gum arabic. It is open to the objection that it is very hygroscopic, although we are informed that this objection to its use has been remedied by an improved process of manufacture.

Gum substitutes of the second class will give low ashes on incineration unless, like Strasser's patent, borax or some other mineral preservative has been added. The ash of "arabol" we found to be 0·58 per cent. It was brown in colour and contained notable quantities of ferric oxide, alumina, and calcium phosphate associated with the usual constituents of a gum or dextrin ash, viz., calcium carbonate and sodium chloride, but no alkaline carbonates. This was the first body of this class in which we found ferric oxide in the ash. It also contains sulphate, which we had not previously found in dextrins or gums.

The viscosity of such substitutes must naturally vary very greatly, but none of those which have come under our notice were equal to second class gum arabics, even allowing for the higher percentage of moisture which they contained. It may be noticed, moreover, that they are easily affected by climate, more readily than dextrins as a class, so that it

would seem that the addition of gelatin, &c. makes the body more hygroscopic. On the other hand, when dry they exhibit a tendency to peel off the surface over which they are spread.

The third class of gum substitutes includes bodies which are made from animal matter.

To the first division belong the so-called "liquid gums" made by heating glue with water, borax, and carbonate of soda for some hours. When this is properly done the product remains permanently liquid on cooling, and may be boiled down to any required degree of strength. Other kinds of "liquid gum" are made by heating glue with alum.

The second division includes the gelatinous substances obtained from fish bones and cartilage, known under the name of fish glue. It is a light brown viscous liquid with an offensive odour and an acrid taste. It forms a sticky mucilage when diluted with water, and as met with in commerce already contains about half its weight of water, and such a liquid is, weight for weight, only about equal to a dextrin in viscosity. If the comparison were made on the dried fish glue, of course it would stand much higher, equalling some of the second class gum arabics.

The ash of these fish glues is comparatively high, being usually about 4 per cent. on the body dried at 100° C. It is usually white in colour and contains, besides calcium and potassium carbonates and soda chloride, some 5 to 10 per cent. of tricalcium phosphate.

On boiling with potash fish glue assumes a greenish yellow colour and absorbs a comparatively small amount. A sample containing 45 per cent. of water gave a potash absorption of 9 per cent.

Liquid gums of this class are easily recognised by boiling with Fehling's solution, when they assume a violet colour and by the tannic acid reaction, the presence of nitrogen and the absence of the dextrin reaction with iodine solution discloses their identity.

The unpleasant odour and taste of fish glue is one of the objections to its use. Otherwise from a commercial point of view it is superior to many dextrins, but it is, like "arabol," somewhat weak in hygrometric character. It, however, rapidly becomes dry and crisp again.

We have made several attempts to remove the unpleasant odour from fish glue, and are still working in this direction. We have found that when the glue is heated on the water bath for several hours with borax, caustic soda, sodium carbonate, and lime, although they have a temporary deodorising effect do not permanently destroy its odour. A better method consists in boiling the fish glue with 1 per cent. sodium phosphate and adding 0·025 per cent. of saccharin. A fish glue thus treated loses its unpleasant odour almost entirely and also its acrid taste.

In reviewing the literature on the analysis and properties of natural gums, we were struck with the small amount of definite data arrived at from an examination of representative samples, and have thought that the following tabular statement showing the sort of results obtained from the analysis of the ashes of other gums than those given on p. 610, and the difference between them and artificial gums would be of interest:—

Sample.	Ash.	$CaCO_3$	$MgCO_3$	K_2O	NaCl.	$Ca_3P_2O_8 + Al_2O_3 + SiO_2$	Total.
	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
Amrad gum.....	2·24	67·20	16·62	7·39	0·14	4·86	96·21
Ghatti gum.....	2·45	53·50	8·40	7·80	0·25	35·80	103·75
Ghatti gum.....	3·11	55·01	10·10	7·10	0·31	23·10	95·62
Ghatti gum.....	2·24	60·90	10·33	9·29	0·30	30·80	101·62
Dextrin.....	0·12	6·45	..	..	15·10	73·40	94·98
Gum tragacanth...	2·803	76·30	8·89	11·80	1·14	4·74	101·97
Australian.....	2·09	20·80	0·45	3·21	1·91	65·95	92·32
Brazilian	1·39	11·80	0·45	17·74	0·468	69·14	99·6
Brazilian	2·38	15·50	10·40	17·12	0·213	53·50	96·78

The above are only intended to give a rough idea of the relative arrangement of the constituents in gums of known origin. They do not pretend to be strictly accurate, in fact the small quantities, never exceeding 0·2 grm., of ash operated upon forbid this. No provision was made for soluble silica, and the estimation of this in some of the gums would probably bring the totals nearer 100 per cent. The amount of potassium carbonate varies very much in the natural gums as reference to the table will show. Dextrins contain generally no potassium carbonate in their ash, while the gum substitutes of the first class increase in potassium carbonate according as more or less true gum is mixed with the dextrin. Amongst the members of the second group of gum substitutes we found no soluble alkali in "arabol," whilst fish glues are rich in potassium carbonate. It will be seen therefore that the presence of potassium carbonate in the ash of a gum or mucilaginous body generally denotes the presence of natural gum or gelatin, whilst its entire absence indicates the body to be largely composed of dextrin.

The potash absorptions which we have already alluded to were obtained with semi-normal aqueous potash and confirm those obtained by Rowland Williams, who used alcoholic potash. He found for three samples of gum arabic figures ranging between 5·5 and 9 per cent. of potash absorption, whilst a single sample of Senegal absorbed 10·42 per cent. It will be seen by comparing these figures by those obtained by us (page 611), that they fall fairly within the limits which we found with a much larger number of samples. The most marked discrepancy is in the gum. senegal, but if an Aden gum arabic, like our first sample, varies as much from another genuine gum arabic as do the values obtained for each, viz., 7·87 and 2·57, it is quite possible for two samples of Senegal gum to vary at least as much. The different colours produced by the action of potash on the various natural gums and on dextrin have already been noted.

If the ash falls below 1 per cent., and the potash absorption rises muchover 10 per cent. the presence of dextrin in the sample may be regarded as certain. Ghatti gums, as was seen, give uniformly low results when boiled with potash, no sample absorbing as much as 1 per cent., while some are below 1 per cent. It is noteworthy, however, that when shaken with saturated baryta water and the resultant liquid precipitated with alcohol and filtered, and the amount of baryta left uncombined determined, Ghatti gums give a higher percentage of BaO absorbed than they should from the ratio K_2O : BaO. The following figures illustrate this, viz.:—

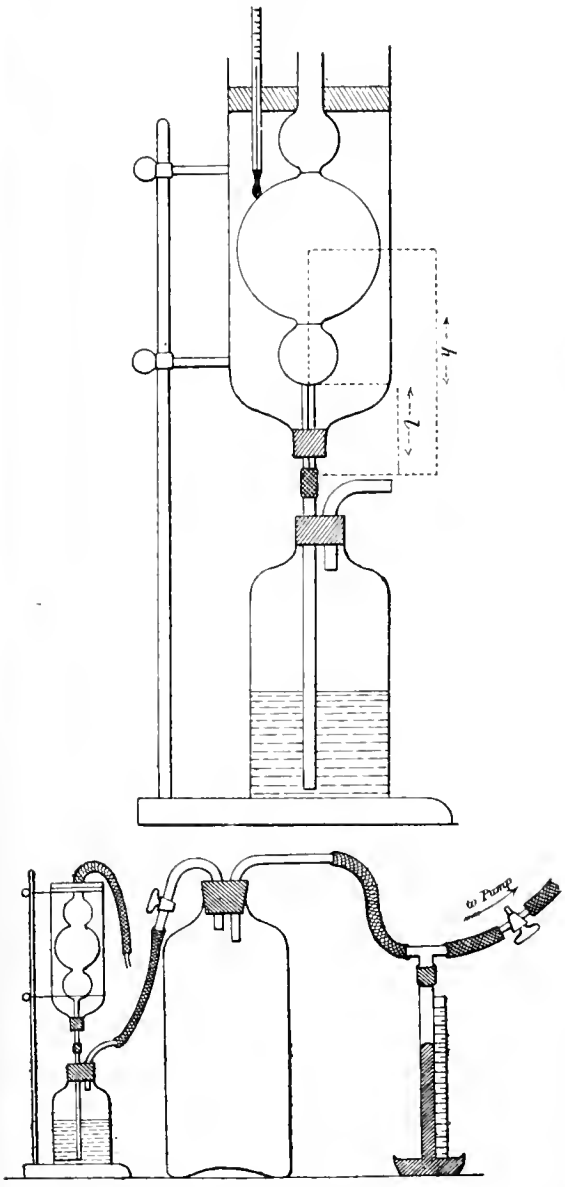
Ghatti Gum.	Amount KOH absorbed reckoned to K_2O.	Theoretical BaO absorption from ratio K_2O : BaO.	Actual BaO absorption.
Sample 1....	3·930	6·49	7·90
Sample 2....	3·680	5·99	7·36
Sample 3....	3·970	6·47	6·92
Sample 4....	0·230	0·374	0·40
Sample 5....	0·225	0·366	0·39

When alcoholic semi-normal potash is substituted for the aqueous potash both gum Ghatti and arabic give lower results, *e.g.*:—

Sample.	K_2O absorbed Aqueous.	K_2O absorbed Alcoholic.
Gum arabic.....	6·28	1·15
Ghatti gum.....	3·94	2·84

In both cases a gummy residue was left undissolved in the flask, whilst aqueous potash causes in every case an immediate solution of the gum on warming. It will be observed that the ratio of the alcoholic K_2O absorption to

Diagram A.



Apparatus used for taking Viscosity of Gums.

the aqueous is much greater in the case of gum arabic than in that of Ghatti. This may furnish another means of identifying Ghatti gum, but our experiments on this point require extending. The fact that the constituents of Ghatti are not nearly so insoluble in alcohol as those of gum arabic is also shown by the respective yield of precipitates with alcohol (page 621).

In order to compare gum tragacanth, which, although it has no adhesive value, makes a good mucilage, with the Ghattis we made a determination of the ash, potash absorption, &c., of a good sample of this gum. The detailed analysis of the ash is given on the preceding page. The potash absorption gave 12·6 per cent. K_2O absorbed or 15·04 per cent. KOH. The resulting liquid was bright yellow. Mr. R. Williams obtained, using alcoholic potash for two samples of tragacanth, the numbers 11·05 and 11·98 for the KOH absorption.

We have already pointed out that for the commercial valuation of the viscosity of gums the burette method is liable to give misleading results. It is true that the emptying times afford a measure of the viscosity of the gums, and were it possible or convenient to make up fresh solutions of various samples of gums, and take their viscosity by this method together with that of a newly received sample, the figures obtained would fix the place of the new gum with regard to any one of the old samples. But in practice it is certainly not convenient, nor even practicable, to make up viscosity solutions of 20 or 30 samples of gum, and we have found by experience that the *numbers* given by the burette method are useless by themselves, and give no indication of the value of the gum, for when it is necessary to determine the true ratio between the viscosity of various gums some other method must be employed. We have found convenient for this purpose a modified form of the apparatus described by Slotte. It consisted of a double bulbed instrument, in which the two bulbs are connected by capillary tubing. The bulbs are practically of the same capacity, and one is fitted with tubes so that the solution undergoing trial can be sucked over, and afterwards when the first bulb is filled returned to the second by means of a tube for a second test. The capillary tube is continued upwards into the first bulb for half its diameter, so that no correction is required for the effect due to gravity upon the liquid in the second bulb.

The apparatus employed by us is shown in the accompanying diagram. The only essential difference is that it has only one bulb, the gum solution being sucked up from a bottle.

To take a viscosity determination by means of this apparatus, certain data must be known, as from them is calculated the "constant" k of the instrument.

This "constant" is equal to the value of $\frac{\pi r^4}{8 l q}$ where q is the volume of the bulb in cubic centimetres, l the length of the capillary tube in centimetres, and r the radius of the capillary in centimetres. The height h from the centre of the bulb to the extremity of the capillary is also required.

From the viscous nature of most 10 per cent. natural gum solutions, we generally use artificial pressure to raise the solution in the bulb, but it is quite possible theoretically to determine the viscosity of a gum by simply allowing it to flow out from the bulb and noting the time taken in seconds; and as this is the simplest case for the calculation of the result, we will consider it first. The gum solution is placed in the bottle, and the gum, by pressure or otherwise, is sucked up into the bulbs till the upper safety bulb is full. The solution is then allowed to run out from the bulbs back to the bottle under the influence of gravity alone, the time taken to flow from the upper to the lower mark between the bulbs being noted in seconds. Representing the absolute viscosity by η, we have:—

$$\eta = k\, g\, h\, d\, t$$

in which k is the constant for the instrument obtained as above, g the effect of gravity in C.G.S. units, d the density of the gum (average density of 15 solutions of 10 per cent. strength 1·024) and h the mean height previously taken. The value for η as thus obtained is usually a small decimal varying from 0·2 to 0·03 per cent., according as the sample is a good natural gum, or a dextrin or other gum substitute,

If the value of the η of distilled water be taken previously to the viscosity, it will afford a check on the calculation on the k of the instrument as the absolute viscosity of water at various temperatures has been accurately determined by Poiseuille and others.

The method of allowing the gum to flow out by itself from the instrument is tedious with good samples of natural gum if 10 per cent. solutions be adhered to; but equally good results are obtained with much greater rapidity by sucking up and forcing out the gum under diminished pressure. The only disadvantage is a slightly more complicated calculation. When working under diminished pressure, the following expression

$$\eta = k_2 \left(\frac{t_1 + t}{2} \text{H D} \cdot \frac{t_1 - t}{2} h d \right)$$

gives the value of the viscosity where t_1 is the time of filling, t the emptying time, and H the height of mercury pressure in centimetres, and D the density of mercury (13·6).

The equation in the above form is deduced from the general one—

$$\eta = K t \left(\tfrac{1}{2} d (V_1 + V_2) - (P - p) \right)$$

in which t is the mean time, and V, V_2 the velocities corresponding to the times t_1 and $t_1 + t$. $(P - p)$ is the effect of difference of pressure expressed in dynes, and so is equivalent to H D g. Our working equation is obtained from the general one by neglecting $\frac{1}{2} d (V_1 + V_2)$, as this expression represents the kinetic energy left in the liquid after falling the height h, and this, in cases where the time is large, is very small and may be disregarded. On the other hand, if the rate of flow be rapid, a correction first made by Slotte comes into play, which is a correction for the kinetic energy in the liquid which increases with the velocity, and in which allowance is made for the liquid at different portions not moving with the same velocity. The equation is expressed thus—

$$\eta = K \frac{t_1 + t}{2} (P - p) - \left(\frac{d Q}{2 \pi^2} \right) \frac{1}{t^2}$$

in which the first portion is a compressed form of the general equation above, whilst $\left(\frac{d Q}{2 \pi^2} \right) \frac{1}{t^2}$ is the new correction. It depends, as will be seen, on the size of the bulb and the length of the capillary, which remain constant, for the same instrument, and on the emptying time for the particular experiment. It will be seen, therefore, that as the emptying time increases so does this correction diminish, and, in fact, for times over three minutes may be disregarded. The best way of using this correction is to find once for all the value of $\left(\frac{d Q}{2 \pi^2} \right)$ for the particular instrument in use, and call this K_2. It is about 0·22 for an instrument of the dimensions described. Then Slotte's correction becomes $\frac{K_2}{t^2}$, and a table can be readily made of the values of the correction from 15 seconds up to about 150 seconds, which will be the highest emptying time ever likely to be obtained working with pressure. This correction is made on the uncorrected absolute viscosity which is previously worked out from the equation by aid of logarithms and expressed as a decimal. The figures obtained thus can be tractormed to a shape more suitable for practice by dividing the absolute viscosity of the gum solution by the absolute viscosity of water obtained in the same instrument at the same temperature and multiplied by 100, *i.e.*, $\frac{\eta \text{ of gum}}{\eta \text{ of water}} \times 100$, which is more convenient to use in comparing various solutions.

Subjoined is a table giving the absolute viscosity of various gums. A comparison of the uncorrected viscosities with the corrected shows the great importance of Slotte's correction for dextrins and inferior gums arabics, in other words, for solutions of low viscosity, whilst it will be observed to have little influence upon the uncorrected η obtained for the Ghatti gums and the best samples of gum arabic.

TABLE OF ABSOLUTE VISCOSITIES OF 10 PER CENT. GUM AND DEXTRIN SOLUTIONS.

Sample.	η Uncorrected.	η Corrected.	% Water = 100.
Gum arabic.....	0·1876	0·1850	1,233
Cape gum.....	0·1575	0·1555	1,029
Indian gum.....	0·0540	0·0470	311
Eastern gum.....	0·0689	0·0639	417
Gum arabic.....	0·0550	0·0480	317
Senegal.....	0·0494	0·0410	271
Senegal.....	0·0468	0·0380	251
Senegal.....	0·0627	0·0557	361
Gum arabic.....	0·0511	0·0430	285
Water.....	0·0149	0·0121	100
Ghatti.....	0·2903	0·2880	2,322
Ghatti, 5 per cent..	0·0903	0·0828	668
Ghatti, 5 per cent..	0·1391	0·1350	1,089
Ghatti, 5 per cent..	0·1795	0·1760	1,420
Ghatti, 5 per cent..	0·1527	0·1485	1,198
Ghatti, 5 per cent..	0·1139	0·1083	873
Ghatti, 5 per cent..	0·1419	0·1369	1,104
Dextrin.....	0·0398	0·0255	169
Dextrin.....	0·0341	0·0186	129
Dextrin.....	0·0455	0·0380	306
Gum substitute.....	0·0318	0·0224	180
Gum substitute.....	0·0318	0·0224	180
Amrad.....	0·0793	0·0708	570
Australian.....	0·0378	0·0283	228
Australian.....	0·0365	0·0268	216
Brazilian.....	0·0968	0·0627	506
Brazilian.....	0·0516	0·0445	359
Ghatti.....	0·3636	0·3621	2,920

In the column for η corrected the differences due to the use of different instruments are of course eliminated. The absolute viscosity of water at 15° C. determined in four different instruments is shown below—

Instrument.	1.	2.	3.	4.
η corrtd. of water.	0·0109	0·01185	0·0124	0·0120
k value.....	0·000000858	0·000000863	0·000000832	0·000000852
k_2 value....	0·235	0·2175	0·226	0·204

Poiseuille's value for water being 0·0122.

The above values for various gums and dextrins were obtained at a constant temperature of 15° C. and are compared with water at that temperature. It is of the utmost importance that the temperature of the water surrounding the bulbs should be adjusted for each series of experiments to the temperature at which the absolute viscosity of the water was determined. As far as we have ascertained, in gum solutions there is a steady diminution in viscosity with increase of temperature until a certain temperature is reached, beyond which increase of heat does not markedly influence the viscosity, and it is possible that above this "critical point," as we may term it, the gum solutions once more begin to increase in viscosity. The temperature at which the viscosity becomes stationary varies somewhat with different gums, but broadly speaking it lies between 60° C. and 90° C.,

no gums showing any marked decrease in viscosity between 80° C. and 90° C.

The experiments we have made in this direction were conducted as follows. The 300 cc. bottle containing the gum was placed in a capacious beaker full of hot water, and the viscosity instrument was also surrounded with water at the same temperature. Thermometers were suspended both in the beaker and the outer jar. The viscosity at the highest temperature obtained, about 90° C., was then taken and repeated for every fall of 4° C. till the water reached the temperature of the air.

The values so obtained gradually diminished with the increase of temperature. From the η values obtained the Z values were calculated using water at 15° C. as a standard. From the Z values thus obtained taken as the ordinate, and the temperature of each experiment as the abscissa, curves were plotted out embodying the results, examples of which are given below. The curves yielded by three gums 2, 7, and 8 changed between 90° C. and 100° C., whilst gum sample 4 has a curve bending between 60° C. and 70° C. Experimentally this increase of viscosity of the latter gum above 60° C. was confirmed, but the critical point of the other solutions tried approaches too nearly to the boiling point of water for experiments to be conducted with accuracy, as the temperature of the bulbs diminishes sensibly while the experiment is being made.

If viscosity values have been determined it is possible to calculate the remaining or intermediate values for Z at any particular temperature from the general equation—

$$Z t = A + B t + C t^2$$

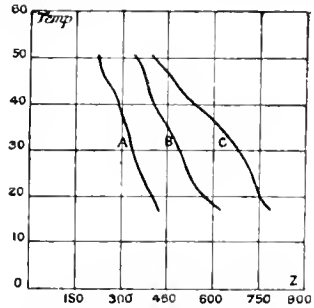
As an example of the mode of calculation we may quote the following. A gum gave the following values for Z at the temperatures stated.

Gum.....	50° C.	$Z_{50°} = 228$
Gum.....	30° C.	$Z_{30°} = 339$
Gum.....	20° C.	$Z_{20°} = 412$

from which the constants—

$A = 592{\cdot}99 \qquad B = -10{\cdot}2153 \qquad C = 0{\cdot}0583$

can be obtained and thus the value of $Z_{t°}$ for any required temperature. The numbers calculated for gums all point to a diminution in viscosity up to a certain point, and then a gradual increase. A comparison of some of the figures actually obtained in some of these experiments, compared with the calculated figures for the same temperature, shows their general agreement.



Curves showing viscosity change with temperature for three typical gums. A—Arabic VII. B—Senegal VIII. C—Ghatti 15.

Effect of Temperature upon Viscosity—Gum VII.

Temperature.	η	Z found.	Z calculated.
° C.			
50	0·0283	228	228·00
46	0·0305	246	246·55
42	0·0352	284	266·75
38	0·0368	297	289·00
34	0·0410	330	313·06
30	0·0419	339	339·00
26	0·0445	359	367·80
22	0·0492	398	396·47
20	0·0511	412	412·00
18	0·0531	428	428·00

Effect of Temperature upon Viscosity.—Gum VIII.

Temperature.	η	Z found.	Z calculated.
° C.			
50	0·0430	347	347
46	0·0475	383	371·14
42	0·0502	405	397·09
38	0·0510	411	424·73
34	0·0575	463	454·06
30	0·0602	485	485
26	0·0637	513	517·82
22	0·0667	538	552·25
20	0·0707	570	570
18	0·0755	609	583·07

The constants for the first gum are those given in the preceding column, whilst for the latter they were—

$$A = 771{\cdot}9 : B = -11{\cdot}15 : C = 0{\cdot}053.$$

As will be observed, the effect of heat appears to be the same upon the two typical gum arabics quoted above, an increase of temperature from 18° C. to 50° C. decreasing the viscosity by nearly one half in both cases, and the same seems to be true of most gum arabics. Roughly also the same holds good for Ghattis as the following numbers show:—

Gum.	Z at 18° C.	Z at 50° C.
Gum arabic.....	1016	579
Gum arabic.....	428	228
Gum arabic.....	609	347
Gum arabic.....	581	258
Ghatti.....	572	306
Ghatti.....	782	418

The following table shows the effect of heat upon the viscosity of a typical Ghatti:—

Ghatti Gum No. 15.—Viscosity.

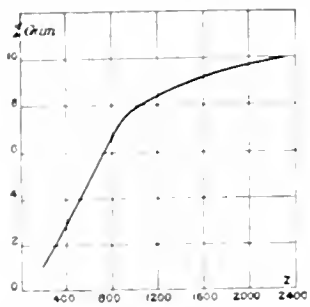
Temperature.	η	Z.
° C.		
50	0·0517	418
46	0·0581	468
42	0·0628	506
38	0·0726	585
34	0·0788	635
30	0·0857	691
26	0·0889	717
22	0·0919	741
20	0·0946	763
18	0·0964	777

There is therefore no essential difference in the behaviour of a Ghatti and a gum arabic on heating. Some interesting results, however, were obtained by heating gums, both Ghattis and arabics, at a fixed temperature for the same time, cooling, and then after making the solutions up to the original volume, taking their viscosities at the ordinary temperature. The effect of treating for two hours to 60° C., 80° C., or 100° C., a small permanent alteration in the

viscosity of the solution, and it would therefore seem desirable that gum solutions should be made up cold to get the maximum results. The following numbers illustrate this change, viz. —

Gum Arabic 10 Per Cent.	Without heat	After heating to 60° C.	80° C.	100° C.
Z at 18° C.	[illegible]	468	470	517
Z at 30° C.	[illegible]	400	422	439
Z at 50° C.	[illegible]	287	258	304
Ghatti gum No. 17·5 per cent. Z at 18° C.	1,104	780	660	758

The variation of viscosity with strength of solution was also studied with one or two typical gums. A 10 per cent. is invariably more than twice as viscous as a 5 per cent. solution. The following curve was obtained from one of the Ghattis. Similar results were shown by other gums.



Variation of viscosity, with dilution. Ghatti No. 888.

It would seem, therefore, that strong solutions, say of 50 per cent. strength, would be more alike in viscosity than solutions of 5 per cent. strength of the same gums. In other words, the viscosity of a gum solution should be taken as nearly as possible to the strength it is used at, to obtain an exact quantitative idea of its gumming value.

The observation of this fact was one of the circumstances which decided us to use 5 per cent. solutions for the determination of Ghatti gum viscosities, the ratio between the 5 per cent. and 10 per cent. solutions of gum arabics being roughly the same as that between the respective weights required for gumming solutions of equal value.

From observation of the general nature of the solutions of Ghatti gums, and from the fact that when allowed to stand portions of the apparently insoluble matter passed into solution, the hypothesis suggested itself that metarabin was soluble in arabin although insoluble in cold water. If this hypothesis were correct it would explain the apparent anomaly of Ghattis giving solutions of higher viscosity than gum arabics although they leave insoluble matter behind. The increase in viscosity would be due to the thickening of the arabic acid by the metarabin. Moreover, the solutions yielded by various Ghattis leaving insoluble matter behind would *be all of the same kind*, viz., a saturated solution of metarabin in arabin more or less diluted by water. Still further, if the insoluble residue of a Ghatti be the residual metarabin over and above that required to saturate the arabin, then it will be possible to dissolve this by the addition of more arabin in the form of ordinary gum arabic. In order to see if this were the case the following experiments were performed. Equal parts of a Ghatti and of a gum arabic were ground up together and dissolved in water. The resulting solution was *clear*. It was diluted until of 10 per cent. strength and its viscosity then taken —

	Contains 50 per Cent. Ghatti.	
A. Pressure 200 mm.	η	Z
Temperature 15° C.	0·517	[illegible]

The viscosity of this solution therefore was considerably greater than the mean viscosity of the 10 per cent. solutions of the Ghatti and the gum arabic, viz., $\frac{0·288 - 0·0636}{2} = 0·1758$ for the calculated η. Hence it is evident that the increase in viscosity is due to the solution of the metarabin.

Next a solution was made from a mixture of 70 per cent. Ghatti and 30 per cent. gum arabic. This was also clear and gave a considerably higher viscosity than the previous solution.

	Contains 70 per Cent. Ghatti.	
B. Pressure 200 mm.	η	Z
Temperature 15° C.	0·3177	2,562

It will be obvious that the increase of viscosity over the previous solution in this case must be due to the smaller amount of the thin gum arabic which is present, *i.e.* in the first case there is more gum arabic than is required to dissolve the whole of the insoluble metabarin. Further experiments showed that this is also true of the second mixture, as the viscosities of the following mixtures illustrate: —

Strength of Solution.	η	Z.
C. 80 per cent. Ghatti	0·3642	2,937
D. 75 per cent. Ghatti	0·33095	2,669
E. 77·5 per cent. Ghatti	0·4860	3,819

This last solution E. we called for convenience the "maximum viscosity" solution as we believe it to be a 10 per cent. solution containing arabin very nearly saturated with metarabin. As will be observed, its viscosity differs widely from those of solutions C. and D., between which it lies in percentage of Ghatti. The first-named solution C. contains *too little* of gum arabic to dissolve the whole of the metarabin, consequently there is a residue left undissolved, which of course diminishes its viscosity. The second solution D. is too low in viscosity, as it still contains too much of the weak gum arabic, and as will be seen further on a very slight change in the proportions increases or decreases the viscosity enormously.

We next tried a series of similar experiments with a Ghatti containing far less insoluble residue and which consequently would require less gum arabic to produce a perfect solution. Mixtures were made in the following proportions, viz. —

	13·3 per Cent. Ghatti.	
F. Pressure 200 mm.	η	Z.
Temperature 15° C.	0·0976	787
	86·6 per Cent. Ghatti.	
G. Pressure 200 mm.	η	Z.
Temperature 15° C.	0·4336	3,497

This latter solution is approaching fairly closely to our "maximum viscosity" with the previous Ghatti, and probably a very slight decrease in the amount of gum arabic would bring about the required increase in viscosity.

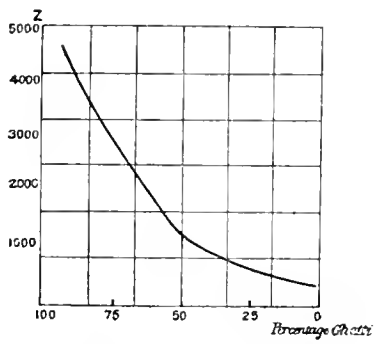
When these experiments were first commenced we were still under the impression, which several months' experience of working with gums had produced, namely, that the Ghattis were quite distinct in their properties to ordinary gum arabics. But the new hypothesis, and the experiments undertaken to confirm it, showed clearly that if the viscosity of a gum solution depends on the ratio of metarabin to arabin, then there is no absolute line of demarcation between

a Ghatti and a gum arabic. In other words, there is a constant gradation between gum arabic and Ghattis, down to such gums as cherry gum, consisting wholly of metarabin and quite insoluble in water. Therefore those gum arabics which are low in viscosity consist of nearly pure arabin, while as the viscosity increases so does the amount of metarabin, until we come to Ghattis which contain more metarabin than their arabin can hold in solution, when their viscosity goes down again.

From these observations it would follow, that by taking a gum of less viscosity than the gum arabic previously used to dissolve the Ghatti, less of it would be required to do the same work. We confirmed this suggestion experimentally by taking another gum arabic of viscosity 0·0557 at 15° C. A mixture containing 93·3 per cent. of this Ghatti and 6·7 per cent. of our thinnest gum arabic, gave a clear solution which had the highest viscosity we have yet obtained for a 10 per cent. solution.

H. Pressure 200 mm.....	η	Z.
Temperature 15° C..	0·5525	4,456

This gum arabic may be regarded as nearly pure arabin (as calcium and potassium, &c. salt). By diluting the new "maximum viscosity" solution therefore with the 10 per cent. solution of the gum arabic in fixed proportions we obtain a series of viscosities which are shown in the following curve.

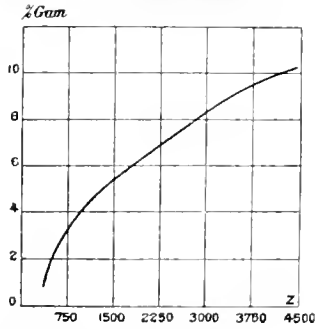


Curve showing influence of Ghatti upon viscosity.

Besides obtaining the curve for change in viscosity from maximum amount of metarabin to no metarabin at all, we also traced the decrease in viscosity of the "maximum" solution by dilution with water. The following numbers were thus obtained, and plotted out into a curve.

Change of Viscosity with Dilution — "Maximum" Solution. 15° C. Temperature.

Percentage.	η	Z.
10	0·55250	4,456
9	0·42850	3,456
8	0·35120	2,832
7	0·27660	2,230
6	0·22290	1,797
5	0·16810	1,355
4	0·11842	955
3	0·08029	647
2	0·06190	499
1	0·03610	291



Curve of variation in viscosity on dilution of the "Maximum" solution.

Having obtained this curve, we are now in a position to follow up the hypothesis by calculating the surplus amount of insoluble matter in a Ghatti. For, let it be conceded that the solution of any Ghatti leaving an insoluble residue is a mixture of arabin and metarabin in the same ratio as our "maximum" solution, only more diluted with water. Then from the found viscosity we obtain a point on the curve for dilution, which gives the percentage of dissolved matter. Now to show the use of this: The Z value for a 10 per cent. solution of the second Ghatti at 15° C. is 2,940. This corresponds on the curve to 8·4 dissolved matter. 10 − 8·4 = 1·6 grms. in 10 grms., which is insoluble. We have already shown that a "maximum" viscosity solution of this gum is formed when 6·7 per cent. of thin gum arabic is added to it, and therefore 6·7 parts of a thin gum arabic are required to bring 16 parts of metarabin into solution. A convenient rule, therefore, in order to obtain complete solution of a Ghatti gum is to add half the weight in thin gum of the insoluble metarabin found from the viscosity determination. But the portion of the gum which dissolved is made up in a similar manner (being a diluted "maximum" solution).

Therefore the 84 per cent. of soluble matter contains 58 parts of metarabin, and the total metarabin in this gum is 58 + 16 = 74 per cent. on the dry gum.

With these solutions of high viscosity some other work was done which may be of interest. The temperature curves of the mixtures marked E, G, and F were obtained between 60° C. and 15° C. The two former curves showed a direction practically parallel to that of the 10 per cent. solutions, and as they were approaching to the "maximum" solution, this is what one would expect. Mr. S. Skinner, of Cambridge, was also good enough to determine the electrical resistances of these solutions and the Ghattis and gum arabics employed in their preparation. The electrical resistance of these gum solutions steadily diminishes as the temperature increases, and the curve is similar to those obtained for rate of change with temperature. Although the curves run in, roughly, the same direction, there does not appear to be any exact ratio between the viscosities of two gums, say at 15° C. and their electric resistances at the same temperature; hence it would not seem possible to substitute a determination of the electrical resistance for the viscosity determination. The results appear to be greatly influenced by the amount of mineral matter present, gums with the greatest ash giving lower resistances.

Experiments were conducted with two Ghattis and two gum arabics, besides the mixtures marked E, F, and H. Comparison of the electrical resistances with the viscosities at 15° C. show the absence of any fixed ratio between them.

Gum or Mixture.	° C.	Ohms Resistance.	Z Viscosity at 15° C.
Ghatti, 1.....	10	5,667	1,190
Ghatti, 2.....	15	2,220	2,940
Arabic 1	15	1,350	605
Arabic 2	10	2,021	449
Mixture F	15	1,930	787
Mixture E	11·3	2,058	3,919

Whilst performing these experiments, an attempt was made to obtain an "ash-free" gum, in order to compare its viscosity with that of the same gum in its natural state. A gum low in ash was dissolved in water, and the solution poured on to a dialyser, and sufficient hydrochloric acid added to convert the salts into chlorides. When the dialysed gum solution ceased to contain any trace of chlorides, it was made up to a 10 per cent. solution, and its viscosity determined under 100 mm. pressure, giving the following results at 15° C. :—

Natural gum	0·06570	449
Ash-free gum	0·06431	438

Thus showing that the viscosity of pure arabin is almost identical with that of its salts in gum.

The yield of furfuraldehyde by the breaking down of arabin and metarabin was thought possibly to be of some value in differentiating the natural gums from one another, but we have not succeeded in obtaining results of much value. 0·2 grm. of a gum were heated with 100 cc. of 12 per cent. sulphuric acid for about 2½ hours in an Erlenmeyer flask with a reflux condenser. After this period of time, further treating did not increase the amount of furfuraldehyde produced. The acid liquid, which was generally yellow in colour, was then cooled and neutralised with strong caustic soda. The neutral or very faintly alkaline solution was then distilled almost to dryness, when practically the whole of the furfuraldehyde comes over. The colour produced by the gum distillate with aniline acetate can now be compared with that obtained from some standard substance treated similarly. The body we have taken as a standard is the distillate from the same weight of cane sugar. The tint obtained with the standard was then compared with that yielded by the gum distillate from which the respective ratios of furfuraldehyde are obtained. The following table shows some of these results :—

Substance.	Comparative Yield of Furfuraldehyde.	Amount of Glucose Produced.
Cane sugar	1·00	..
Starch	0·70	..
Gum arabic	1·34	34·72
Gum Senegal	1·20	43·65
Ghatti, 1	1·00	26·78
Ghatti, 2	1·33	22·86
Metarabic	1·75	..

The amount of reducing sugar calculated as glucose is also appended. This was estimated in the residue left in the flask after distillation by Fehling's solution in the usual way. The yields of furfuraldehyde would appear to have no definite relation to the other chemical data about a gum, such as the potash and baryta absorptions of the sugar produced on inversion.

The action of gum solutions upon polarised light is interesting, especially in view of the fact that arabin is itself strongly lævo-rotatory (α_D = −36°), whilst certain gums are distinctly dextro-rotatory. Hence it is evident that some other body besides arabin is present in the gum. We have determined the rotatory power of a number of gum solutions, the results of which are subjoined. On first commencing the experiments we experienced great difficulty from the nature of the solutions. Most of them are of strongly yellow in colour and almost opaque to light even in dilute solutions such as 5 per cent. We found it necessary first to bleach the gums by a special process. 5 grms. of gum are dissolved in about 40 cc. of luke warm water, then a drop of potassium permanganate is added, and the solution is heated on a water-bath with constant stirring until the permanganate is decomposed and the solution becomes brown. A drop of sodium hydrogen sulphite is now added to destroy excess of the permanganate. At the same time the solution becomes perfectly colourless.

It can now be cooled down and made up to 100 cc., yielding a 5 per cent. solution of which the rotatory power can be taken with ease. Using a 200-mm. tube and white light the above numbers were obtained.

Gum or Dextrin.	Solution used.	$[\alpha]_D$.
	Per Cent.	
Aden, 1	5	− 33°8
Cape, 2	5	+ 28°6
Indian, 3	5	+ 66°2
Eastern, 4	5	− 26°0
Eastern, 5	5	− 30°6
Senegal, 6	5	− 17°6
Senegal, 7	5	− 18°4
Senegal, 8	2½	− 19°6
Senegal, 9	5	− 38°2
Senegal, 10	5	− 25°8
Amrad	2½	+ 57°6
Australian, 1	5	− 28°2
Australian, 2	5	− 26°4
Brazilian, 1	2½	− 36°8
Brazilian, 2	2½	+ 21°0
Dextrin, 1	5	+148°0
Dextrin, 2	5	+133°2
Ghatti, 1	5	− 39°2
Ghatti, 2	5	− 80°4

These numbers do not show any marked connexion between the viscosity, &c. of a gum and its specific rotatory power.

When gum arabic solution is treated with alcohol the gum is precipitated entirely if a large excess of spirit be used. With a view to seeing if the precipitate yielded by the partial precipitation of a gum solution was identical in properties to the original gum, we examined several such precipitates from various gums to ascertain their rotatory power. We found in each case that the specific rotatory power of the alcohol precipitate redissolved in water was not the same as that of the original gum. In other words these gums contained at least two bodies of different rotatory powers, of which one is more soluble in alcohol than the other. O'Sullivan obtained similar results with pure arabin. The experiments were conducted in the following manner :—

(a.) Five grms. of a dextro-rotatory gum (No. 3 in table) were dissolved in 20 cc. of water. To the solution was added 90 cc. of 95 per cent. alcohol. The white precipitate which formed was thrown on to a tared filter and washed with 30 cc. more alcohol. The total filtrate therefore was 140 cc. The precipitate was dried and weighed, 2·791 grms. or 55·88 per cent. of the total gum. The precipitate was then re-dissolved in water, bleached as before and diluted to a 5 per cent. solution. This was then examined in the polarimeter. Readings gave the value α_D = + 58°4. The previous rotatory power of the gum was + 66°. Now the alcohol was driven off from the filtrate which, allowing for the 11·95 per cent. of water in the gum, should contain 32·17 per cent. of gum. The alcohol free liquid was then diluted to a known volume (for 5 per cent. solution), and $[\alpha]_D$ found to be + 57°7. This experiment was then repeated again, using 5 grms. of No. 3, when 3·5805 grms. of precipitate were obtained, using the same volumes of alcohol and water. The precipitate gave α_D = + 57°4 ; the filtrate treated as before.

only the percentage of gum dissolved being directly determined instead of being calculated by difference, gave $[\alpha]_J = +52{\cdot}5$.

(*b.*) Another gum (No. 9) with $[\alpha]_J = -38{\cdot}2$ and containing 13·86 per cent. of moisture, gave 2·3315 grms. of precipitate when similarly treated. The precipitate gave when re-dissolved in water $[\alpha]_J = -20{\cdot}8$. The filtrate containing 39·5 per cent. real gum gave $[\alpha]_J = -67{\cdot}5$, so that the least lævo-rotatory gum was precipitated by the alcohol.

The Ghattis apparently are all lævo-rotatory, and give much less alcoholic precipitates than the gum arabic. The precipitation moreover was in the opposite direction, that is, the most lævo-rotatory gum was thrown down by the alcohol. The appended table shows the nature of the precipitates and the respective amounts from two Ghattis and two gum arabics. It will be observed that the angle of rotation in three of the cases is decidedly less both for precipitate and filtrate than for the original solution :—

Specific Rotatory Powers of Gums.

Gum used.	Weight Gum Waken.	Weight Alcohol Precipitate.	Weight Gum Filtrate.	$[\alpha]_J$ original Gum.	$[\alpha]_J$ Alcohol Precipitate.	$[\alpha]_J$ Filtrate.
	Grms.					
3 *a*	5	2·7940	1·9415	+ 66·2	+ 58·4	+ 53·7
3 *b*	5	3·5805	0·8910		+ 57·4	− 52·5
9 *a*	5	2·3315	2·3736	− 38·2	− 20·8	− 67·5
9 *b*	4·9620	2·3510	2·4480		− 19·4	− 62·4
Ghatti *a*	3·4900	0·3925	2·7920	− 140·8	− 104·2	− 76·0
Ghatti *b* ...	3·2450	0·4065	2·8385		− 106·0	− 72·4
Ghatti *a* ...	2·2550	0·2900	1·8078	− 147·05	− 106·04	− 69·0
Ghatti *b* ...	2·6635	0·2845	2·3360		− 102·04	− 66·2

The hygrometric nature of a gum or dextrin is a point of considerable importance when the material is to be used for adhesive purposes. The apparatus which we finally adopted after many trials for testing this property consists simply of a tinplate box about 1 ft. square with two holes of 2 in. diameter bored in opposite sides. Through these holes is passed a piece of wide glass tubing 18 in. long. This is fitted with india-rubber corks at each end, one single and the other double bored. Through the double-bored cork goes a glass tube to a Woulffe's bottle containing warm water. A thermometer is passed into the interior of the tube by the second hole. The other stopper is connected by glass tubing to a pump, and thus draws warm air laden with moisture through the tube. Papers gummed with the gums or dextrins, &c. to be tested are placed in the tube and the warm moist air passed over them for varying periods, and their proneness to become sticky noted from time to time. By this means the gums can be classified in the order in which they succumbed to the combined influences of heat and moisture. We find that in resisting such influences any natural gum is better than a dextrin or a gum substitute containing dextrin or gelatin. The Ghattis are especially good in withstanding climatic changes.

Dextrins containing much starch are less hygroscopic than those which are nearly free from it, as the same conditions which promote the complete conversion of the starch into dextrin also favour the production of sugars, and it is to these sugars probably that commercial dextrin owes its hygroscopic nature. We have been in part able to confirm these results by a series of tests of the same gums in India, but have not yet obtained information as to their behaviour in the early part of the year.

The fermentation of natural gum solutions is accompanied by a decrease in the viscosity of the liquid and the separation of a portion of the gum in lumps. Apparently those gums which contain most sugar, as indicated by their reduction of Fehling's solution, are the most susceptible to this change. Oxalic acid is formed by the fermentation, which by combination with the lime present renders the fermenting liquid turbid, and also some volatile acid, probably acetic.

We have made some experiments with a gum which readily fermented—in a week—as to the respective value of various antiseptics in retarding the fermentation. Portions of the gum solutions were mixed with small quantities of menthol, thymol, salol, and saccharin in alkaline solution, also with boric acid, sodium phosphate, and potash alum in aqueous solution. Within a week a growth appeared in a portion to which no antiseptic had been added ; the others remained clear. After over five months the solutions were again examined, when the following results were observed :—

Antiseptics.	Solution after Five Months.
Menthol in KOH.....	Some growth at bottom, upper layer clear.
Thymol in KOH	Growth at top, gum white and opaque.
Salol in KOH	Growth at top, gum black and opaque.
Saccharin in KOH ...	White growth at top.
Boric acid.....	Remained clear ; did not smell.
Sodium phosphate ...	Slight growth at top.
Potash alum	Slight growth at top.

The solution to which no antiseptic had been added was of course quite putrid, and gave the reactions for acetic acid.

In the earlier part of this paper we have given a short account of the chief characteristics of the more important gum substitutes. The following additional notes may be of interest.

The ashes of most gum substitutes, consisting chiefly of dextrin, are characterised by the high percentage of chlorides they contain, due no doubt to the use of hydrochloric acid in their preparation. The soluble constituents of the ash consist of neutral alkaline salts, but as a rule no alkaline carbonates, and it is thus possible to demonstrate the absence of any natural gum in such a compound. We have seldom noticed the presence of any sulphates in such ashes, but when sulphurous or sulphuric acids have been used in the starch conversion it will be found in small quantities.

We have already pointed out that the potash absorption value of a gum is low and that dextrins give high numbers, but the latter vary very considerably, and as the starch and sugar present also influence the potash absorption value, it does not give information of much service. The following table shows the kind of results obtained :—

Sample.	KOH absorbed.	Starch.	Real Gum.
		Per Cent.	Per Cent.
Dextrin, 1	25·40	1·99	..
Dextrin, 2	19·70	13·13	..
Dextrin, 3	7·57	24·72	..
Artificial gum, 1	19·70	10·98	9·06
Artificial gum, 2	13·70	8·05	23·50
Starch	9·43	100·00	None

The baryta absorptions seem to be chiefly due to the quantity of starch present in the composition :—

Sample.	Starch.	BaO absorbed.
	Per Cent.	Per Cent.
Dextrin, 1	1·99	1·75
Dextrin, 2	13·13	3·53
Dextrin, 3	24·72	5·64
Starch.....	100·00	23·61

The viscosity of a dextrin or artificial gum is determined in exactly the same way as a natural gum, using 10 per cent. solutions. It would probably be an improvement to use 10 per cent. solutions for many of the dextrins, as they are when low in starch extremely thin.

The hygroscopic nature of dextrins renders them unsuitable for foreign work, but when the quantity of starch is appreciable, better results are obtainable. A large percentage of unaltered starch is usually accompanied with a small percentage of sugar, and no doubt this is the explanation of the fact. An admixture containing natural gum of course behaved better than when no such gum is present. Pastes like "starabol" made up with water and containing gelatin are very hygroscopic when dry, although as sold they lose water on exposure to the air. Gum substitutes consisting entirely of some form of gelatin with water, like fish glue, are also somewhat hygroscopic when dried. The behaviour of these artificial gums and dextrins on exposure to a warm moist atmosphere can be determined in the same apparatus as described for gums.

The process we have adopted for estimating the glucose starch and dextrin in commercial gum substitutes is based on C. Hanofsky's method for the assay of brewers' dextrins (this Journal, 8, 561). A weighed quantity of the dextrin is dissolved in cold water, filtered from any insoluble starch, and then the glucose determined directly in the clear filtrate by Fehling's solution. The total dextrin is determined by inverting a portion of the filtered liquid with HCl, and then determining its reducing power. The starch is estimated by inverting a portion of the solid dextrin, and determining the glucose formed by Fehling. After deducting the amounts due to the original glucose and the inverted dextrin present, the residue is calculated as starch. A determination of the acidity of the solution is also made with decinormal soda, and results returned in number of cc. alkali required to neutralise 100 grms. of the dextrin. Results we have obtained using this method are embodied in the following table:—

Analysis of Gum Substitutes.

No.	Glucose	Dextrin	Starch	Moisture	Gums, &c.	Ash.	Acidity.
1	8·72	81·37	1·70	10·13	None	0·297	cc. 57·3
2	7·14	71·10	13·13	10·10	None	0·120	13·8
3	1·20	63·42	24·72	4·17	1·12	0·250	5·22
4	8·40	0·08	30·08	50·60	9·02	0·530	20·0
5	1·60	41·8	8·05	12·0	35·57	0·680	52·0
6	14·00	61·2	0	24·87	1·83	0·781	8·0
7	8·00	7·24	0·75	2·08	0·88	0·720	88·0
8	1·20	2·8	7·0	None	77·45	0·315	0·6

In those cases in which the adulteration is made by admixture with gelatin or a good glue the quantity of other organic matter obtained can be checked by a hydrolytic determination of the total nitrogen. If a natural gum is added it will be partially converted into sugar when the filtered liquid is inverted, and so make the dextrin determination slightly too high.

Discussion.

The Chairman, in opening the discussion on the paper, complimented Dr Ridealon his admirable abstract of a voluminous manuscript, which had appeared to him to be practically incapable of condensation.

Mr. Bertram Blount wished to say a word or two with respect to the authors' method of determining viscosity. It was preferable to take the velocity with which the oil or other liquid was flowing out under a definite known pressure rather than while flowing out under a varying pressure. There was a well-known method for maintaining a constant head, and when that method was employed the flow was quite regular, the difficulty referred to in getting the last drops out did not present itself, and the precision of the entire operation was greatly enhanced. The reduction of the various viscosities to an absolute standard by comparison with water was by no means necessary, as an arbitrary standard could be adopted. But it was essential, he thought, to allow the liquid to flow out under a constant head; and he would have appreciated the author's determinations much more highly had that condition been fulfilled.

Mr. Thos. Christy exhibited a sample of a product made in Germany from the Ghatti gum referred to in the paper. This product, he said, had the well-known properties of gum arabic, and he had therefore hoped that the authors would have given some account of it. He had shown the sample to the lecturer before the meeting, and was surprised to learn that he had not seen it before. They had heard that these Ghatti gums were sent over mixed; that was because the Indians, having a great demand for these products, sent men into the forests to collect them indiscriminately in the best way they could. He had himself sorted the gums, and had endeavoured to secure a supply of certain specified varieties, but had failed to do so, because it was found to be quite impossible to control the picking in Indian forests. The German manufacturers of these gums found no difficulty in disposing of them, and when the price of raw gum went down to 4*l.* per ton they bought largely, and were able to make contracts in advance in this country. In fact, until the recent arrival in this country of gum arabics of good quality from the Niger Company, we had had to depend upon the Germans and Austrians for the supply of reliable gums for envelope making, &c.

Mr. A. Boake said that he had been for years past endeavouring to obtain a reliable method for ascertaining the viscosity of fish glue solution. In the case of that substance, however, a 10 per cent. solution would be quite impracticable, as it would not pass through a capillary tube; and if the solution was reduced to half that strength the results bore no definite proportion to one another. Then, again, the question of temperature was a great difficulty. In the case of the material in which he was interested, if the temperature was raised so as to make it possible to pass it through a capillary tube the substance itself was destroyed. He would be very glad if the reader of the paper could give him any information as to the best means of dealing with such a material.

Dr. Ridealon, having been called upon to reply, said that in regard to Mr. Blount's objection, in trying to be brief he was afraid he had not described the form of the apparatus employed sufficiently. The experiment was conducted, not exactly at a constant pressure, but still at a mean pressure. They noted the time taken by the liquid in flowing from the upper to the lower mark on the apparatus. If the bottle was large the alteration of pressure during the experiment was very small. Taking it, say, at 102 mm. at the beginning, it would diminish to 98 mm. at the end; so that the mean pressure would be 100 mm. As to getting the last drops out of the burette or ordinary viscosity apparatus, the necessity for that was obviated by the use of the safety bulbs (Fig. B). The volume that ran through the capillary would be the volume between the two marks.

Mr. Bertram Blount admitted that that was so. But the other defect remained, and as it could easily be overcome, it was a pity that the slight modification necessary to that end should not be made, and the apparatus thus rendered perfect.

Dr. Ridealon replied that the reason that was not done was that a different pressure was sometimes required, especially in the case of strong solutions, but he admitted that a constant pressure arrangement could be used if it was wished for.

Continuing, he said that the sample shown by Mr. Christy appeared to him to be an insoluble Ghatti gum which had been rendered soluble. Such gums could be got to dissolve in potash or lime in the laboratory, and they would sometimes dissolve to a certain extent if treated by steam under pressure. In the case of gum tragacanth patents had been

taken out for rendering it soluble by frying it in oil; but until Mr. Christy had mentioned it, he had no idea that a process was at work satisfactorily for the insoluble Indian gums. With regard to the determination of the viscosity of fish glue, of course it was difficult to deal with strong solutions in a burette; but it was quite possible to make the determination in a short time if pressure and the apparatus described was employed. The difficulty consisted in keeping the solution clear, so that it should run through the burette or other instrument employed without stoppage, filter paper being, of course, useless. That difficulty could be overcome by using a battery of capillary tubes through which the solution could be drawn by aid of the pump before use in the viscosimeter.

Liverpool Section.

UNIVERSITY COLLEGE, BROWNLOW STREET.

Chairman: H. Brunner.
Vice-Chairman: A. Norman Tate.
Committee:

E. Carey.	A. H. Knight.
V. C. Driffield.	D. McKechnie.
F. Gossage.	E. K. Muspratt.
W. D. Herman.	Henry Tate.
C. L. Higgins.	A. Watt.
F. Hurter.	

Hon. Treasurer: W. P. Thompson.
Hon. Local Secretary:
Dr. Chas. A. Kohn, University College, Liverpool.

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

Meeting held on Wednesday, May 6th, 1891.

MR. A. NORMAN TATE IN THE CHAIR.

AN INTERESTING POINT FOR CHEMICAL MANUFACTURERS IN THE NEW GERMAN PATENT LAW.

BY JOHN HAYES.

In November 1886 a notice appeared in an official international publication, "La Propriété Industrielle," stating that the representatives of German chemical industry were under the impression that, since only the process for manufacturing a new product and not the product itself could be patented, the process might be worked abroad and the products introduced into Germany with impunity.

Section 1 of the 1877 German patent law states what kinds of inventions can be patented and what not. Among the latter are "substances produced by chemical means in so far that the invention does not relate to a particular process by which the substances are produced." It was this provision which occasioned the complaints of the German chemists, and it was admitted at the time that there was ground for them. They had the effect of producing from the German ex-Chancellor a circular on the question (which he addressed in August 1886 to the various Federal Governments), combatting the views of the manufacturers which he attributed to a wrong interpretation of certain words in the law.

After October next, when the new German patent law comes into force, there will be no longer any ground for complaints on this head, as paragraph 4 of the new law now states directly and definitely (this Journal, 1891, 491) that a German patent which is granted for a process will also extend to the products obtained by such process; and paragraph 35 of the same law further states (*id.* 494) that when the substances produced by a patented process are new substances, then any substances of similar constitution or nature ("Beschaffenheit") is to be regarded as having been produced by the patented process until there is proof to the contrary; showing that an endeavour has been made to meet the views of the chemical trade.

Possibly certain passages of the 1877 law might be construed in such a way (and this construction had the support of the ex Chancellor) as to give sufficient protection to manufacturers against products illicitly produced. Nevertheless, it is a good thing for the chemical trade that it has now been clearly and definitely laid down that the patent covers the product; or in other words, that although the process, as under the 1877 law, still remains the thing to be patented, yet after October next the patentee has a claim to all products produced by his process without his consent.

The burden of proving that a product has been produced by his process will be on the patentee, but with this very important exception, that he will be relieved of such burden when the product is a new one, in which case the burden of proof will lie on the other party.

Manchester Section.

Chairman: Ivan Levinstein.
Vice-Chairman: Edw. Schunck.
Committee:

J. Angell.	J. Grossmann.
G. H. Bailey.	P. Hart.
R. F. Carpenter.	A. Liebmann.
G. E. Davis.	Sir H. E. Roscoe, M.P.
H. Grimshaw.	C. Ruby.
Harold B. Dixon.	D. Watson.

Hon. Local Secretary:
J. Carter Bell,
Bank House, The Cliff, Higher Broughton, Manchester.

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Newcastle Section.

Chairman: John Pattinson.
Vice-Chairman: T. W. Stuart.
Committee:

A. Allhusen.	T. W. Lovibond.
P. P. Bedson.	John Watson.
G. T. France.	B. S. Proctor.
G. Gatheral.	W. W. Proctor.
C. H. Hills.	W. L. Rennoldson.
T. W. Hogg.	J. E. Stead.

Hon. Local Secretary and Treasurer:
Dr. J. T. Dunn, The School, Gateshead.

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

Nottingham Section.

University College, Nottingham.

Chairman: [illegible]
Vice-Chairman: J. R. Ashwell.
Committee:

F. [illegible]	F. W. Small.
J. B. Coleman.	H. J. Staples.
C. H. [illegible]	C. Taylor.
H. [illegible]	Sir John Turney.
E. Francis.	J. T. Wood.
S. J. [illegible]	

Treasurer: J. M. C. Paton.
Hon. Local Secretary:
R. L. Whiteley, University College, Nottingham.

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

Glasgow and Scottish Section.

Chairman: E. C. C. Stanford.
Vice-Chairman: A. Crum Brown.
Committee:

J. Christie.	R. Irvine.
W. J. A. Donald.	J. Falconer King.
D. B. Dott.	G. McRoberts.
C. J. Ellis.	T. P. Miller.
C. A. Fawsitt.	J. Pattison.
Wm. Foulis.	J. B. Readman.
J. Gibson.	E. Smith.
R. A. Inglis.	R. R. Tatlock.

Hon. Treasurer: W. J. Chrystal.
Hon. Local Secretary:
Dr. G. G. Henderson, Chemical Laboratory, University of Glasgow.

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

Yorkshire Section.

[illegible] Sir James Kitson, Bart.
[illegible] Dr. F. H. Bowman.
Committee:

A. R. [illegible]	J. Lewkowitsch.
W. [illegible]	C. [illegible]
[illegible]	Jas. Sharp.
A. H. [illegible]	[illegible]
R. H. [illegible]	[illegible] Ward.
J. J. [illegible]	[illegible] Whitaker.

Hon. [illegible]
H. R. Procter [illegible]

Notices of Papers and Communications [illegible] addressed to the Hon. Local Secretary.

Journal and Patent* Literature.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

Asbestos Discovery in Victoria. Adelaide Advertiser. May 15, 1891.

See under V., page 634.

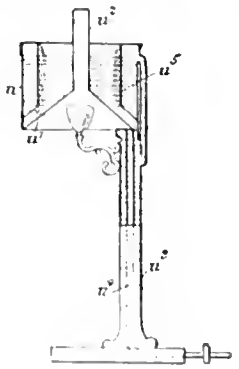
PATENTS.

Improvements in Apparatus for Evaporating Liquors containing Salts, and for Separating such Salts when rendered Insoluble by Evaporation of the Liquors. E. G. Lawrance, London. From S. Pick, Szczakowa, Galicia. Eng. Pat. 3087, February 26, 1890. 8*d.*

This invention relates to improvements in Eng. Pat. 5124 of 1887 (G. T. J. Wells), and is intended to render the apparatus more efficient and economical. The boiler is made with an upper and a lower part, having the heating chamber placed between them. This latter is constructed of tubes increasing in cross-sectional area as they proceed downwards. The upper part of the boiler is of greater diameter than the heating chamber, by which method the depth of liquor is but small even when a large quantity is to be treated, and boiling can be carried on more advantageously. The filtering medium is secured within the bottom part of the filter casing, connecting that part to the top of the filter, and also by means of a flexible pipe with the interior of the upper part of the boiler, wherein a partial vacuum is maintained. The lower part of the filter is so hinged to the upper, that it can be readily and quickly caused to take such a position as will allow the contents of the top part to fall out without breaking connexion with the boiler.—F. S.

Improvements in the Softening of Water and in Apparatus therefor. W. Lawrence, London. Eng. Pat. 7138, May 7, 1890. 11*d.*

The main feature of this invention is claimed to be the utilisation of the free carbonic acid gas naturally existing in water, when treated with alkali and, at the same time, subjected to heat, for throwing down the salts of lime and



Apparatus for Softening Water.

* Any of these specifications may be obtained by post, by remitting the cost price, *plus* postage, to Mr. H. Reader Lack, Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C. The amount of postage may be calculated as follows:—

If the price does not exceed 8*d.*	.....	½*d.*
Above 8*d.*, and not exceeding 1*s.* 6*d.*	.....	1*d.*
" 1*s.* 6*d.*, " 2*s.* 4*d.*	.....	1½*d.*
" 2*s.* 4*d.*, " 3*s.* 4*d.*	.....	2*d.*

magnesia. The application of heat considerably reduces the time required for precipitation as compared with the same treatment cold. According to the original state of hardness of the water and to the amount of impurities it contains, the treatment differs, as does also the arrangement of the apparatus employed, which is further influenced by the use to which the purified water is to be put, whether for steam boilers, laundries, dyeworks, for alimentary or general household purposes. The 17 illustrations accompanying the specification show a variety of apparatus of which the selected figure represents a household lamp with water softener combined.

The underside (a^1) of the vessel (a) is cone-shaped and acts as reflector for the lamp, the chimney (a^2) adds to the heating surface. A circular filter (a^5) separates the vessel into two compartments, and the hard water mixed with any desired ingredients rises through the internal tube (a^4) of the stand, enters the enclosed space, is heated, and, after passing through the filtering material, descends for utilisation through the annular space (a^3) of the stand. There are 18 claims, and for further particulars the specification should be consulted.—B.

Improvements in and Relating to Apparatus for Filtering Water. W. J. Baker, Huddersfield. Eng. Pat. 9802, June 24, 1890. 11*d*.

In connexion with the filtration of considerable quantities of water under pressure, the inventor discards the use of large cylinders and employs instead a number of small cylindrical filtering vessels, for the purpose of facilitating inspection and cleaning. The filtering tubes are placed by preference upright between two systems of pipes, the impure water entering through the lower set and the filtered water leaving through the upper, each filter being separately detachable. An open filter is also used in connexion, for the purpose of removing the coarser impurities from the water before entering the system. There are six sheets of drawings and five claims.—B.

Improved Means and Appliances for Manufacturing Glass Tubing and for Coupling together such Tubing. D. Rylands, Stairfoot. Eng. Pat. 10,348, July 4, 1890. 8*d*.

See under VIII., *page* 643.

Improvements in Apparatus for Distilling Sea-Water and supplying Fresh Water to Marine Boilers, or for other purposes. J. Gilmour, Glasgow. Eng. Pat. 10,379, July 4, 1890. 8*d*.

Sea-water, by preference warmed, such as it issues from the casing of a surface condenser, is evaporated in an independent vessel by means of pipes heated by steam taken either from the main boilers or after having passed through the high pressure cylinder of the engines. The steam arising from the sea-water may be led to the valve chamber of the low pressure cylinder where it joins the expanding steam and gives out work. Or if led direct to the condenser from the evaporating vessel it creates a vacuum in the latter and thus conduces to economy. In either case its condensation replenishes the boiler feed, and it may also be treated partially for drinking purposes to the saving of separate distilling apparatus. There are two sheets of drawings and three claims.—B.

Improvements in and relating to Pyrometers or Thermometers. J. Murrie, Glasgow. Eng. Pat. 10,380, July 4, 1890. 8*d*.

This invention relates to thermometers or pyrometers, in which the heat to be registered is imparted to one end of a closed tube containing a liquid which, by its expansion and pressure, acts upon a yielding medium at the other end of the tube, and through its means moves the index or pointer of the register.

The improvements relate to the manufacture and construction of the apparatus, and consist in making the tube of solid drawn steel, plugged at the inner end, in bending the tube downwards at the outer end where it joins the indicator or gauge, for the purpose of retaining at the inner or heated end all gases that may be developed. Further, in bending backwards and twisting the inner end of the tube, in sheathing or encasing the free length of the tube, in interposing a diaphragm and separate mercury chamber between the heated liquid and the gauge, and in various other details for aiding correct indication as represented by two sheets of drawings and nine claims.—B.

Improved Apparatus for Drying and Mixing Bones and other Substances. A. H. Hobson, London. Eng. Pat. 10,562, July 8, 1890. 6*d*.

A cylinder mounted on an inclined axis is provided internally with sets of partitions or "baffles," which are semi-circular in shape and reach about half-way across the cylinder. The baffles are, more or less, inclined to the axis of the cylinder, being either fixed or regulated from the outside, and so arranged that the edges of one set come opposite the intervals of the other set. Any substance fed into the upper end of the cylinder will thus be compelled to take a zig-zag, up and down course through the apparatus, and be thoroughly mixed. The lower end of the cylinder passes into a chamber provided with a balanced door for the exit of the substance undergoing treatment and with an inlet for hot air or flue gases for drying the material as it passes through the apparatus.—H. T. P.

Improvements in or connected with Apparatus for Drying Granular Substances. J. H. R. Dinsmore, Liverpool. Eng. Pat. 10,888, July 12, 1890. 8*d*.

The object of this invention is to provide a more simple, rapid, and effective mode of drying granular substances such as wheat, brewers' grains, &c.

The grains are enclosed, by preference, in a horizontal cylinder (or cylinders), provided internally with pockets or scoops set in a vertical direction. The cylinder, on being made to revolve, elevates and turns the grain over or through a system of heated pipes extending over a greater part of the length of the cylinder, the moisture or vapour given off being removed by a current of air produced by a fan placed in the space between the end of the heating pipes and the outlet end of the cylinder. The grain is afterwards cooled in the above space or in a separate cylinder into which the grain is discharged by a shoot. Heated gases or fluids may be used, if desired, instead of steam.—E. S.

Improvements in Evaporating Apparatus, Specially adapted for the Extraction of Salt from Brine. A. Chapman and S. Vickers, jun., Liverpool. Eng. Pat. 11,529, July 23, 1890. 8*d*.

See under VII., *page* 641.

Improvements in Apparatus for Straining or Sifting Fixings and other Analogous Materials. C. O. Gridley, London, and A. Bishop, Walthamstow. Eng. Pat. 11,672, July 25, 1890. 6*d*.

An inverted conical sieve, formed of wire gauze or other suitable material, is fixed by its base to the upper end of a cylindrical vessel used for collecting the materials after passing through the sieve. Another cylindrical vessel is mounted and fixed upon the sieve, and holds the materials to be operated upon. A vertical shaft, carried by suitable bearings, is fitted to the cylinder and sieve, and carries a spiral screw consisting of three or more helices corresponding to the form of the sieve. The bearings are made adjustable so that the spiral screw can be placed nearer to or further from the inner surface of the sieve as desired. The materials to be operated on being placed in the upper cylinder the screw is revolved, and the materials are passed through the meshes of the sieve and brought to the requisite degree of fineness. Meshes of various sizes are used, according to the nature of the materials and the fineness required.—E. S.

Improvements in Methods of Treating Heated Liquid Wastes, and Apparatus therefor. E. Nelson, New York, U.S.A. Eng. Pat. 3435, February 25, 1891. (Int. Conv. August 30, 1890.) *8d.*

By means of this apparatus, the waste hot water and partially condensed steam, mixed with more or less lubricating material, derived from the leakage of steam-cocks, valves, &c., may be utilised. The "drips" from various sources are collected by means of branch pipes into a main drip-pipe, which enters the bottom of a closed cylinder called an "extractor," terminating within it at a height equal to about two-thirds of the distance from the top to the bottom of the vessel. A second pipe issues from the bottom of the extractor, and terminates in a water-trap, which serves to maintain the liquid within the apparatus at a constant level. This pipe is bent on itself several times, has a condenser, and is provided with a water-jacket. The oil which floats to the top in the extractor is drawn off from time to time; whilst the hot water passing off through the pipe at the base of the cylinder serves to warm the boiler feed water which is made to circulate through the jacket surrounding the pipe.

For treating large quantities of waste, especially when contaminated with much oil, the apparatus is somewhat modified. Two extractors are employed, the liquid being partially cooled in its passage from the first to the second of them. For drawings of the apparatus the original specification must be consulted.—H. T. P.

Improved Method of and Apparatus for Regulating the Egress of Spent Liquor from Distillatory Apparatus. M. Schwab, Manchester. Eng. Pat. 6317, April 13, 1891. *6d.*

This invention is for the purpose of maintaining the level of the liquid in the distilling vessel at a constant height, and consists in the addition of a separate vessel containing a valve which may be kept on its seat by its own weight or by a spring. This outside vessel is connected with the distilling vessel by a pipe, through which the excess of liquor flows under the automatic control of the valve.

—G. H. B.

An Improved Alloy for Hermetically Closing Glass Tubes and other Purposes. F. Walter, Vienna, Austria. Eng. Pat. 7459, April 25, 1891. *4d.*

See under X., *page* 646.

II.—FUEL, GAS, AND LIGHT.

The Action of Heat on Carbonic Oxide. Berthelot. Compt. Rend. 112, 594–597.

See under XXIII., *page* 662.

PATENTS.

Improvements in Apparatus for Burning Liquid Fuel. W. E. Smith, Brighton. From S. I. J. Bray, Moscow, Russia. Eng. Pat. 42, March 18, 1890. *11d.*

This invention is designed for the purpose of utilising hydrocarbon and other oils as fuel in steam boiler and other furnaces. One of the improvements consists in providing means for simultaneously mingling the oils with air and steam before combustion, thereby effecting a saving of steam and diminishing the quantity of air which has to enter the furnace in order to support combustion. Another important feature consists in providing a series of cross pieces or wires, or netting, against which the sprayed vaporised or atomised hydrocarbons are thrown, thereby causing the air to intermingle with the already formed gases and producing a broad and economical flame resembling that produced by wood, coal, or other fuel in an ordinary furnace or combustion chamber.

This ensures a more economical combustion of the fuel and a less detrimental effect upon the furnace walls or boiler-plates than is produced by the usual "blow-pipe" form of flame which impinges constantly upon the same spot.

This improved burner can be easily fitted to existing furnaces or boilers. It makes no objectionable noise, and has the further advantage that the combustion takes place at some distance from the mouth of the shield, thus preventing the rapid deterioration from overheating to which such burners as hitherto constructed are liable.—D. E. J.

Improvements in the Production of Water-Gas. J. Blum, Berlin, Germany. Eng. Pat. 5239, April 5, 1890. *8d.*

This is a process for the production of water-gas by the interaction of hydrocarbon, preferably petroleum and water, in the presence of a metal, preferably nickel, cobalt, or copper. The hydrocarbon and water must be intimately mixed in the proportion required for their mutual decomposition. The requisite temperature is not less than 570° F. for nickel, 630° F. for cobalt, and 850° F. for copper. An apparatus is described, in which the petroleum and water are delivered in the right proportion to a heated chamber containing metallic wire, the supply of fluids being regulated by the pressure of the water-gas produced.—H. K. T.

Improvements connected with the Manufacture of Water-Gas and other Gases for Lighting and Manufacturing Purposes. H. Williams, Stockport. Eng. Pat. 5434, April 10, 1890. *11d.*

This invention relates to "apparatus for generating that class of gas composed of a combination of hydrogen gas produced from the decomposition of superheated steam, carbonic oxide gas, gas produced by the distillation and carbonisation of coal or wood, and gas produced from liquid hydrocarbons." By preference, a set of two vertical furnaces lined with fire-brick is used. The furnaces communicate with each other by ducts controlled by valves, and each furnace is surmounted by a small retort, also communicating with it by a suitable valve. One condenser (consisting of a group of pipes of small diameter) is used in conjunction with the pair of retorts. In connexion with the furnaces is a carburetter, wherein the gases may be diffused with the vapour of liquid hydrocarbons to any required degree of illuminating power, and afterwards fixed into a permanent gas. This fixing apparatus consists of an iron brick-lined chamber, within which are arranged a group of retorts or pipes charged with iron or steel trimmings or scraps loosely packed; surrounding the chamber or adjacent thereto is a multiple carburetter, in which the gases are intimately mixed with hydrocarbon vapours prior to their introduction into the carburetting retorts and fixers. The process is practically a continuous one. The furnaces are charged with coke, coal, or charcoal, and the retorts above them are charged with bituminous coal or wood. The fuel in the furnaces is brought to incandescence by forcing air through them, and the producer gases (at a high temperature) are passed into the carburetting chamber, thus raising the carburetting retorts and fixers to the high temperature required to enable them to carry out their functions of carburetting and fixing the gases permanently. For details the specification and its four sheets of drawings must be consulted.—D. E. J.

Improvements in or connected with the Manufacture of Water-Gas. J. von Langer and L. Cooper, Leeds. Eng. Pat. 7739, May 17, 1890. *11d.*

The object of this invention is to produce water-gas more economically in those cases where the generator-gas obtained at the same time cannot be separately made use of, and also to provide a simple means for removing undecomposed steam from the water-gas.

The first object is attained by employing a recuperator of the class previously described (Eng. Pat. 6400 of 1890), in which the producer-gas from the generator is burnt; the products of combustion are employed for heating air, some of which is used in the generator and some to supply the required amount for the combustion in the recuperator.

The hot water-gas is freed from steam by passing it through a coke stack on its way to the scrubber. (See also this Journal, 1890, 170; 1891, 245 and 452.)—F. S. K.

Improvements in and Apparatus for the Manufacture of Gas for Lighting and other Purposes. E. W. Walker, London. Eng. Pat. 8373, May 30, 1890. 8*d*.

Coal-gas, produced in the usual way, is passed through condensers and washers, and then into carburetters; before drawing the charge, steam is admitted to keep the retorts free from carbon, and the gas produced is either led into the main, or, should the sulphur be objectionable, discharged elsewhere. The hot coke is then withdrawn and placed in water-gas producers, arranged in batteries of two, and there treated with superheated steam, the gas being passed into the same carburetters as the coal gas. The percentage of carbonic oxide in the finished gas may be reduced by the addition of hydrogen, which is obtained from spongy iron and steam; the hydrogen is passed into the same carburetters as the other constituents. All the retorts, chambers, &c. may be arranged in a furnace of any convenient form.—F. S. K.

Improvements in Apparatus for Generating and Burning Mineral Oil Gas for Heating Purposes. O. Linder, Brussels, Belginm. Eng. Pat. 9393, June 17, 1890. 8*d*.

This invention relates to apparatus in which petroleum is converted into gas by the heat generated by the burning of the petroleum in the apparatus. The petroleum runs under pressure into a valved feed-pipe, which first ascends vertically, is then bent so as to form a horizontal canal, from which a pipe, parallel with the vertical portion, descends for a short distance, and is finally bent upwards towards the axis of the canal, terminating in a jet or burner. The horizontal canal is covered by a dome-shaped, perforated plate, provided with a conical deflector; the object of this arraugement is to throw the heat downwards, so that the canal or evaporating chamber is raised to a high temperature. A spirit vessel, fixed underneath, serves to start the apparatus.

The pressnre on the petroleum supply pipe is regulated by means of a water-reservoir, placed above and communicating with an air-reservoir; the air pressure forces the petroleum from a tank into the burner, which is placed at a higher level.—F. S. K.

Improvements in or Relating to the Treatment of Peat for the Production of Fuel and By-products. W. Loé and C. Gumbart, Munich, Germany. Eng. Pat. 9651, June 21, 1890. 8*d*.

Peat is dug or dredged, made into blocks and dried on "drying fields" or in kilns heated by the gases from the carbonising kilns to be afterwards mentioned. The drying kiln contains two or more travelling bands, from which are hung slats, so arraoged that duriog the greater part of their course they are kept horizontal by contact with a fixed guide-rail, but towards the end are allowed to drop and hang vertically from the travelling band, dropping their burden on slats similarly hung and guided on the lower side of the band. By the use of the same device of a fixed guide-rail for the greater part of the travel of the band and slats, the peat to be dried is made to traverse the kiln from side to side once more, and then drops in the same way as before on to a second travelling band of construction identical with that of the first.

The dried peat is mixed with well-burnt and newly-slaked lime, and either heated in an ordinary charcoal kiln, if it be not intended to obtain the by-products of its distillation, or in an externally fired charcoal kiln in the contrary case. A furnace is described which can either be used for the obtainment of by-products or without, in which case the draught is improved.

The temperature at which the carbonising is effected should not exceed 500° (C.?). It is alleged that the lime mixed with the peat "analyses the protein substances, and thereby increases the output of ammonia," and that "the carbonate of lime formed thereby is again burnt by the subsequent heating, and enters into a cement-like connexion with the silicic acid contained in the peat and the silicate of alumina, &c.," which increases considerably the fitness for forming the mixture into blocks. The carbonised substance is cooled with water as it leaves the kiln, ground to a stiff paste, and pressed into blocks, which are said to form a good fuel, free from smoke and smell, and leaving an ash that may be used as a mortar or a manure. The by-products, chiefly acetic acid, ammonia and tar, are collected by known means.—B. B.

Improvements in Gas Producers. J. E. Bott, Eyam, W. Mortimore, Manchester, and F. H. Lindley, Redelyffe. Eng. Pat. 11,106, July 16, 1890. 11*d*.

The improved producer consists of a circular vertical casing of wrought iron, lined with refractory materials. The hearth is so constructed that there are three ash-pits of water, intersected at equal distances by three iron tuyère chambers, which connect with the blast chamber by channels in the casing of the producer; the communication between the tuyères and the blast chamber is so arranged that when the tuyères are in use the openings are in juxtaposition, and when the tuyères are withdrawn to be cleaned the blast is shut off automatically.

The blast is admitted into the fuel through ports at the sides of the tuyères at some distance from the centre of the producer, the space in the centre being composed of refractory material on which unburnt coal continually drops. The tuyères are made in two parts, the upper of which slides, like a drawer, over a supporting trough, its sides and bottom being in contact with water. The escape of gas through the stoking holes is prevented by using ball-valves, constructed with a centre hole, through which the stoking rods are passed; when not in use the holes are closed by turning the balls.

The advantages of this form of producer are, amongst others (1) the production of gas is more regular; (2) the tuyères are prevented from too rapid destruction, and can be cleaned and repaired while working; and (3) a richer gas is produced.—F. S. K.

Improvements in the Manufacture of Artificial Fuel. R. Schimper, Jersey City, U.S.A. Eng. Pat. 12,639, August 12, 1890. 4*d*.

This is said to be a fuel composition to be burnt in a flueless stove or other vessel, such fuel burning slowly without giving flame, smoke, or "obnoxious gases." It consists of a mixture of 100 lb. of pulverised charcoal or coke, 3½ lb. of nitre, and 3 lb. of starch. These are mixed into a paste with water, ½ lb. of brownstone is added, and the composition is then pressed into blocks. The fuel, when burnt, leaves 5 per cent. of ash. The brownstone "serves to absorb and neutralise any smell" produced by the combustion of the starch and serves to retard the burning.—H. K. T.

Improvements in Means employed in the Manufacture of Hard Coke, the Distilling of Shale, the Roasting of Ores, or other Operations wherein Carbonaceous Matter is subjected to the Action of Heat. L. H. Armour, Gateshead-on-Tyne. Eng. Pat. 14,052, September 6, 1890. 6*d*.

The patent relates especially to ovens such as are described in Eng. Pats. 1947 and 5032 of 1882 (see this Journal, 1890, 488; 1891, 436—443). "Water or liquid" is supplied under the charge in regulated quantity, the pipes or conduits through which it is supplied being provided with a water-seal and preferably with a sight feed arrangement. The

patentee prefers to use two inlet pipes, one of which should be as near as is practicable to the exit for the gaseous products of the material under treatment.—B. B.

Improvements in or relating to Burning Petroleum and other Hydrocarbons, and Apparatus connected therewith. W. H. Thompson, Liverpool. From A. Mason, Brooklyn, and J. Wilson, New York, U.S.A. Eng. Pat. 16,762, October 21, 1890. 1*d.*

This invention relates *inter alia* to a method of burning hydrocarbon fuel which consists of injecting a portion of the same into the upper portion of the furnace chamber, and at the same time maintaining a distinctively separate set of lower-placed jets of oil in the lower space, upwardly and locally impinging their products on the laterally projected fire. Reference is made to a prior patent (Eng. Pat. 1241 of 1875) in which carburetted air or gas are introduced from below, together with injected oil spray "above the level of the fire-bed." It is pointed out that in this prior patent the two elements are in such close proximity that there is practically only one fire in which both elements are combined; whereas in the present patent it is the distinctively separate upper and lower fires that are relied upon. By their use the best results are obtained; smoking, clogging up, and choking of the furnace grate do not occur; and the mutual support of the cross fires provides an effectual preventative of the sudden interruption of the fire which is common in the burning of oil in one fire only from such causes as momentary stoppage of the oil supply by clogging, &c.

Any drippings from the injector are retained by a bed consisting of asbestos, porous stone, or other refractory and absorbent material. To this refractory bed a further supply of oil may be conveyed. Air or air and steam may also be admitted below the said bed.

The invention further relates to a method of burning liquid hydrocarbon fuel which consists of injecting oil, steam, and air into a pipe retort and maintaining them for a time therein subject to the heat of the combustion chamber for mixing, expanding, vapotising, and gasifying them therein.—D. E. J.

Improvements in the Manufacture of Gas. T. G. Springer, Chicago, U.S.A. Eng. Pat. 17,159, October 27, 1890. 6*d.*

This invention relates to the manufacture of gas from the decomposition of steam and heavy hydrocarbon oils, which oils, owing to their low specific gravity, are difficult to treat. The lower part of the apparatus used consists of a furnace with appliances for admitting an air blast and a steam supply. This furnace acts as a fuel and steam decomposing chamber. Above this are two chambers containing refractory material. One of these is a vaporising and mixing chamber into the upper part of which hydrocarbon oil is admitted and allowed to descend, percolating the refractory material. As it descends it meets the upward current of decomposed steam with which it mingles; here there may be a partial decomposition of the oil and fixing of gases. The second chamber is larger than the first, and is used as a fixing chamber for fixing the oil-vapours, and water-gas. Between these two chambers and the furnace itself are two combustion chambers for burning the waste gases from the fuel chamber during the blasting of the fuel to incandescence.

In carrying out the process the furnace is first charged, the air blasts are set in action, and the products of combustion from the fuel are caused to heat the apparatus, including the refractory material in the vaporising and fixing chambers. When the fuel is in a state of incandescence the air blast is stopped and steam is admitted beneath the fire bars. The steam is decomposed in passing through the incandescent mass of fuel, and is further heated when it comes in contact with the refractory material in the vaporising chamber. The hydrocarbon oil is now admitted into the latter, drips down and vaporises, its vapour mingling with the water gas resulting from the decomposition of the steam. After being forced through the fixing chamber the products issue as a fixed gas which can be used for illuminating or other purposes. The operation continues as long as the heat is sufficiently maintained, but as soon as it becomes too low to properly decompose the steam and oil, the supply of these is cut off, and the blasting operation is repeated until the requisite heat is attained.—D. E. J.

Incandescent Gas Lights. C. M. Langsen, New York, U.S.A. Eng. Pat. 17,674, November 4, 1890. 6*d.*

Plastic wires made of compositions containing refractory earths are woven instead of being wound one above the other, and pressed together. In this way the wires are less liable to cut one another, and the structure is more elastic. To give the thread sufficient plasticity and tensile strength for this purpose, a small quantity of glycerin is added to the glue of which it is composed. Or such substances as rubber dissolved in naphtha, or boiled linseed oil, may be used as binders. In making the threads, the refractory earth is mixed with the binder, and then forced through a die. The wires so produced are then supplied to a weaving or braiding machine.—H. K. T.

Improvements in Coking Processes. J. Bowing, Tilbury. Eng. Pat. 1682, January 29, 1891. 4*d.*

In previous patents (Eng. Pats. 10,137 of 1888 and 9199 of 1890) the inventor has claimed the manufacture of briquettes from coal and similar substances by mixing with tar or shale oil and water, and compressing, the mixing being preferably carried out by forcing steam through the mixture, whereby the excess of water and oil are forced out. He now claims the coking of the briquettes prepared as above. The above preparation is very suitable for coking, especially when materials of an anthracite nature, which will not usually coke, are to be dealt with.—H. K. T.

Improvements in Separating Carbonic Acid from other Gases, specially in the Production of Gas for Lighting and Heating Purposes Free, or practically Free, from Carbonic Oxide. P. F. MacCallum, Helensburg. From J. C. Reissig, La Plata, and J. Landin, Stockholm, Sweden. Eng. Pat. 2021, February 4, 1891. 4*d.*

When steam is passed through incandescent carbonaceous fuel maintained at 550°—750° C., a gas is produced which consists mainly of hydrogen and carbonic acid, with only small quantities of carbonic oxide. When the fuel is maintained at a higher temperature, the proportion of carbonic oxide increases until, at a temperature of 1,000° the resulting gas consists of a mixture of about 40 per cent. of carbonic oxide and 50 per cent. of hydrogen, with only about 5 per cent. of carbonic acid. This is known as water-gas, and its use is often objected to on account of the poisonous properties of the carbonic oxide contained.

The main object of this invention is to produce a gas containing but little carbonic oxide, and to increase its calorific power by removing the carbonic acid from the combustible gases. The process consists in passing steam (preferably superheated) or water through fuel contained in externally-heated retorts, or in water-gas generators, maintained at 550°–750° C. The resulting gas, consisting of hydrogen and carbonic acid, in the proportion of 2 to 1, is cooled and freed from sulphur impurities in the usual way. It is then passed through an absorbing apparatus containing carbonates of alkali or alkaline earths, preferably solutions of sodium carbonate (soda) or potassium carbonate (potash). These substances readily absorb (especially under pressure) the carbonic acid, forming bi-carbonates, from which the carbonic acid is easily removed by the action of a moderate vacuum, especially if aided by heat. The remaining gas consists principally of hydrogen, and is ready for use, while the solutions are again available for unlimited repetition of the absorbing operations, &c.

—D. E. J.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

On the Composition of Certain Petroleum Oils, and of Refining Residues; the Sulphur Compounds in Ohio Petroleum. C. F. Mabery and A. W. Smith. Amer. Chem. J. **13**, 232—243. (See also this Journal, 1890, 275.)

Much difficulty having been experienced in the removal of sulphur from the distillates of Ohio oil, few if any of the commercial products are entirely free from it, while it is frequently present in considerable quantities. The authors have been able to separate and identify in the crude oil methyl, ethyl, normal propyl, normal and iso-butyl, pentyl, ethyl-pentyl, butyl-pentyl, and hexyl sulphides, and also various sulphides which correspond neither in boiling point nor in composition with any previously described, together with some apparently unsaturated sulphur-free oils, which will be further examined.

When the acid sludge from the washing of the various products is diluted and neutralised with lime or chalk, unstable calcium salts are formed, which are decomposed by distillation with steam, the sulphides passing over. This oil is colourless when freshly distilled, and is entirely free from sulphuretted hydrogen. Its specific gravity at 16·5 is 0·9245, and it contains 14·97 per cent. of sulphur. On distillation under atmospheric pressure considerable decomposition takes place, but by reducing the pressure to from 100 to 150 mm. it becomes inappreciable. This decomposition, however, occurs only in the case of the sulphides boiling above 140° (at 760 mm.). By repeated fractionation the oil may be split up into a number of fractions, which give with alcoholic and aqueous mercuric chloride precipitates, crystalline in the case of the more volatile sulphides, thick viscid oils with the less volatile. They also readily form platinum salts and bromine addition products. The lower sulphides may also be obtained from the crude spirit boiling below 150° by precipitation with aqueous mercuric chloride. The heavy precipitate is dried by pressure, and decomposed by sulphuretted hydrogen in presence of alcohol, the mercuric sulphide invariably separating in the red form. After filtration the oil is thrown out by the addition of water, washed, and dried. Thus prepared it is nearly colourless, and has a specific gravity at 20° of 0·8543. From this latter product the authors have prepared methyl, ethyl, ethyl-propyl, and normal propyl sulphides, the remainder of those mentioned above being obtained from the oil from the acid sludge. All attempts to isolate iso-propyl sulphide were unsuccessful, as although some of the distillate collected between 115°—125°, analysis showed that it could not be the iso-compound boiling at 120°. From the sludge oil various sulphur-free oils uniting readily with bromine and those of lower boiling points with hydrobromic acid were obtained.

To remove any doubts whether these sulphides exist in the crude petroleum, the authors distilled several litres under diminished pressure, and extracted various distillates, some with sulphuric acid, and some with mercuric chloride, and obtained sulphides corresponding in all respects to those previously mentioned.

About one-third of the sludge oil distilled above the boiling point of hexyl sulphide, but with considerable decomposition even under diminished pressure. It consisted in great measure of sulphides, but the authors have not attempted to separate them.—F. H. L.

Constitution of Cymene. O. Widman. Ber. **24**, 439—456.

The author describes the synthetical preparation of paramethylpropylbenzene and paramethylisopropylbenzene, and in the following table compares the properties of these isomeric hydrocarbons with those of cymene:—

—	Paramethylpropylbenzene.
Boiling point	183°—184°.
Specific gravity	0·8682 (15°).
Odour	Pleasant.
Treated with HNO_3(1·40)	Does not yield tolylmethylketone.
Ba-α-sulphonate	$(C_{10}H_{13}SO_3)_2Ba + H_2O$, plates; do not lose water at 100°.
Na-α-sulphonate	$4\,C_{10}H_{13}SO_3ONa + 5\,H_2O$, plates.
α-sulphone-amide	Large plates melting at 102°—103°.
Ba-β-sulphonate	$(C_{10}H_{13}SO_3)_2Ba + 4\,H_2O$, short needles.
β-sulphone-amide	Scales melting at 112°—113°.

—	Paramethylisopropylbenzene.
Odour	Somewhat unpleasant.
Ba-α-sulphonate	$(C_{10}H_{13}SO_3)_2Ba + 3\,H_2O$, plates, lose all water at 100°.
α-sulphone-amide	Plates, melting at 115°—116°.

—	Cymene.
Boiling point	175°—176°.
Specific gravity	0·8802 (15°).
Odour	Unpleasant.
HNO_3(1·40)	Yields tolylmethylketone.
Ba-α-sulphonate	$3\,H_2O$, plates, lose all water at 100°.
Na-α-sulphonate	$5\,H_2O$ (according to Sieveking) $3\,H_2O$ (Paterno).
α-sulphone-amide	Plates melting at 115°—116°.
β-sulphone-amide	Scales melting at 148° (Remsen and Day).

The author concludes from his investigations that cymene is paramethylisopropylbenzene, and not paramethylpropylbenzene as hitherto assumed.—D. B.

Ethylpropylbenzene. O. Widman. Ber. **24**, 456—459.

In a recent communication (Ber. **23**, 3191) von Becke, in treating ethylbenzene with propylbromide in the presence of aluminium chloride, and fractionating the product, claims to have obtained the following compounds:—Fraction, 150°—155°: isopropylbenzene. Fraction 178°—185°: diethylbenzene. Fraction 189°—195°: *m*-ethylisopropylbenzene. Fraction 195—201°: *p*-ethylisopropylbenzene. Fraction 201°—208°: di-isopropylbenzene. The author argues that it is quite impossible to obtain pure hydrocarbons in this way, and expresses the opinion that in most cases the fractions in question contain mixtures of two or more hydrocarbons. This is clearly shown in the case of ethylpropylbenzene which von Becke prepared according to Sempotowski's method. This, on sulphonation, yields an acid, the magnesium salt of which was converted into the sulphone-amide. The latter melts at 84°. The author, however, positively asserts that on sulphonating the hydrocarbon two sulphonic acids are formed, the corresponding sulphone-amides melting at 112°—113° and 108° respectively.—D. B.

History of Cymene. R. Meyer. Ber. **24**, 970—971.

Referring to Widman's researches on the constitution of cymene (preceding abstract), the author considers it necessary to mention that he has at no time entertained the

least doubt as to the accuracy of his own experiments or those of Jacobsen, and for this reason it was unnecessary for him to repeat his former trials. He has not attempted to prepare the hydrocarbon or its sulphone amides in a pure form as suggested by Widman. The only substance analysed by the author has been the barium salt of para-isopropyltoluene sulphonic acid, which he, in agreement with Jacobsen, found to contain 1 mol. of H_2O. According to Widman it contains $3H_2O$. It is the author's intention to repeat his former work and if, as he hopes, his results confirm Widman's recent observations, the whole chemistry of the cymene and cumene groups will have been greatly simplified, and further proof adduced respecting the correctness of the conclusions drawn by the author from his researches on hydroxylation. If, as Widman shows, cymene contains iso- and not normal propyl, the only plausible exception to the rule that "tertiary hydrogen atoms" only are convertible directly into hydroxyl falls to the ground and the oxidation of cymene and its sulphonic acid into hydroxypropylbenzoic and hydroxypropylsulphobenzoic acids takes place without any chemical resolution.—D. B.

History of Cymene. O. Widman. Ber. **24**, 1362.

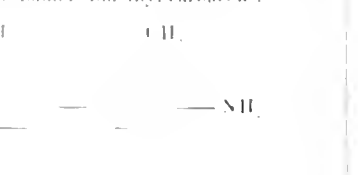
A REPLY to Meyer's remarks (preceding abstract) on the same subject calling for no special notice.—D. B.

Syntheses of Carbazole Derivatives. E. Täuber and R. Loewenherz. Ber. **24**, 1033—1036.

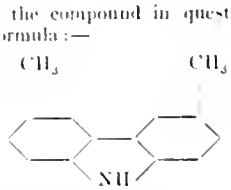
TÄUBER has recently described the synthesis of a diamidocarbazole from benzidine, and has also prepared carbazole synthetically from benzidine. The authors now give an account of the preparation of carbazole derivatives from benzidine homologues.

Diamidodimethylcarbazole, $C_{14}H_{11}N_3$, was obtained by heating metadiamido orthotoluidine hydrochloride with 20 per cent. hydrochloric acid (3—4 parts) for 15 hours at 190°—200°, treating the filtered solution of the product with stannous chloride and hydrogen sulphide, evaporating the filtrate and precipitating with hot concentrated hydrochloric acid. The hydrochloride which results crystallises in colourless needles. The base forms colourless microscopic needles. It is almost insoluble in water, sparingly soluble in cold, more readily in hot alcohol, benzene, toluene, and ether. It turns black at 260° and melts at 271°. The *diacetyl compound*, $C_{18}H_{15}N_3O_2$, is obtained when the base is boiled for six hours with glacial acetic acid (5 parts). It crystallises from the latter solvent in colourless needles which melt at 300°.

The following constitutional formula represents the synthetical formation of diamidodimethylcarbazole:—



Dimethylcarbazole is obtained by heating orthodiamidoditolyl with 20 per cent. hydrochloric acid at 200°, also by removing the amido groups of diamidodimethylcarbazole. Both methods yield the same product, which closely resembles carbazole in appearance. From a consideration of the properties and the syntheses referred to, the authors are satisfied that the compound in question is dimethylcarbazole of the formula:—



The picrate crystallises in reddish-brown needles, melting at 192°. Although it melts somewhat higher than the picrate from carbazole, the dimethyl base obtained therefrom melts at 249°, which is 19° lower than the temperature at which carbazole melts. Unlike the latter, a solution of dimethylcarbazole in sulphuric acid does not give the characteristic greenish-blue colour reaction with nitric acid, nor is it possible to obtain the blue dye by treating the dimethyl compound with oxalic acid.—D. B.

Utilisation of Dorsetshire Shale. Chemist and Druggist.

A SCOTTISH Company has started the manufacture of a new disinfectant and deodorant, from an uncommon kind of blackstone shale found at the Dorset mines. Composed altogether of animal and vegetable remains, this shale is remarkably light, yet it contains oils of a very heavy and volatile character. When distilled these oils are declared to possess valuable insecticide and deodorant qualities. The shale is found at a depth ranging from 300 to 500 ft. below the surface of the ground, and contains the remains of saurians and other extinct animals. The oil is extracted from the shale by distillation, and the residual product is reduced to different sizes of grain, ranging from a fine black powder to granules the size of an ordinary pea. The oil, mixed with other substances, is stated to form a a manure, combining the double qualities of a good fertiliser and powerful insect killer.

PATENTS.

Improvements in the Apparatus for Destructive Distillation of Mineral Oils. J. Laing, Edinburgh. Eng. Pat. 11,079, July 16, 1890. *6d.*

THIS invention relates to the destructive distillation of mineral oils in such a manner as to convert them into oils of light specific gravity. Its essential feature is a "superheater," which is a metallic vessel of any convenient form, used in conjunction with the "primary oil still" which may either be of ordinary construction or of that described by the author (Eng. Pat. 4120 of 1890; this Journal 1891, 534).—A. R. L.

Improvements in the Treatment of Crude Blast Furnace or Coke Oven Oils, and Application of the Oils so Treated or Produced for Making or Enriching Illuminating Gas. W. W. Staveley, Pontefract. Eng. Pat. 11,195, July 18, 1890. *6d.*

WHEN "crude or once run" blast furnace or coke oven oils, containing varying quantities of phenol, cresol, and their higher homologues, together with hydrocarbons of the paraffin series and pyridine bases, are fractionally distilled in an ordinary still or retort provided with a dephlegmating column, similar to Coupier's benzene apparatus, but constructed mainly of cast-iron, a distillate boiling at 220°—250° (thermometer in vapour), and usually amounting to 50 per cent. of the original oil is obtained. It contains about 50 per cent. of phenol, cresol, &c., 47 per cent. of "light paraffin oils and bases," and 3 per cent. of water.

The author claims the economic production of an oil—as above described—which yields on destructive distillation benzene, toluene, &c., the latter being better adapted to increase the luminosity of illuminating gas than the original oil.

When the "improved oil" is used for manufacturing illuminating gas, it is heated in a retort to a high temperature, and the resulting gases, after cooling, collected in a

suitable holder; or (preferably) the oil is passed in a stream or spray into a heated retort through which coal-gas or water-gas is passing, when the vapours of benzene, toluene, &c. are taken up and held as permanent gas by the latter; "the oil may be sprayed into the retort by means of compressed coal or water-gas."—A. R. L.

Improvements in the Apparatus for Destructive Distillation of Mineral Oils. J. Laing, Edinburgh. Eng. Pat. 11,757, July 28, 1890. 6*d*.

This invention relates to the treatment of mineral oils by destructive distillation under high pressure, in order to convert them into "lighter products." The "primary oil still" may be one of ordinary construction or of that described by the author (Eng. Pat. 4120 of 1890; this Journal, 1891, 534). The patentee claims "the combination with a still for the destructive distillation of mineral oils, of a loaded outlet valve and a relief tank interposed between the said outlet valve and an ordinary condenser, the said relief tank being used more or less as a condenser." The pressure to which it is requisite to load the valve depends upon the nature of the oil, and may be ascertained by trial; the patentee believes that to obtain an oil having a specific gravity of 0·700, from one of specific gravity 0·970, a pressure of about 80 lb. per square inch will be necessary. (See also Eng. Pat. 11,079 of 1890; preceding page).

—A. R. L.

Improvements in the Continuous Distillation of Hydrocarbon and other Oils and Liquids. C. M. Pielsticker, Harlesden. Eng. Pat. 1308, January 24, 1891. 8*d*.

This invention relates to improvements by which the distillation of hydrocarbons and other oils and liquids can be conducted in a continuous manner. In a previous patent (Eng. Pat. 1706 of 1882) the author described a method in which the oil was forced by means of a pump or steam injector into a coil open at the other end, in which coil the oil was heated to its distilling point, the heated oil entering from the coil into a heated retort in which it was vaporised and afterwards condensed in a cooler connected with the retort. With this apparatus it was found difficult to regulate the temperature of the coil so that all the oil at once assumed the form of vapour on entering the retort, while at other times the coil became so superheated that a portion of the oil was converted into permanent gas. Moreover, the coil being directly exposed to a high temperature, was soon burned through, and it was impossible to clear the coil from the carbon deposited in it.

These defects were partly obviated by improvements described by the present patentees in Eng. Pat. 6466 of 1890 (this Journal, 1891, 456), and are more perfectly removed in the apparatus now described. The oil is heated in the tank by means of a steam coil, and from this is forced by means of a pump into the heating coil. Between the pump and the inlet to the coil a steam connexion is provided for the purpose of emptying the oil contained in the heating coil at the end of the operation by means of a steam blast into a retort into which the other end of the coil leads; otherwise, when the pumping is stopped the oil remaining in the heating coil would speedily become carbonised and choke the coil. The retort is provided with a number of baffle plates causing the oil vapours to take a lengthened passage through the retort, a passage being left in the baffle plates to allow of the flow of tar or residuum. For removing this, a valve is fitted at the lower end of the cover, a steam inlet being connected with the tar outlet, in order to blow steam when the outlet is opened. This not only assists in the removal of the thick tar, but more particularly prevents the entry into the retort of air, which would form a dangerously explosive mixture with the gases. The vapours are led through a dome into the condensing pipe, which reaches nearly to the bottom of the first of a series of condensing vessels in which the heaviest vapours condense. In the succeeding vessels oils of gradually diminishing specific gravities condense. If the manufacture of permanent gas or very light oil is desired the retort is directly connected with a second heating coil similar to the first one, and superheated steam is simultaneously injected into this second coil by means of a steam injector. The apparatus may be used for the distillation of other liquids besides hydrocarbons; for instance, for fats and oils in the separation of fatty acids and glycerin.—D. E. J.

IV.—COLOURING MATTERS AND DYES.

Cochineal-Carmine. F. Lafar. J. Prakt. Chem. **43**, 130—138.

From the results of an analytical examination of carmine, Liebermann (this Journal, 1885, 585) concluded that the inorganic base of the same consisted of alumina and lime in the same relative proportion, namely, $Al_2O_3 : 2\,CaO$, as Kopp found in the mordant for Turkey red. The author has analysed a sample of "carmine nacarat" by the method described by Liebermann, for the purpose of ascertaining whether the above relationship obtains in all cases, with the results appended, Liebermann's results being given for comparison:—

	Liebermann.	Lafar.
	Per Cent.	Per Cent.
Moisture	17	15·50
Ash	7	6·87
Nitrogenous matter	20	23·26
Colouring matter (by difference)	56	54·37

or calculated on the dry substance:—

	Liebermann.	Lafar.
	Per Cent.	Per Cent.
Ash	8·4	8·14
Nitrogenous matter	24·7	27·6
Colouring matter	67·2	64·26

The moisture was determined by drying at 110°, the whole of it not being removed at a lower temperature. At this temperature the carmine lost much of its brilliancy, which was not recovered even on long exposure to an atmosphere saturated with moisture. The percentage of nitrogen found was 3·49, which, on the assumption that it is all contained in the nitrogenous matter accompanying the colouring matter proper, corresponds to 23·26 per cent. of that substance. The agreement in the two results as regards the content in inorganic matter is notable; the composition of the ash was also found to be practically the same as Liebermann stated, namely:—

	Liebermann.	Lafar.
	Per Cent.	Per Cent.
CuO	Trace	0·35
SnO_2	0·67	0·14
Al_2O_3	43·09	40·48
Fe_2O_3	Trace	Trace
CaO	44·85	44·20
MgO	1·02	0·61
Na_2O	3·23	5·49
K_2O	3·56	3·20
P_2O_5	3·20	2·71
SiO_2	Trace	0·60
CO_2 (by difference)	..	2·31

Calculating the magnesia found into its equivalent of lime, and adding this to the percentages of lime found, the percentages of lime and alumina are respectively:—

	Lehmann.	Lafar.
	Per Cent.	Per Cent.
Al_2O_3	47·00	44·48
$(CaO + MgO) + CaO$	46·98	47·05

or the formula of the lake, calculated for $Al_2O_3 : (CaO + MgO)$, is, from Lehmann's results, 1 : 1·972, and, from the authors', 1 : 2·041. The results obtained, therefore, completely support Lehmann's hypothesis.

These results, the author points out, would prove that the hitherto published methods of preparation of carmine are purely empirical.—E.B.

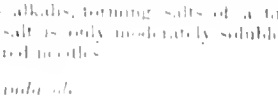
New Mode of Formation of Indazole Derivatives. O. N. Witt, F. Noelting, and E. Grandmougin. Bull. Soc. Ind. Mulhouse, 1891, 70–81.

p NITRO-*o*-CRESOL ($CH_3 : OH : NO_2 = 1 : 2 : 4$), melting at 106°–108°, is formed almost quantitatively when a solution of the calculated amount of sodium nitrite is added to a boiling solution of *p* nitro-*o*-toluidine ($CH_3 : NH_2 : NO_2 = 1 : 2 : 4$) in dilute sulphuric or hydrochloric acid. When, however, this base is diazotised in the ordinary way, and the solution of the resultant diazo-compound heated gradually to the boil, there is obtained, along with nitro-*o*-cresol, another substance, which has been recognised as nitro-indazole:

Nitro-indazole—

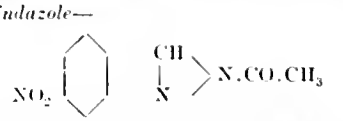
was obtained, as above indicated, by slowly heating to the boil an aqueous solution of *o*-diazo-*p*-nitrotoluene sulphate, only a faint evolution of nitrogen taking place. The solution, whilst still hot, is filtered to separate a little tarry matter. The filtrate, as it cools, deposits the products of the reaction in the form of oily drops, which collect together and soon solidify to a mass of yellow needles. After filtering off and washing, these crystals melt, as a rule, at 120°, and consist of about equal parts of nitro-indazole and nitro-*o*-cresol. It was not found possible, by variation of the manner of decomposition of the diazo salt, to effect any material increase in the yield of nitro-indazole. The two compounds were separated by repeated crystallisation from water, in which nitro-*o*-cresol is the more soluble. Five such crystallisations yielded nitro-indazole in a pure condition. It crystallises in white, silky, lustrous needles, melting at 181°. Small quantities of it sublime unchanged; larger quantities decompose with explosive violence. It is soluble in alcohol, acetic acid, xylene, &c. It dissolves easily in solutions of the alkalis, forming salts of a fine red colour. The potassium salt is only moderately soluble, and crystallises in orange-red needles.

Methylnitro-indazole—



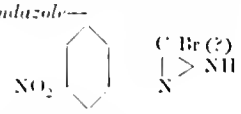
is obtained by methylation of nitro-indazole with methyl iodide and a minimum amount of potash. It crystallises from benzene in long, flat, yellow needles, which melt at 159°, and sublime, without decomposition, at a higher temperature. It is very feebly soluble in water. When boiled with excess of alcoholic potash it is converted into an azoxy derivative; hence the necessity for avoiding an excess of potash in its preparation.

Acetylnitro-indazole—



forms colourless needles, melting at 139°–140°, and volatile without decomposition. This compound is quite insoluble in water. It is readily saponified by alkalis.

Bromnitro-indazole—

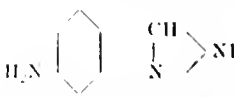


was prepared by the action of an excess of bromine water on nitro-indazole, precipitated by acid from its alkaline solution, and, therefore, in a fine state of division. The product, after being washed, was crystallised from benzene. It forms small yellow prisms, which dissolve in hot aqueous soda, yielding, on cooling, splendid needles of the sodium salt.

Oxidation of Nitro-indazole.—Nitro-indazole is not attacked by boiling nitric acid; chromic acid solution decomposes it with formation of nitrogen, carbon dioxide, and a little tar; prolonged boiling with potassium bichromate and dilute sulphuric acid causes the production, in addition to the gases named, of a small quantity of a yellow powder. This powder dissolves very feebly in the ordinary solvents; it appears to be a weak base. Its analysis shows it to contain 19·06 per cent. of nitrogen. Sufficient of it was not obtained for further examination.

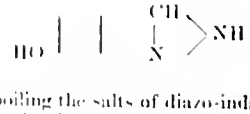
The behaviour on oxidation of nitro-indazole proves that it does not contain a methyl group.

Reduction of Nitro-indazole.—This was effected by adding 5 grms. of nitroindazole to a hydrochloric acid solution of 30 grms. of stannous chloride. The nitro-compound dissolves immediately with disengagement of heat, and the stannic double-salt separates in colourless needles. On the removal, by precipitation, of the tin, the hydrochloride of *amido-indazole*—



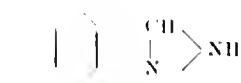
is obtained in deliquescent, colourless needles. The free base is best obtained by the reduction of nitro-indazole with alcoholic ammonium sulphide. By repeated crystallisation from water it is obtained pure, either in the form of anhydrous white needles or colourless plates, containing a molecule of water of crystallisation. The needles melt at 270°, but sublime at a lower temperature. Amido-indazole is sparingly soluble in alcohol and cold water, freely so in hot water. It is dibasic; thus, if suspended in water and treated with acid, complete solution only takes place when two molecules of a monobasic acid have been added to one of the base. That it contains only one amido group is shown by the lbluing of iodised starch-paper, on the addition to a solution of it of an amount of sodium nitrite slightly in excess of that required to diazotise one amido-group.

Hydroxy-indazole—



is obtained by boiling the salts of diazo-indazole with water, and extracting with ether. After evaporation of the ether, it is left in the form of beautiful red needles, which, on purification by sublimation, suddenly become white. Crystallised from water, it melts at 215°–216°. It possesses a quinone-like smell.

Indazole—



was prepared from amido-indazole both by Friedländer's (this Journal, 1889, 50) and the ethyl nitrite methods. Prepared by the first method, the product melted at 146 — 147°; by the second, at 145°—146°. Fischer and Kuzel give the melting point as 146·5°. The product was found to be identical in all respects with the indazole of Fischer and Kuzel.

The authors, further, diazotised *o*-toluidine and boiled the product with water to ascertain whether any indazole were formed in this manner, but found no trace of that substance. Their attempt also to prepare a homologue of nitro-indazole from *p*-nitro-*m*-xylidine ($CH_3 : NH_2 : NO_2 : CH_3 = 1:2:4:5$) was unsuccessful, the corresponding nitroxenole alone being formed.—E. B.

PATENTS.

Colouring Matters Obtainable by the Combination of Tetrazoditolyl- or Tetrazodixylyl-salts with Alpha- and Beta-naphthylamine or their Mono- and Disulpho-acids, and Process for the Manufacture of the same. H. J. Haddan, London. From the "Farbenfabriken vorm. F. Bayer and Co.," Elberfeld, Germany. Eng. Pat. 3803, March 24, 1885. Amended March 27, 1890. (Second Edition.) 6*d*.

The original specification has already been abstracted (this Journal, 1886, 96). In the present amendment the use of tetrazodixylyl is disclaimed and also the use of the α-monosulphonic acid and the γ-disulphonic acid of β-naphthylamine. The weight of β-naphthylamine-δ-sulphonic acid which combines with the tetrazoditolyl chloride from 100 kilos. of tolidine sulphate is amended to 145 kilos. instead of 112 kilos. in the original specification, and there are besides some corrections of clerical errors.—T. A. L.

The Manufacture and Production of a New Compound and of Artificial Indigo from Phenyl-glycocoll, or Analogues, Compounds, or Derivatives thereof. J. Y. Johnson, London. From the "Badische Anilin und Soda Fabrik," Ludwigshafen, Germany. Eng. Pat. 8726, June 5, 1890. 6*d*.

This process for the production of artificial indigo consists in fusing phenyl-glycocine or one of its homologues with twice its weight of caustic potash at a temperature of about 300° C. in a closed vessel. The end of the reaction is shown by the melt assuming a deep orange colour, or tests may be taken at intervals from the melt, dissolved in water, and air blown through the solution. When no increase can be observed in the amount of precipitate formed, the reaction is complete. The whole melt is then dissolved in water and air passed through the solution so long as a precipitate is formed. The indigo thus produced is filtered off, washed successively with water, hydrochloric acid, and alcohol, and finally dried. The phenyl-glycocine used is prepared by boiling for about 4 to 6 hours two molecular proportions of aniline with one molecular proportion of monochloracetic acid and twice the whole quantity of water. The phenyl-glycocine separates out on cooling, and when dry is sufficiently pure to use for the process. In place of aniline, its homologues *o*-toluidine and *m*-xylidine, and also methyl-aniline and its homologues may be employed. The products thus produced in their turn are used for the formation of homologues of indigo. A sulphonated indigo which can be employed like indigo carmine is produced by adding phenyl-glycocine to twice its weight of fuming sulphuric acid containing about 30 per cent. of SO_3, the temperature not being allowed to rise above 40° C. When dissolved, a stream of moist air is passed through the solution until the colour becomes no deeper. The whole is then poured into 10 times its weight of water, salted out, filter-pressed, and dried.
—T. A. L.

The Production of New Azo-Colouring Matters. Brooke, Simpson, and Spiller, Limited, and A. G. Green, London. Eng. Pat. 10,448, July 5, 1890. 4*d*.

Direct-dyeing cotton colouring matters are obtained by combining diazotised primuline with *m*-diamines, azo-derivatives of *m*-diamines, such as Bismarck brown and chrysoidine, or with α-naphthylamine, and in this latter case re-diazotising the product and combining it with a phenol or amine, but preferably with a *m*-diamine. The order of combination may, in many of these cases, be reversed, giving the same result, viz., the *m*-diamine may be diazotised and combined with primuline. A colouring matter dyeing cotton and wool red from an alkaline bath is produced by dissolving 25 lb. of primuline and 3·5 lb. of sodium nitrite in 30 galls. of water, adding 1·5 galls. of hydrochloric acid of 33 per cent. to the cold solution. A solution of tolylene diamine, equivalent to 10 lb. of *m*-binitrotoluene, and 20 lb. of sodium acetate is then run into the diazotised primuline. After the combination is complete the colour is dissolved up by the addition of caustic soda, precipitated with salt, filter-pressed, and dried.
—T. A. L.

The Manufacture and Production of Artificial Indigo and of a New Material suitable for Use therein. J. Y. Johnson, London. From "The Badische Anilin und Soda Fabrik," Ludwigshafen, Germany. Eng. Pat. 10,509, July 7, 1890. 6*d*.

An extension of Eng. Pat. 8726 of 1890 (see above), describing the preparation of artificial indigo from phenyl-glycocine *o*-carboxylic acid obtained by condensing aniline-*o*-carboxylic acid (anthranilic acid) with monochloracetic acid. About 25 kilos. of anthranilic acid, 20 kilos. of monochloracetic acid, and 33 kilos. of calcined soda are boiled for several hours with 1,000 litres of water in a vessel fitted with an inverted condenser. After acidifying, crystals of the new acid separate out on cooling, and may be separated in a hydro-extractor. One kilo. of the dry product thus obtained is fused in a closed vessel with 2—4 kilos. of caustic potash at a temperature of about 200° C. The operation is stopped when the orange colour of the melt no longer increases in intensity. After rapidly cooling the melt it is dissolved in about 200 litres of water, filtered and air passed through the solution until no more precipitate separates out. The artificial indigo is then filtered off, washed with water, then hydrochloric acid, and finally with alcohol, after which it is dried.—T. A. L.

Production of Novel Colouring Matters for Wool Dyeing and Printing. O. Imray, London. From the "Farbwerke vormals Meister, Lucius, und Brüning," Hoechst-on-the-Maine, Germany. Eng. Pat. 10,802, July 11, 1890. 6*d*.

An extension of Eng. Pat. 4577 of 1890 (this Journal, 1891, 249). The sulphonic acids there described (obtained by the action of nitrosodimethylaniline hydrochloride on β-naphthol sulphonic acid) when heated with aniline, and its homologues, or with various other bases in presence of water and soda-lye form sulphonic acids which are valuable colouring matters.—T. A. L.

Manufacture of Azo-Colouring Matters derived from Azoxyamines. J. Imray, London. From "La Société Anonyme des Matières Colorantes et Produits Chimiques de St. Denis," Paris, France. Eng. Pat. 11,548, July 23, 1890. 6*d*.

An extension of Eng. Pat. 5736 of 1890 (this Journal, 1891, 358) describing the preparation of yellow and orange-yellow colouring matters for mordanted wool, giving shades which are fast to light, air, and fulling. The process consists in combining diazotised *m*-nitraniline or one of its homologues with salicylic acid or with one of the cresotic acids, and reducing the products thus obtained in an alkaline solution with glucose as described in the previous patent.—T. A. L.

V.—TEXTILES: COTTON, WOOL, SILK, Etc.

Asbestos Discovery in Victoria. Adelaide Advertiser, May 15, 1891.

The locality of the discovery is Red Hill, about nine miles easterly from Broken Hill, in the Rockwell paddock, where for a long time past R. Hinspeter has been prospecting on the side of a hill, in which asbestiform rock was known to exist, and lately he struck a large vein of true amianthus, as the true Italian variety of this valuable mineral is called. Specimens have been obtained of great length, one being as much as 28 in., and the staple ranges from a striated salmon-tinted variety known as pierolite from near the surface, to a beautiful snow-white flossy fibre of a considerable length and good tensile strength, taken from the shallow depth of 20 ft., while the material is now improving rapidly every foot. On the top of the hill veins of coarse crysotile, the Canadian variety, are found in a ferruginous gangue of what appears to be chrome iron. Lower down a strong vein has been opened, while to the eastward is the deposit of amianthus, which seems of considerable extent. Stains of green carbonate of copper are plentiful, and both silver and gold in small quantities have been found on the property, a not unfrequent occurrence in asbestos country.

PATENT.

An Improved Apparatus for Testing Wool. E. Jaegermayer and V. Michel, Vienna, Austria. Eng. Pat. 9755, June 24, 1890. 8*d*

To estimate the true market value or "rendement" of wool, a sample of it is placed in a cylindrical box of sheet metal, and its weight ascertained by means of a scale beam and sliding weight. Then the wool is compressed by screwing down the cover of the box, the same pressure being used in all cases. To effect this the nut of the screw is connected with a series of levers so weighted as to regulate the force applied. The volume of the compressed wool is then read off a scale, and the patentees are of opinion that the "rendement" of the wool can be calculated from the weight and volume thus indicated.—H. S.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

The Fastness of Dyed Colours to Light and Air. A. Woscher. Zeits. f. angew. Chem. **7**, 211—212.

The fading, or change of shade, of dyed colours, which in most cases takes place on exposure to light and air, is due to one of the following causes:—

1. The action of light alone.
2. That of atmospheric oxygen.
3. That of atmospheric moisture.
4. That of certain acid gases contained in the air, namely, carbon and sulphur dioxides.
5. The volatility of the dyestuffs or colours.
6. Two or more of the above influences acting simultaneously.

Joffre (this Journal, 1885, 674) has shown that by exposure to light alone very few colours are altered, and then only slightly. In the absence of air, some of the most fugitive colouring matters known, such as Cyanine, for example, are unattacked by light; Picric acid, dyed on wool, is reddened.

With dyed goods exposed to the air in the dark, too, the author finds that change of shade or tone takes place exceedingly slowly.

Atmospheric moisture can by itself affect only those colours which are not absolutely fast to washing, the dyes or colours, by the action of moisture, becoming dissolved out from the interior of the fibre; thus, Crocein scarlet on cotton is loose to washing, and therefore badly withstands exposure to moist air, whereas on wool, on which it is fast, it is unaffected by moisture.

Carbon dioxide and sulphur dioxide directly affect many colours. Certain dyes of the benzidine class, in particular, are very sensitive to the former of these gases. The injurious effects of sulphur dioxide are frequently visible in the more exposed parts, *i.e.*, the folds and selvedges, of dyed goods, stored in rooms where coal-gas is burnt. In consequence of this, many firms have either adopted electric lighting or have made arrangements for the thorough ventilation of their store-rooms.

Volatility is a defect seldom or never possessed by dyestuffs in use at the present time.

Under ordinary circumstances, the colours on dyed fabrics are exposed to the combined action of light, atmospheric oxygen, moisture, carbonic acid, and sulphur dioxide. In presence of air and moisture, light encourages an oxidising action, as is seen in the old method of croft-bleaching. The effect of this action varies considerably with different colours, according to their chemical constitution. Colours produced, or partially produced, by oxidation naturally offer more resistance to this oxidising action than others; thus Aniline black, Indigo blue, Paraphenylene blue chromed after dyeing, Benzoazurin treated, after dyeing, with copper sulphate, &c., are very fast. On the other hand, there is a large number of colours not produced by oxidation, which are very fast to light and air, for example, Alizarin red, Alizarin carmine (on wool), Alizarin blue, Crocein scarlet (on wool), Chrysamin, Mikado orange (on cotton), and many others.

The rays of light, which, acting in conjunction with air and moisture, produce the maximum oxidation of dyed colours, are not, as generally supposed, the blue, violet, and ultra-violet, but the red, orange, yellow, and green. Other conditions being equal, the more intense the sunlight, the greater is the fading action or change of colour, the solar heat being also a factor of some importance in this change.

It is difficult on account of the great diversity in chemical nature of the numerous dyes in use, to find a general means of increasing the fastness to light and air of dyed colours, without at the same time modifying their shades or characters. Scheurer (this Journal, 1891, 460) has recently recommended the use of a thickened solution of ammoniacal cupric hydrate for rendering colours fast to light. The results obtained by this method are satisfactory, but the range of colours experimented upon was too limited to warrant Scheurer's conclusions as to the generally beneficial effect of the treatment, especially as there are many colours whose purity of shade is injured thereby. The author also differs from Scheurer as regards the theory of the action of the copper oxide layer. Scheurer attributes the action solely to the power possessed by that layer of intercepting the actinic rays of light, apparently considering that the chemical action of light on the whole range of colours is confined to certain rays. In the author's opinion, on the other hand, ammoniacal copper hydrate, applied in the way Scheurer directs, acts on the cotton-cellulose, producing a superficial water and air-proof film over the fibres, and so robbing the light of its power of acting on the colours.—E. B.

On the Formation of Coloured Lakes. L. Vignon. Compt. Rend. **112**, 580—582.

The author has compared the relative lake-forming power of stannic acid in solution and precipitated meta-stannic acid, the basic colouring matter, safranine, being employed. The first substance gave a lake of a full red colour, whilst the meta-stannic acid had taken up only a faint rose colour after washing with water until free from adhering colouring matter. The author considers that the lake-forming power of the two acid substances may be regarded as equivalent to their relative thermo-chemical energies which in combining with soda are as 32·7 to 2·3 heat units respectively. (See also this Journal, 1890, 771 and 855.)—G. H. B.

Note on the Theory of various Phenomena in Dyeing. L. Vignon. Compt. Rend. **112**, 623.

THE greater ease with which the animal fibres absorb dyes is due simply to the fact that they exhibit in a far stronger degree than the vegetable fibres, acid or basic properties; and seeing that all known soluble dyeing materials, whether natural or artificial, contain either the acid groups OH or NO_2 or the basic NR_2, the absorption of the colour by the fibre becomes a purely chemical phenomenon. The single exceptions to this rule are the tetrazo dyes, which are absorbed by cotton in an alkaline bath without mordants.

—F. H. L.

PATENT.

Improvements in Apparatus for Dyeing Straw Goods and for Similar Purposes. H. H. Lake, London. From E. B. Seaver, Boston, U.S.A. Eng. Pat. 2439, February 10, 1891. 1*1d.*

THIS invention relates to the dyeing of straw goods, and particularly of made-up straw hats. The process of dyeing hitherto generally practised is to dye the braided straw in an open kettle. By the present invention the articles made up to shape are supported on a suitable carrier placed within a closed chamber capable of withstanding considerable internal pressure, and within this the whole of the processes of steaming, dyeing, and drying are carried out without removal of the goods. Means are provided for admitting steam into the cylinder, for subsequently exhausting the air and condensed water; then admitting the dye-liquor and maintaining it in a state of agitation or ebullition (as may be required); and finally for withdrawing the liquor and drying the material by means of either hot or compressed air. The details of the devices employed for carrying out these processes do not admit of suitable abstraction, and for them the original specification and accompanying drawings must be consulted.—W. E. K.

VII.—ACIDS, ALKALIS, AND SALTS.

Twenty-Seventh Annual Report on Alkali, &c. Works by the Chief Inspector. Proceedings during the Year 1890, presented to the Local Government Board and to the Secretary for Scotland. 1891. 7*d.*

THE report covers 112 pages.

The following tables show the distribution of the various registered works in England, Ireland, and Wales for the year 1890, and also the kinds of processes under inspection. The number of works in Scotland was 126, including 16 alkali works, giving a total of 1,034 works in the United Kingdom.

NUMBER OF REGISTERED WORKS.

	Dist. I. Ireland.	Dist. II. North of England.	Dist. III. Cheshire, N. Wales, and part of Lancashire.	Sub-Dist. Widnes.	Dist. IV. East Lancashire and Yorkshire.	Dist. V. South Midland.	Dist. VI. South-West of England and South Wales.	Dist. VII. South-Eastern Counties.	Sub-Dist. VII. Eastern Counties.	Total. 1890.	1889.	1888.
Alkali works	2	18	15	18	34	11	8	..	11	117	116	119
Other works	47	84	80	13	126	129	121	93	98	791	787	807
Total	49	102	95	31	160	140	129	93	109	908	903	926

TABLE OF SEPARATE PROCESSES UNDER INSPECTION.

	Dist. I. Ireland.	Dist. II. North of England.	Dist. III. Cheshire, N. Wales, and part of Lancashire.	Sub.-Dist. Widnes.	Dist. IV. East Lancashire and Yorkshire.	Dist. V. South Midland.	Dist. VI. South-West of England and South Wales.	Dist. VII. South-Eastern Counties.	Sub-Dist. VII. Eastern Counties.	Total. 1890.	1889.
Alkali	2	13	14	16	12	5	4	..	2	68	69
Hydrochloric acid (cylinder)	..	..	..	..	13	4	..	..	9	26	24
Copper (wet process)	..	4	3	4	2	2	4	..	..	19	19
Cotton carbonising (alkali)	..	..	..	..	7	..	..	..	..	7	7
Sulphuric acid	11	23	22	18	42	27	41	4	27	215	217
Chemical manure	17	33	15	2	22	46	40	6	45	226	232
Gas liquor	..	2	2	3	18	5	..	..	..	30	28
Nitric acid	..	2	6	1	43	22	3	6	17	100	94
Sulphate and muriate of ammonia	21	35	27	7	54	60	59	37	38	338	334
Chlorine and bleaching powder	2	9	17	20	7	2	1	..	1	59	57
Sulphur recovery	..	3	1	12	1	2	..	..	..	19	12
Salt	9	8	33	1	..	6	..	..	..	57	78
Cement	2	13	1	1	5	7	9	11	12	91	93
Total	64	145	141	85	226	188	161	97	151	1,258	1,264

TABLE OF AVERAGE AMOUNT OF ACID GASES ESCAPING FOR EACH DISTRICT.

	Dist. I. Ireland.	Dist. II. North of England.	Dist. III. Cheshire, N. Wales and part of Lancashire.	Sub-Dist. Widnes.	Dist. IV. East Lancashire and Yorkshire.	Dist. V. South Midland.	Dist. VI. South-West of England and South Wales.	Dist. VII. South-Eastern Counties.	Sub-Dist. VII. Eastern Counties.	Average. 1890.	1889.	1888.
Hydrogen [illegible] chlorine gases. [illegible]	0·02	0·12	0·06	0·104	0·067	0·097	0·087	..	0·085	0·090	0·088	0·089
Hydrochloric [illegible]	2·03	2·66	1·22	1·98	1·41	2·64	1·40	..	2·31	1·950	1·943	1·960
[illegible]	1·54	1·217	1·06	1·26	1·22	1·26	1·60	1·18	1·21	1·280	1·370	1·490
Acidity of chimneys given as SO_2. Grains per cubic foot.	0·88	0·57	0·62	0·69	0·47	0·52	1·06	..	0·84	0·700	0·715	0·737
Acidity of gases from manure [illegible] given as SO_3. Grains per cubic foot.	0·18	0·125	0·27	0·59	0·471	0·56	0·40	..	0·343	0·367	0·349	0·350

There have been no prosecutions during 1890 for exceeding the limit laid down in the Act of the amount of noxious gas emitted, but complaints have been received of nuisances arising from works not registered under the Alkali Act. One notable exception to this freedom from complaint is the new Chance-Claus process, not yet included within the Act, for the recovery of sulphur from tank waste, which has given rise to serious complaint owing to the escape of sulphuretted hydrogen gas. As this process is only recent, its difficulties are only in course of being surmounted, and as it has been widely adopted, complaints have been numerous. Various means for preventing the escape of sulphur gases from this process have been tried, and at the works of the Newcastle Chemical Company the residual gases were effectually cleansed by pumping through layers of tank waste diluted with water and then through ferric oxide, but the method had to be abandoned as the pumps could not be kept in working order. The British Alkali Company in Widnes adopt the plan of burning and sending the residual gases through sulphuric acid chambers. Any loss arising from the dilution of the chamber gases is said to be balanced by the gain of sulphur yielded by the gases. At another works the gases are burned in pyrites kilns and allowed to pass through the salt cake cylinders of the Hargreaves process. In the majority of the works special furnaces have had to be employed for burning the sulphuretted hydrogen to sulphurous acid as a preliminary to sending it away through the chimney of the works. A satisfactory method of dealing with the waste gases from the Chance-Claus process adapted for universal needs has not yet appeared.

The amount of salt manufactured in different districts was

	Tons.
[illegible]	1,[illegible]858
[illegible]	208,488
Staffordshire	6,500
Durham	[illegible]
Ireland	10,740
Scotland	8,478
Total in 1890	1,7[illegible]

In 1889 the total amount was 1,7[illegible],7[illegible] tons, which was less by 12 per cent than that made in 1888. Of the salt produced in the United Kingdom, about one third is exported. Of the remaining two thirds, three fourths are used in the soda industry, leaving one-fourth to supply all that is required for domestic use, the salting of provisions for agricultural and all other purposes.

In giving the relative strength of the two rival branches of the soda manufacture in the following table, the salt consumed by the ammonia-soda process is calculated from the manufacturing equivalent of 1·46 tons of salt to 1 ton of 58° alkali.

SALT DECOMPOSED IN THE LEBLANC AND AMMONIA-SODA PROCESSES (INCLUDING SCOTLAND), IN TONS.

	1890.	1889.	1888.
Leblanc process	602,769	584,203	585,498
Ammonia soda	252,260	219,279	212,181
Total	855,029	803,482	797,679

AMOUNT OF SULPHATE OF AMMONIA PRODUCED IN THE UNITED KINGDOM, IN TONS.

	1890.	1889.	1888.
Gas works	102,138	100,711	92,896
Iron works	5,064	6,145	5,280
Shale works	24,730	23,953	22,072
Coke and carbonising works	2,325	2,795	2,537
Total	134,257	133,604	122,785

The total value of sulphate of ammonia at 12*l.* per ton was 1,611,084*l.* Two recent improvements in this manufacture are noticed, namely, the use of sheet copper for constructing the "saturators" in which the ammonia is absorbed by sulphuric acid, and the employment of a steam jet for raising the sulphate of ammonia crystals from the saturator to the drainer, whereby labour is saved and escape of offensive vapours can be avoided by carrying on the work in closed vessels. A method of adapting the "Bee-Hive" coke ovens to a system for recovering the ammonia produced and utilising the gases, introduced by Newton, Chambers, & Co., is described in detail. The yield is 6 to 7 lb. of sulphate of ammonia per ton of coal coked, and the calorific power of the gases is nearly equal to that of blast furnace gases when coke is used for smelting. The economy achieved by the recovery of ammonia from producer gases has received a check in the advanced price of coal in the past year. The combination recently effected amongst alkali makers under the style of the United Alkali Company, is referred to as affording a prospect of still greater efficiency all round in the management of the various works. An extended notice is given of the process of Haddock and Leith for the recovery of sulphur from Leblanc vat waste,

in which the other products obtained are sodium carbonate and bicarbonate, besides calcium carbonate and sulphate.

A process devised by F. Gossage of Widnes is being placed on a manufacturing scale. By it sodium sulphide is formed from sulphate and decomposed by carbonic acid with formation of sodium bicarbonate and evolution of sulphuretted hydrogen which is utilised in any convenient way. No lime is required and no tank waste formed in this process for making alkali.

A third new process for the manufacture of alkali has been patented by Mr. James Simpson, resembling in some respects that of Haddock and Leith, but instead of tank waste it is a mineral phosphate which is submitted to the action of sulphuretted hydrogen, and a highly concentrated calcium phosphate is produced.

The report pleads for the inclusion of all chemical works within the Alkali Act so as to enforce a more complete supervision over the escape of noxious gases.

By the adoption of various means and precautions the escape of chlorine from the chambers used in the manufacture of bleaching powder is kept under close control, and complaints are now but rarely heard. An improvement in the working of the Deacon process has been devised by Mr. Hasenclever, who adds sulphuric acid to the hydrochloric acid of the Leblanc process and blows air through the mixture. This carries away strong hydrochloric acid gas mixed with air, in the proportions suited to their mutual reaction in the Deacon decomposer, leaving much of the water of the hydrochloric acid combined with the sulphuric acid. This acid, thus somewhat diluted can be used conveniently in the Leblanc decomposing pans for action on the salt, and the hydrochloric acid there generated, being more hydrated than hitherto, will need less water in the condensing towers.

The method of producing chlorine introduced by Weldon in connexion with Pechiney, of Salindres, in France, has been adopted by Albright and Wilson at Oldbury.

During the past year continued progress has been made in the adoption of means for diminishing the discharge of black smoke from factory chimneys, and an extensive movement has been organised in several large towns of the United Kingdom for ascertaining the relative merits of mechanical stokers and other smoke-preventing appliances. This work was under the superintendence of Mr. E. W. Parnell, and is now in the hands of Professor A. B. W. Kennedy. It is expected that the outcome of this inquiry will afford information of the highest value to coal consumers and engineers, and to the country at large. The evil which presses most in London and other residential cities is the aggregation of smoke coming from the multitude of house fires, and it is suggested that the remedy for this will probably be found in superseding the use of the open fire by a central stove for supplying warm air for distribution through the building.

The systematic testing of chimney gases in salt works has caused greater care to be exercised in stopping or preventing leakages from salt pans, by which the generation of acid gases has been lessened, and the effect has been beneficial on the vegetation of the neighbourhood.

A mass of detailed information is given in the separate reports of the inspectors for the various districts which cannot be usefully abstracted. In the separate report for Scotland, the following lists are given to show the extent of the manufactures under the inspection provided by the Alkali Act:—

Number of separate Processes.

Alkali	12
Muriatic acid	3
Copper extraction	2
Sulphuric acid	32
Chemical manure	46
Nitric acid	7
Sulphate, &c. of ammonia	54
Chlorine	8
Salt	14
	178

In these there have been the following quantities of material employed or manufactured during the year 1890:—

		Tons.
Salt decomposed....	Alkali works... 34,985 / Copper works .. 5,946	40,031
Pyrites burned		78,890
Sulphur burned		5,005
Bones and phosphates used in chemical manure works		47,753
Bleaching powder made		8,826
Sulphate of ammonia made	Gas liquor. 10,395 / Slude ..... 24,730 / Iron works 4,564	39,689
Salt manufactured		8,478
Nitric acid made		3,230

—G. H. B.

Inspection of Chemical Works.

In the discussion on the Local Government Board vote, in the House of Commons, on Wednesday, July 15th, Mr. Brunner, M.P. for Northwich, said:—"Then there is another matter which, I think, comes under this vote,—the inspector of alkali works. The law at present is in a very anomalous condition. There are a number of manufactories in the country where the business comes under the designation of alkali works. These works carry on operations on a large scale, and are prevented, under the Act, from the discharge of noxious vapours; but, strange to say, in other works, where they use the products made in the larger manufactories, the Act does not apply. In point of fact there are smaller factories using the products of the larger works, and discharging fumes which do quite as much mischief as those which are evolved from alkali works. Oddly enough, if the inspector can induce the owners of these works to consume these noxious gases instead of turning them out into the air, then the works come under the Act. Those who carry on their work in the most wasteful and harmful fashion are not watched; but as soon as a man ceases doing mischief to his neighbours, then he comes under the watchful eye of the Local Government Board inspector. If the right hon. gentleman (Mr. Ritchie) will consult with the officials of his department, he will, I have no doubt, find that they are entirely at one with me in this matter, and he may be assured an amendment of the law will have the hearty co-operation of the manufacturers who do come under the Act. So far as the sanitary authorities who understand this matter—more especially in London, where the mischief is rife—are concerned, he may rely upon their support too. I hope the right hon. gentleman (Mr. Ritchie) will consider the representation made to him on this subject, and endeavour to put the law into a condition consistent with common sense."

Mr. Ritchie: "I have to say that the matter has been under our consideration, and a Bill to amend the Alkali Acts has been prepared, and I believe it would meet the views of the hon. gentleman; but there has been no opportunity of introducing it this session. I hope the Alkali Acts will be so extended as to embrace the offending factories mentioned by the hon. member, with regard to which I am quite at one with him."

On some Constants of Ammonia. H. von Strombeck. Reprint from J. Franklin Inst. 1890 and 1891.

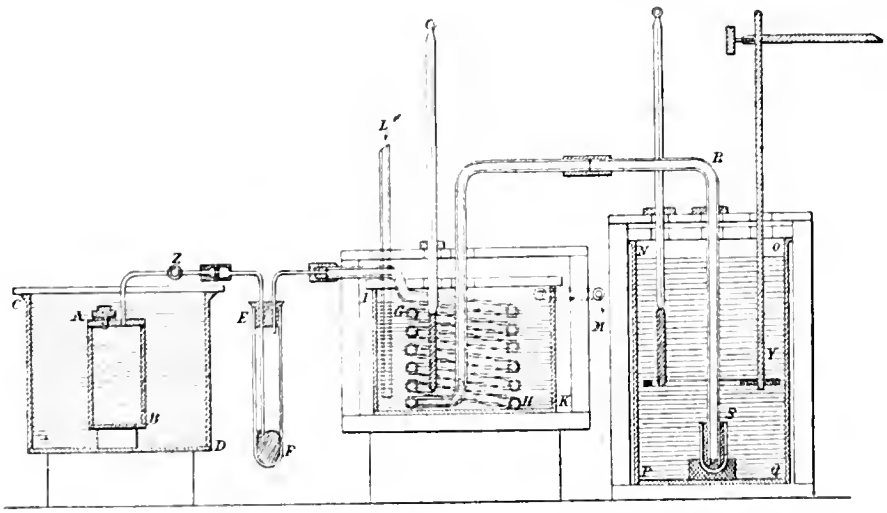
In calculating the dimensions of a refrigerating machine it is necessary to know the exact value of the latent heat of evaporation of the liquid used. When the heat of evaporation of ammonia was first determined, it was found to be about 500 French or 900 English thermal units, and many designers still claim that these figures are correct, although it was afterwards shown that the ammonia used in the determination referred to contained a good deal of water. H. V. Regnault afterwards made tests with ammonia free from moisture, and found the heat of evaporation to be

291·2 French thermal units. This and other constants of ammonia have been redetermined with great care by the author in the laboratory of the De la Vergne Refrigerating Machine Co. with the following results:—

I. The *specific heat* of liquid ammonia was measured by placing about 128 grms. of it in a steel cylinder, which was heated to about 62° C. in vapour of boiling methyl alcohol. This was then introduced into a calorimeter containing about a litre of water. The mean value of the specific heat was found to be 1·22876. To make sure that this surprising result was not due to any experimental error, the author filled the steel cylinder with water, and determined its specific heat. The result came out very close to one, namely, 0·99302.

II. The *total heat* of ammonia was measured by allowing liquid ammonia contained in a small tank to evaporate gradually, the gas escaping slowly through vessels divided into small chambers arranged spirally, the whole being surrounded by water contained in a large calorimeter. In the calculation, the value above obtained for the specific heat was used instead of the value (0·799) which Regnault supposed to be correct. The total heat was found to be 313·7 thermal units (being the sum of 292·4 units = heat of evaporation, and 21·3 units = what the author calls "heat of liquid.")

III. *Heat of Absorption of Ammonia.*—The gas was developed from liquid ammonia contained in the tank A B in the figure. This was placed in the larger tank C D filled



Apparatus for the Determination of the Heat of Absorption of Ammonia.

with water, so as to make the evolution of gas as constant as possible. The gas was passed through the low stratum of mercury contained in the tube E F, and its velocity could further be controlled by the stop-cock Z. By passing slowly through the glass coils G H lying in the tank I K, the gas was brought to a constant temperature before entering the absorption tank N O P Q. The pipe R S dips into a small glass tube filled with mercury, the object of which is to prevent the water from rushing up in this pipe after coming into contact with the ammonia. The heat of absorption per unit was found to be 505·3 thermal units.

IV. *Heat of Combination of Liquid Ammonia with Water.*

For details of this difficult determination, the original paper must be referred to. According to the equivalents of NH_3, H_2O, 17 grms. of the former combine with 18 grms. of the latter to form 35 grms. of $NH_4(OH)$. Thus, from a theoretical point of view, it might be best to take the ammonia and water in the proportion of 17 to 18. But for technical reasons it was found preferable to use a larger amount of water, and in the tests made the proportion of ammonia to water was only 8 to 18. Under these conditions the heat of combination (per unit mass of ammonia) was found to be 498·4 thermal units.—D. E. J.

Condensation of Nitric Acid. O. Guttmann. Zeits. f. angew. Chem. 1891, 238–239.

The results shown in the table (see next page) were obtained with a double battery of the author's nitric acid condensers (this Journal, 1890, 882), kept in almost uninterrupted working for upwards of two months. The acid manufactured had the concentration of monohydrate, and contained 1—2 per cent. of lower oxides, the weaker tower-acid (specific gravity 1·3—1·4) not being collected, but in factories where the latter is of value, nearly the whole of that quantity shown under "loss" can be recovered. The mean loss of 7 per cent. shown in the table is accounted for by the following: (*a.*) The acid retained by the bisulphate: (*b.*) The lower oxides formed; (*c.*) The tower-acid; (*d.*) The portion escaping in the flue. Without the Lunge-Rohrmann tower it is found impossible so to regulate the firing that no portion of acid is uncondensed in the flue; it is seen, however, that in spite of the increased loss of 1·5 per cent. the percentage of lower oxides is only slightly augmented. Rohrmann's earthenware pipes, 8 mm. in thickness, are now used; these are capable of withstanding a higher temperature and facilitate condensation. It has not been found desirable to shorten the time for distilling one charge to less than 11—12 hours, and as a simple control the firing is regulated so that the last pipe remains cold while the one before it is warm. After driving off the lower oxides the acid thus obtained may be used as chemically pure.—A. R. L.

The Preparation and Reactions of Mercury Ammonium Chlorides. G. André. Compt. Rend. **112**, 859—861. (Compare this Journal, 1889, 915, 916; 1890, 647).

A solution prepared by boiling yellow mercuric oxide with a solution of ammonium chloride deposits on cooling a small quantity of crystalline mercuro-diammonium chloride. The mother-liquor from these crystals when treated with an excess of ammonia yields a white curdy precipitate, consisting of a mixture of mercuro-diammonium chloride and mercuriammonium chloride, $HgCl_2.2\,NH_3 + Hg(Cl)NH_2$. Long washing further decomposes this precipitate into a mixture of mercuriammonium chloride and oxy-dimercuriammonium chloride, $NH_2(Hg_2O)Cl$; whilst extremely prolonged washing results in the production of the latter body alone. When the curdy precipitate mentioned above is heated in a sealed tube to 200° C. with an excess of ammonia, the liquid on cooling deposits mercuro-diammonium chloride. This well-known substance may be prepared in several other ways. A solution of yellow mercuric oxide in

Each charge consisted of 12 cwt. of nitrate and 13 cwt. of sulphuric acid. The tower acid was not taken into account; all other acid was collected in the same receiver.	Analysis of Sodium Nitrate.				Analysis of Sulphuric Acid.	Employed Sodium Nitrate.		Employed Sulphuric Acid.	
	H_2O	NaCl	$NaNO_3$	Available $NaNO_3$		Crude.	Available $NaNO_3$	Crude.	H_2SO_4
	Per Cent.	Per Cent	Per Cent.	Per Cent.	Per Cent.	Cwt.	Cwt.	Cwt.	Cwt.
Best result obtained	2·489	0·590	95·670	94·814	94·98	12	11·350	13	12·377
Good average result.....	3·089	0·515	94·838	94·091	96·38	12	11·291	13	12·530
Result obtained without Lunge-Rohrman tower.	2·912	0·538	95·938	95·158	95·70	12	11·419	13	12·441

Each charge consisted of 12 cwt. of nitrate and 13 cwt. of sulphuric acid. The tower acid was not taken into account; all other acid was collected in the same receiver.	Yield. Analysis. Concentrated Acid.	Specific Gravity.	Total Acidity as HNO_3	N_2O_4	Corresponding to HNO_3	Yield of Absolute HNO_3	Theoretical Yield of HNO_3	Loss of HNO_3	
	Cwt.		Per Cent.	Per Cent.	Per Cent.	Per Cent.	Cwt.	Cwt.	Cwt.	Per Cent.
Best result obtained	8·563	1·517	96·52	1·88	1·27	95·25	8·156	8·442	0·256	3·04
Good average result.....	8·206	1·515	95·87	2·11	1·45	94·42	7·748	8·368	0·620	7·40
Result obtained without Lunge-Rohrman tower.	8·054	1·525	95·11	3·77	2·57	92·54	7·453	8·464	1·021	11·95

ammonium chloride is treated in the cold with ammonia until the precipitate first formed just re-dissolves. The solution is allowed to stand for several weeks over quicklime, when it will yield splendid crystals of the diammonium chloride. The salt may also be obtained by adding the mercurial solution to the ammonia; or again, a current of ammonia may be passed into the solution of yellow mercuric oxide. The mother-liquor from the mercuro-diammonium chloride when largely diluted with water yields a white precipitate, which when washed and dried at 100° C. has the composition of oxy-dimercurammonium chloride. Its formation may be represented by the following equations:—

$$2\ NH_4Cl + HgO = HgCl_2\,2\ NH_3 + H_2O$$
$$2\ (HgCl_2\,2\ NH_3) + H_2O = NH_2(Hg_2O)Cl + 3\ NH_4Cl$$
$$NH_4Cl + 2\ HgO = NH_2(Hg_2O)Cl + H_2O$$

When a solution of mercuric chloride is added to a mixture of ammonia and ammonium chloride in the cold a curdy precipitate is formed having the composition $HgCl_2NH_3$. It is also formed by adding the mercuric chloride in excess to the boiling solution of the other reagents. Washed with cold water the curdy precipitate is decomposed thus—

$$2\ HgCl_2NH_3 = NH_2HgCl + NH_4Cl.HgCl_2$$

—H. T. P.

Two New Forms of Sulphur. Engel. Compt. Rend. **112**, 866—868.

The author describes two new modifications of sulphur, one of which is crystalline and the other amorphous. The first variety is prepared by adding two volumes of strong hydrochloric acid cooled to 10° C. to one volume of a saturated solution of sodium thiosulphate. The liquid, which must be rapidly filtered to separate the precipitated salt, gradually turns yellow, and sulphur dioxide is given off. When the colour has become very deep and a precipitate begins to form the liquid is agitated with an equal volume of chloroform. The chloroform solution on evaporation yields crystals of sulphur which differ entirely from octahedral sulphur. They have a density of 2·135 and are orange-yellow in colour. The crystals are at first transparent; but after 3—4 hours, they begin to alter, increase in volume, and pass into the insoluble modification of sulphur. The crystals melt below 100° C., and are converted into a variety of sulphur resembling that obtained from thiosulphates, *i.e.*, it is partially insoluble in carbon disulphide.

When a mixture of hydrochloric acid and sodium thiosulphate is allowed to stand, a precipitate of sulphur separates, which soon becomes flocculent. In this state it is entirely soluble in water. The solution is yellow and rapidly decomposes, ordinary thiosulphate sulphur being precipitated. The change from soluble to insoluble sulphur is not accompanied by any evolution of sulphuretted hydrogen, proving that the above flocculent precipitate does not consist of a polysulphide of hydrogen.—H. T. P.

PATENTS.

Improvements in Treating Pyrites and in Apparatus employed therein. J. Hargreaves, T. Robinson, and J. Hargreaves, Widnes. Eng. Pat. 5681, April 27, 1886. (Second Edition.) 6*d*.

See this Journal, 1889, 368.

Improved Method and Apparatus for Concentrating Sulphuric Acid. C. S. Négrier, Périgueux, France. Eng. Pat. 4171, March 17, 1890. 8*d*.

In the space above a range of burners a chamber is partitioned off, the floor of which is an inclined plane made of iron plates, in which are basin-like depressions. Into these, are set vessels of porcelain or glass, which are filled with the sulphuric acid to be concentrated. The acid flows in a slow stream from one vessel to another, the depressions being arranged so that the lip of one vessel protrudes just over the vessel next below it on the inclined plane. The acid is heated and concentrated by the heat from the burner-gases below the inclined plane. The water and acid vapours rising from the sulphuric acid are drawn off into a leaden receiver, and from there into a second

receiver which unites the products from several systems, and, like the first receiver, is intended for cooling the vapours, which are then carried into the chief lead chamber by means of a carefully regulated injector. (See also this Journal, 1891, 46.)—H. S. P.

Improvements in Apparatus for Producing Carbonic Acid and similar Gas. H. H. Lake, London. From "La Soci'et'e Jph. Jay et Jallifier," Lyon, France. Eng. Pat. 4173, March 21, 1890. 8*d*.

The apparatus described is for making carbonic acid gas by the action of sulphuric acid upon cakes or blocks of sodium bicarbonate, but it is applicable to the generation of other gases when they are obtained by the action of a liquid upon a solid. The arrangement is automatic in its working. It consists of an outer metallic receptacle or casing, which can be closed hermetically at the top by a cap, which is also fitted with a safety valve and a pressure gauge. There is a stopcock in the upper part of the side of the vessel for drawing off the evolved gas. An opening in the bottom of the casing admits the upper end of a metal rod, which passes down through the inside of an india-rubber tube, and at its bottom end rests upon a metallic cap, which closes, and is fixed to the bottom end of the india-rubber tube. The tube is surrounded by a helical wire, which prevents it expanding laterally; and any increase of the pressure of the gas inside the casing thus causes the tube to lengthen. The lengthening or contraction of the tube raises or lowers the rod moving within it. An arrangement attached to the metal cap at the lower end of the tube allows of the attachment of a lever arm upon which is hung a weight, so that the pressure required to lengthen the tube to a given degree may be regulated by adjusting the weight.

Within the casing and resting upon the upper end of the rod, which just protrudes into the bottom of the casing, is placed a glass vessel which holds sulphuric acid diluted to the proper degree, and within this glass vessel, and in its upper part, is suspended a shorter glass or enamelled porcelain vessel which holds the blocks of bicarbonate of soda. The bottom of this inner vessel is perforated. By moving the lever, the rod below the vessel containing sulphuric acid is raised, and the vessel itself is thus raised and the acid enters through the perforations in the bottom of the vessel holding the bicarbonate of soda, and, acting upon this substance, generates carbonic acid, which is drawn off at the stopcock as required. When the stopcock is closed, the pressure of the gas confined within the apparatus lengthens the india-rubber tube, allowing the rod within it to fall, and lowering the vessel holding sulphuric acid so that the acid is no longer in contact with the bicarbonate of soda. On reopening the stopcock, the pressure is relieved and the acid containing vessel again is raised by the contraction of the india rubber tube and the pressure of the lever arm. One of the advantages of the apparatus is that the acid and gas do not come into contact with lead, as is the case with apparatus in which a leaden receptacle is used to hold the acid.—H. S. P.

Improvements in the Manufacture of Nitrate of Ammonium and of Resulting By-product. C. A. Burghardt, Manchester. Eng. Pat. 7442, April 10, 1890. 6*d*.

This patent relates to improvements in the inventor's patent (Eng. Pat. 8841 of 1889, this Journal, 1890, 624), by which he produced ammonium nitrate by the action of a solution of ammonium sulphate upon a solution of lead nitrate, lead sulphate being obtained as a by-product. In the present patent he uses one of the carbonate salts of ammonium instead of ammonium sulphate, and obtains lead carbonate as a by-product, this salt being more valuable in its crude state and more readily converted into valuable lead compounds than lead sulphate. As a modification of the process, he treats the lead nitrate solution with a solution of ammonia, or with gaseous ammonia, which produces a precipitate of white hydrated lead oxide. This precipitate is filtered off and washed, and is very suitable for conversion into chrome yellows. The filtered liquor from the lead hydrate precipitate contains ammonium nitrate and some lead oxide in solution. The dissolved lead is precipitated with a solution of ammonium carbonate, and the precipitate of lead carbonate filtered off. The purified solution of ammonium nitrate is then concentrated and the ammonium nitrate recovered by crystallisation.—H. S. P.

Improvements in connexion with Obtaining Chlorine, and in Utilising Calcium Chloride and other By-products. A. Campbell, Upton Park, and W. Boyd, Glasgow. Eng. Pat. 5571, April 12, 1890. 6*d*.

With the calcium chloride which occurs as a by-product in the various processes for manufacturing chlorine from salt, already patented by the inventors in 1888 and 1889 (this Journal, 1889, 706, 983, 508), and also the calcium chloride obtained as a by-product in any other manufacturing process, as for instance, in the ammonia-soda process, the inventors propose to mix a solution of sodium sulphate, which has been first neutralised with an alkali or alkaline earth, allowed to settle and separated from the precipitated matters. The reaction that takes place is accelerated by heat and results in a precipitate of very pure calcium sulphate and a solution of common salt. The calcium sulphate is then separated, washed, and dried in any suitable way, and the solution of salt is concentrated and used like the original salt for making chlorine.—H. S. P.

A Process and Apparatus for the Manufacture of Ammonia. H. Baudouin and P. Escarpit, Paris, France. Eng. Pat. 7217, May 9, 1890. 8*d*.

Carbon, nascent hydrogen, and sodium nitrate react with each other under certain conditions, with formation of ammonia and sodium carbonate. To obtain such a result the following materials are used: 125 parts of hydrocarbons, with coal to suit requirements, and 100 parts of nitre; the decomposition is best performed in a closed vessel, at a temperature of from 800—900°; the coal used should be perfectly dry.

Another mixture consists of 45 parts of naphthalene and 100 parts of nitre, heated in a retort-shaped apparatus to nascent red heat. "Naphthalene at this temperature decomposes into carbon and hydrogen, which latter acting in its nascent state upon the nitrate is in its turn decomposed." Ammonia and carbonic acid are generated, and ultimately ammonia, ammonium carbonate and sodium carbonate are obtained. The inventors expect to produce from the above quantities: 18 parts of ammonia gas, 175—185 parts of sodium carbonate with 10 equivalents of water, and in the first case also 50 parts of coke and 5—7 of heavy oils.

In carrying out the process the mixed materials are charged by means of a screw-conveyor from a hopper into one end of an inclined cast-iron retort, in which a pitch chain is working. The sodium carbonate and coke are delivered at the opposite end into a receiver; the escaping gases are first passed in a receiver, in which the heavy oils condense, and then washed with milk of lime to retain the carbonic acid contained in the ammonia.—H. A.

Improvements in Apparatus for Use in the Manufacture of Bicarbonate of Soda by the Ammonia-Soda Process. J. Vivian, St. Bees, and G. Bell, Wavertree. Eng. Pat. 7527, May 14, 1890. 8*d*.

The improvement consists mainly in the cooling of the carbonating vessels and connexions by means of brine, which is afterwards introduced in the process.

The apparatus consists of, say, three carbonators, a saturator, a wash-tower, and a brine storage tank, all these parts being arranged vertically, one above the other. Two of the carbonators have conical ends, and are provided with a cylindrical jacket, the upper extension of which forms the sides of the third carbonator, the bottom being formed by the top of the second carbonator. The carbonators are connected by means of pipes, surrounded by brine, for the cooling of the gases, both coolers being attached to the

outer casing of the carbonators. Above the third carbonator, and supported on a suitable framework, is the saturator, which consists of a cylindrical, closed, jacketed vessel, provided with brine-feed and delivery pipes and ammonia gas supply pipes, for both the vessel and the jacket. Above the saturator is a wash-tower with false bottom, and packed with coke; the tower rests on a tray, for collecting and delivering the brine which is fed in from a tank on top of the apparatus.

The carbonators are first charged with ammoniated brine from the saturator. Carbonic acid enters through a valve on the bottom of the lowest carbonator; on leaving this it passes through a cooler in the second, from this through another cooler in the third carbonator; the escaping gases are absorbed in the wash-tower by means of brine, and the inert gases allowed to escape.

The brine is forced in the annular space surrounding the bottom and second carbonator, enters from here the first cooler, ascends the second cooler, and is delivered from here in the brine tank on the top of the tower. The brine is then distributed over the coke in the scrubber, and while descending absorbs the ammonia escaping from the carbonators; it is then delivered in the inner and outer casing of the saturator, where it is treated with ammonia and afterwards charged in the carbonators.

In working the plant, the ammoniated brine is charged in the third carbonator; from here it is run, after a suitable interval, in the second; and after a further interval in the first, where it is completely converted into sodium bicarbonate. The charge is then blown out on a filter through the carbonic acid valve, which for the purpose is provided with a second perforation.—H. A.

A Phosphated Preparation of Common Salt. G. D. Bowie, Guernsey. Eng. Pat. 11,196, July 18, 1890. 4*d*.

Potassium, sodium, and calcium phosphates in nearly equal proportions are well mixed and finely ground. Common salt is then well ground and incorporated with 3 per cent. of the phosphate mixture to form a prepared table salt.

—G. H. B.

Improvements in the Manufacture of Alkaline Carbonates and By-products, and in Arrangement of Plant therefor. A. G. Haddock, Halewood, and J. Leith, St. Helens. Eng. Pat. 11,296, July 19, 1890. 8*d*.

According to this invention strong solutions of salt-cake and calcium sulphydrate are mixed to form sodium sulphydrate and gypsum, the clear solution of the former concentrated and treated with carbonic acid, for conversion into sodium bicarbonate. The sulphuretted hydrogen given off is passed into alkali waste or milk of lime for the preparation of fresh quantities of calcium sulphydrate, and the remainder used for other purposes.

The salt-cake is dissolved in the wash-waters obtained in the process, to which are preferably added the bicarbonate mother-liquors, whereby any free acid in the salt-cake is neutralised, and iron, lime, and magnesia precipitated. The solution passes through a series of settling tanks into a mixer, where it meets a similarly well settled solution of calcium sulphydrate; the resulting mass is run out on the bottom on the "pearl hardening filters," which retain the precipitated gypsum, whilst the filtered liquor is drawn into vacuum pans. These deliver the liquor into a mixer, to precipitate the dissolved gypsum with some bicarbonate mother-liquor, and the filtered liquor is further concentrated in vacuum pans until it contains 26·2 per cent. of sodium sulphydrate, equivalent to 14·5 per cent. of alkali (Na_2O). This solution is pumped into a series of carbonators and subjected to treatment with carbonic acid (free from oxygen), until the alkalinity of the solution decreases to 3·4 per cent. of Na_2O or less. Sulphuretted hydrogen is given off, part of which will have to be passed into a series of carbonators, for the preparation of calcium sulphydrate, whilst the bicarbonate is run on filters, dried for sale, or finished in a closed furnace to soda ash. The carbonic acid here evolved may be pumped back into the carbonators. The bicarbonate mother-liquor may be boiled down and treated again with carbonic acid for the separation of more bicarbonate, and the remaining mother-liquor used for dissolving fresh quantities of salt-cake.—H. A.

Improvements in Evaporating Apparatus Specially adapted for the Extraction of Salt from Brine. A. Chapman and S. Vickers, jun., Liverpool. Eng. Pat. 11,529, July 23, 1890. 8*d*.

This apparatus is constructed on the multiple-effect system and is here described as arranged for a quadruple effect. Each pan is fitted with a steam drum as usual, and between the plates forming the top and bottom of the drum is a number of small tubes for the upward flow of the brine, while a large tube, preferably central, is used for the down-flow and is carried some distance below the drum or bottom tube plate. The bottom of each pan is in the form of an inverted cone, having an outlet communicating with a salt receiver below, each of which has a hinged valve door at the bottom. Immediately under each receiver, but not connected with it, is a filter containing gravel, coke, &c., to a depth of 9—12 in., in which is laid a perforated pipe connected with an exhausting pump. These filters may if desired, contain an ordinary salt mould, so that the salt may be drained and moulded at the same time. The last pan of the series is connected with a heater, a condenser, and a vacuum engine. The exhaust steam is conducted to the drum of the first pan as usual, the vapour evolved from the brine going to the drum of the second pan, and so on. The water due to condensation of steam or vapour in each drum, except the last, is conducted to the next pan, preferably by a syphon arrangement of the kind described in Eng. Pat. 2511 of 1888 (A. Chapman) (this Journal, 1889, 128). The feeding arrangement of the brine and other details are fully explained in the specification.—E. S.

Improvements in the Conversion of Hard-Burnt into Soft-Burnt Magnesia. F. M. Lyte, London, and J. G. Tatters, Runcorn. Eng. Pat. 11,545, July 23, 1890. 6*d*.

By dissolving hard-burnt magnesia in strong aqueous hydrochloric acid and evaporating to dryness, a mixture of, say, 9—10 parts of magnesia and one of magnesium chloride will be formed, and weak hydrochloric acid given off. The mass is then broken up and subjected to a dull red heat, preferably in a current of steam; soft-burnt magnesia will thus be formed, which is suitable for decomposing double ammonium-magnesium-chloride (this Journal, 1890, 1128—1129).

The magnesium chloride present may be eliminated, if necessary, by boiling the soft-burnt mass with water and calcining the residue at a dull red heat.

A modification of the process consists in adding sufficient soft-burnt magnesia to the concentrated acid solution of hard-burnt magnesia, to cause it to "solidify into an oxychloride," which is decomposed as above. The hydrochloric acid gas is condensed, and those fractions which are sufficiently strong used over again for dissolving fresh quantities of hard-burnt magnesia.—H. A.

An Improved Process for Producing Sulphate of Calcium. T. Elliott, Bristol. Eng. Pat. 11,638, July 25, 1890. 4*d*.

Liquids containing calcium chloride in solution, such as certain waste liquors from alkali manufactures, are treated with dilute sulphuric acid, whereby calcium sulphate is precipitated and recovered by draining off the solution.

—G. H. B.

Improvements in the Method of and Apparatus for obtaining Chemical Products by Utilising Fluoride of Silicon. H. B. Yardley, Leytonstone. Eng. Pat. 12,717, August 14, 1890. 8*d*.

The apparatus consists of a lixiviating tank with perforated false bottom, emptying into a series of superimposed funnel-shaped vessels furnished with taps for controlling the flow

of the solutions used. The upper vessel is covered in and arranged for passing gases containing fluoride of silicon through the solution. A salt, such as sodium sulphate, is placed on the perforated tray and covered with water, and the solution is then run into the first vessel for treatment with fluoride of silicon. The products of the reaction are fluosilicate of soda and gelatinous silica, which is washed with water in the series of vessels, the washings being used for preparing fresh solution for treatment. The fluosilicate solution is utilised in any of the usual ways. The precipitated silica also contains fluosilicate, and may be dried and furnaced with lime for the production of soda.

—G. H. B.

Process and Apparatus for the Simultaneous Manufacture of Phosphorus and of Alkaline Silicates by the Treatment of the Mineral Phosphates of Lime, Alumina, or Bone Ash. L. M. C. Fohe-Desjardins, Toulouse, France. Eng. Pat. 13,240, August 22, 1890. 11*d*.

This process consists in heating a mixture of bone ash or a mineral phosphate of lime or alumina, with an alkaline carbonate or sulphate in a reverberatory furnace or in retorts, silica being added to the mixture when phosphate of alumina is used. The calcined mass is then lixiviated to dissolve out the tribasic phosphate of soda, the solutions evaporated to dryness, and the residue pulverised. The powdered tribasic phosphate is then mixed with silica and carbon and heated in retorts. The reaction results in sodium silicate, carbonic oxide, and phosphorus, and the latter substance is distilled over and collected in a condenser. The specification describes the means to be adopted for recovering the alkali from residues of silico-aluminate of soda that are formed, and drawings of a suitable apparatus for carrying out the process are given.—H. S. P.

New Process for Manufacturing Alkaline or Alkaline-earth Cyanides through Atmospheric Nitrogen, and the Application of the same to the Production of Ammonia. E. Haddan, London. From Viscount de Lambilly, Paris, France. Eng. Pat. 16,049, October 9, 1890. 6*d*.

This method consists in the decomposition of illuminating gas in an atmosphere of nitrogen and in the presence of a mixture of charcoal and alkali.

The nitrogen is prepared by passing air over copper at a red heat, and collecting the nitrogen, thus freed from oxygen, in a gasometer. The copper oxide thus produced is afterwards used for removing the hydrogen from illuminating gas, by passing the gas over the oxide heated to a red heat, and in this way the copper is recovered for using again to remove oxygen from the air. Equal volumes of nitrogen and illuminating gas freed from hydrogen, are then passed over an intimate mixture of powdered charcoal and alkali. The alkali is preferably an oxide or a carbonate of potassium, sodium, barium, or a mixture of these. The mixture of charcoal and alkali is heated in retorts to a high temperature, but a temperature not as high as a white heat. The first result of heating the mixture is to cause an evolution of a considerable quantity of carbon monoxide, and the evolution of this gas prevents the intimate contact of the nitrogen with the "cyanogenable substance." The inventor finds it advisable, therefore, before passing the mixture of nitrogen and illuminating gas into the retorts, to draw off the carbon monoxide, and this gas is used as a fuel for the heating furnace. After the evolution of carbon monoxide has subsided, the nitrogen and illuminating gas are sent into the retorts, and by regulating the speed of outflow these gases are kept at a light pressure in the retorts, which brings them into closer contact with the alkali and facilitates the formation of cyanide. The gases that are then given off, principally consisting of hydrogen and some carbon monoxide, are also used as fuel. Small iron shots may be introduced advantageously among the alkali and charcoal, which, becoming rapidly heated, accelerate the formation of cyanide; and further, it is found that a certain quantity of lime in the retorts is useful as it helps to maintain the porosity of the mixture and assists the dissociation of alkaline carbonates.

The decomposition of the cyanide formed is effected by distilling the product from the retorts with water. The cyanide is first wetted with water and, after the lapse of 24 to 48 hours, heat is applied and the ammonia distilled off. The reaction is represented by the equation—

$$KCN + 2\,H_2O = CHKO_2 + NH_3.$$

The residue, after the distillation, is dried, and, after a suitable addition of charcoal, may be again used in the cyanurating retorts.—H. S. P.

Improvements in the Manufacture or Production of Chlorine and Caustic Soda, and in Apparatus therefor. J. Greenwood, London. Eng. Pat. 18,990, November 22, 1890. 8*d*.

The process refers to the manufacture of caustic soda and chlorine by electrolysing a solution of salt. The walls of the electrolysing vessel are made of iron or carbon, in which latter case an outer jacket of electrolytically deposited copper is provided; this vessel forms the cathode. A metal cylinder, coated with carbon, is placed in the centre of the vessel, forming the anode. At a suitable distance between the two poles there is a porous diaphragm, consisting of a number of V-shaped troughs of porcelain or glass, which are built up inside each other, the intermediate space being filled up with asbestos fibre or powdered steatite. It is said that this diaphragm offers less resistance than the usual porous partition and that it prevents the diffusion of the chlorine evolved in the anode section into the caustic soda formed in the cathode section. The vessels may be arranged in series. The brine is supplied from separate tanks to the anode and the cathode of the first vessel, and gravitating along the entire series through the respective sections of the cells, it flows into separate catch-vessels, from whence it is delivered back into the respective tanks; the circulation is maintained till the solutions are sufficiently decomposed. Each electrolysing vessel is sealed with a porcelain cover, provided with a chlorine outlet pipe.

The description is given of another combination, in which a containing vessel of an oblong form is divided by parallel plates (representing the poles) and diaphragms into anode and cathode sections, through which the respective liquors circulate. In this case the cathodes are not coated with carbon.—H. A.

Improvements in Packages for the Packing or Putting-up of Chloride of Lime, Carbonate of Ammonia, and other Volatile and Deliquescent Substances. T. Needham, Huddersfield. Eng. Pat. 19,121, November 25, 1890. 4*d*.

The packages are made of thin wood, cardboard, brown paper, or other paper, and are of any suitable shape. After shaping, the package is dipped into boiled linseed oil, which permeates and closes the interstices of the material.

—H. S. P.

An Improved Process and Apparatus for obtaining Silicates for Making Glass and the Production of Hydrochloric Acid. W. Walker, London. Eng. Pat. 2019, February 4, 1891. 8*d*.

See under VIII., *page* 643.

Improvements in or relating to the Manufacture or Production of Caustic Soda. J. Greenwood, London. Eng. Pat. 2134, February 5, 1891. 4*d*.

The caustic soda solution obtained by means of electrolysis as described in Eng. Pat. 18,990, of 1890 (see above), is contaminated with a certain amount of undecomposed salt. It is proposed to eliminate this by concentrating the liquid and fishing out the salt. The solution may be further concentrated till it solidifies on cooling, and is then packed in the usual manner.—H. A.

Improvements in the Treatment of Alkali Waste for the Production of Sulphuretted Hydrogen. R. H. Davidson and R. H. Davis, Widnes. Eng. Pat. 8901, June 9, 1891. 4*d*.

The inventors find that the presence of soluble and insoluble soda in alkali waste is detrimental to the working of the Chance sulphur-recovery process, as the sulphuretted hydrogen given off from such waste is not of a regular strength and the elimination of the last traces of sulphides is not easily accomplished. These difficulties are due to the formation of sodium sulphydrate, which is not as easily decomposed by carbonic acid as calcium sulphydrate. It is proposed to add calcium chloride to the milk of waste, and thus to convert the soda compounds into sodium chloride, with formation of calcium carbonate.—H. A.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

PATENTS.

Improved Means and Appliances for Manufacturing Glass Tubing and for Coupling together such Tubing. D. Rylands, Stairfoot. Eng. Pat. 10,348, July 4, 1890. 8*d*.

The invention consists of certain improvements for making and coupling glass tubes so as to form safe and water-tight joints. The tubes may by use of suitable moulds be formed with flanged ends and a screw thread. To join two such tubes a metal union is cut into halves, passed over the screwed end of one tube, and then the two halves are clamped or screwed so that it can be screwed on the threaded end of another glass tube.—V. C.

Improvements in the Manufacture of Glass Tubing. D. Rylands, Shepcote, and A. Husselbee, Stairfoot. Eng. Pat. 11,651, July 25, 1890. 8*d*.

By this invention screw threads are formed on glass tubes so that two pipes furnished with these threads can be joined together by a metal socket or coupling having a screw thread formed on it. By somewhat similar arrangements to those employed in the above, a glass tube can be formed to a polygonal or fluted shape, thereby giving increased strength. To form a screw thread the end of the tube is re-heated in the furnace and the heated end introduced into a mould having a screw thread cut on the inside. Air is then forced down the tube so as to drive the glass into the threads of the mould. The mould carries at one end a box, so that a sort of "burst off" is formed at the end of the thread, which is subsequently removed. The moulds are generally made to open at the sides. The improved mould is an essential part of this invention.—V. C.

An Improved Process and Apparatus for obtaining Silicates for Making Glass and the Production of Hydrochloric Acid. W. Walker, London. Eng. Pat. 2019, February 4, 1891. 8*d*.

The advantages of this process are (*a*), that best quality plate glass can be made from impure sand; (*b*), that a new use is found for waste calcium chloride; and (*c*), that the chlorine of the calcium chloride is recovered in the form of hydrochloric acid, which can be condensed and used for making bleaching powder. The process depends on the mutual decomposition (at a temperature somewhat below that at which common salt volatilises) of calcium and sodium chlorides, steam, and silica (sand). The sand is first finely pulverised (preferably wet), washed with hydrochloric acid, dried, and then 60 parts are mixed in a crucible with 36 parts of chloride of calcium and 32 parts of common salt. The crucible is placed in a circular gas-fired regenerative furnace (the improved construction of which is a part of the invention), and when the temperature has been raised nearly to the point at which common salt volatilises, superheated steam is passed in through a pipe which first coils several times round the outside of the crucible (the steam being thus superheated), and finally passed nearly to the bottom of the crucible, the steam issuing from a number of perforations in the side of the tube. The operation is continued till no more hydrochloric acid is formed. The pure silicates of soda and lime which remain are mixed with plate glass cullet and are subsequently treated as in the ordinary process of plate glass manufacture.—V. C.

Improvements in the Methods and Appliances for Drying Moist Material, for instance newly-formed Bricks, Pipes, Flags, and such like, by Means of Artificial Heat. G. Weigelin, Stuttgart, Germany. Eng. Pat. 6797, April 20, 1891. 8*d*.

The patent relates to the drying of bricks pottery, and similar materials quickly but without risk of fracture.

The drying chambers are placed on each side of a passage common to the set, with which communicate the furnaces by which the chambers are heated. The chambers are worked systematically, the air that is used for cooling one of a set passing into another chamber and thence to the furnace of a third, the heat from which is utilised for a fourth. Although the system is described with sets of four chambers, any other number suited to the work in hand may be used. The circulation of the products of combustion through the goods to be dried is arranged so as to avoid the mixture of large volumes of air with the hot gases, which would lead to waste of fuel.

It is claimed that the utilisation of the fuel is so complete with this apparatus that the artificial drying of goods such as bricks, generally dried with difficulty in the open air, can be effected economically.—B. B.

An Improved Alloy for Hermetically Closing Glass Tubes and other Purposes. F. Walter, Vienna Austria. Eng. Pat. 7159, April 25, 1891. 4*d*.

See under X., *page* 646.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

Asbestos Discovery in Victoria. Adelaide Advertiser, May 15, 1891.

See under V., *page* 634.

PATENTS.

Improvements in Concrete to be used in the Construction of Vaults, Roofs, Arches, Floors, and the Like. F. Sang, London. Eng. Pat. 8108, May 23, 1890. 4*d*.

Tufa sand, which is found as small pellets or granules in the Rhenish provinces, is mixed dry or wet with Portland or other cement, and the concrete formed moulded into any desired shape. A mixture of equal parts is said to be as strong as granite and less than half its weight, but for many purposes a mixture of 1 part of cement to 3—5 of Tufa sand, suffices.

Besides being applicable for ordinary building purposes, the patented material is said to be a good non-conductor of heat, and therefore to be fit for forming the roofs of bakers' ovens and similar uses.—B. B.

Improvements in the Manufacture of Cement and in the Treatment of Articles cast therefrom. O. Prinz, Schwarzenberg, Germany. Eng. Pat. 8519, June 2, 1890. 6*d*.

The inventor claims "the employment of gelatinous substances, such as albumen of white of egg, gum, dextrine, starch, vegetable mucus, agar agar, gelatinous silica, hydrate of alumina, hydrated oxide of iron, and generally all oxides that are voluminous and gelatinous, as an addition to chloride of magnesium solution for the purpose of the production of non-separating and non-swelling sorel cement" (sic), a compound of magnesium oxide with magnesium chloride and water); also, "the treatment of sorel cement articles alternately with carbonic acid and with water for the purpose of suppressing the sweating of the cement." E. G. C.

Improvements in Apparatus for Use in the Manufacture of Cement, and Improvements connected with the said Manufacture. D. Wilson, Chewer. Eng. Pat. 8919, June 9, 1890. 8*d*.

In the revolving cylinder lined with refractory material, through which the flame and dried and pulverised slurry, &c., are caused to pass, the displacement of the lining blocks is avoided by the inventor's plan of securing the blocks to one of them by suitable projections inside the cylinder. For the details the specification must be referred to.

— E. G. C.

A New or Improved Counting Material. V. L. Daguzan, St. Medard, France. Eng. Pat. 8993, June 10, 1890. 6*d*.

This material is called by the inventor pyro cement, and is "a blackish product, which adheres strongly to iron, wood, stone, &c." The following constituents and proportions yield a useful result: "18 to 25 per cent. of gas petroleum or other resinous matters, 75 to 80 per cent. of clay or argillaceous earth and silica, 7 to 8 per cent. of natural sulphates." E. G. C.

An Improved Artificial Marble. H. Rauck, Frankenstein, Germany. Eng. Pat. 5300, March 25, 1891. 6*d*.

This composition ("macmolit") contains 2 parts of magnesia, 2 parts of lime and quicklime, 1 part of carbonic acid, ½ part of silicic acid, ½ part of argillaceous earth, and 1 part of magnesium chloride. E. G. C.

X.—METALLURGY.

Aluminium. Iron and Min. Journ. 1891, 280.

A. E. Hunt stated in a lecture before the Boston Society of Arts, that the extravagant claims made concerning the production and properties of aluminium had constituted the chief difficulty in its introduction and extended use. The pure metal is soft and weaker than the commercial variety containing 3–4 per cent. of impurity. The tendency of aluminium to become coated with a thin film of oxide on exposure to air gives it a dull appearance and makes it unsuited for table ware. It loses its tensile strength and much of its rigidity at 600°–700° F., becomes pasty at 1,000° F., and melts at 1,300° F. It does not roll or cast well, and its conductivity for heat and electricity is only about half that of copper, its tensile strength is not greater than that of common cast iron, and only about one third that of structural steel, while its strength in compression is only about one-sixth that of cast iron. A bar of aluminium 1 in. square and 4 ft. 6 in. between its supports deflects 2 in. with a load of 250 lb., while a similar bar of cast iron requires double the load to give an equal deflection. The modulus of elasticity of cast aluminium is about 11,000,000, being only about one-half that of cast iron and one-third that of steel. Its presence in iron is stated to be deleterious, and it is said not to lower the melting point of steel, statements to the contrary notwithstanding. The theoretical cost of 1 lb. of aluminium as made by the Pittsburg Company is 20 cents per lb., the items being: 2 lb. of alumina, 6 cents; 1 lb. of carbon electrode, 2 cents; chemicals, carbon dust, and pots, 1 cent; 22 electrical horse-power for one hour (water power being used), 5 cents; labour and superintendence, 3 cents; general expense, interest, and repairs, 2 cents (this amounts to only 19 cents).

Although the value of aluminium has been much overrated, both it and its alloys have many useful qualities. The difficulty of soldering it is alleged to have been overcome by the use of a special flux (nature not stated). Hard or soft solder, zinc or an alloy of zinc and aluminium are the solders used. The difficulty caused by the softness of aluminium is also said to have been overcome by alloying it "with a few per cent. of hardening metal," or hammering or drop forging.—B. B.

Note on a Volatile Compound of Iron and Carbonic Oxide. L. Mond and F. Quincke. Proc. Chem. Soc. 1891, **100**, 117–118.

Experiments were described by the authors, which lead them to the conclusion that iron forms a volatile compound with carbonic oxide of the formula $Fe(CO)_4$, corresponding with the nickel compound already prepared and described by them in conjunction with Langer (this Journal, 1890, 808 and 809). Very finely divided iron—obtained by the reduction with hydrogen of oxalate of iron at a temperature very little over 100°, and allowing it to cool to 80° in hydrogen—when heated in an atmosphere of carbonic oxide yielded a gas burning with a yellow flame. On passing the gas through a heated tube a mirror of iron was formed at between 200° and 350°, whilst at high temperatures black flakes of iron and carbon were deposited. After six weeks' treatment of 12 grms. of the metal, only about 2 grms. of iron were volatilised, and then it was found necessary every five or six hours to interrupt the operation and to re-heat the iron to 100° in hydrogen during about 20 minutes. When passing carbonic oxide at the rate of about 2½ litres per hour, not more than 0·01 grm. of iron was volatilised, corresponding to less than 2 cc. of the compound $Fe(CO)_4$ in a litre of gas. An analysis of the compound has been made by passing the mixture of gases into mineral oil boiling between 250° and 300°, and heating the solution so obtained to 180°. Iron free from carbon is then deposited and carbonic oxide gas is evolved. The five analyses recorded indicate a ratio of Fe:CO varying only from 1 : 4·03 to 1 : 4·264.

In the discussion which followed H. E. Armstrong considered that the results given afforded an explanation of the permeability of iron by carbonic oxide at high temperatures as well as of the production of steel by the cementation process. Just, the speaker imagined, as platinum was permeable by hydrogen and silver by oxygen at high temperatures, so iron was permeable by carbonic oxide, and in each case it might be supposed, because a dissociable volatile compound of the metal with the respective gas was formed.

T. E. Thorpe also referred to the light shed by the experiments quoted upon the manner of producing steel by cementation, and pointed out that in conjunction with Hills, in studying the interaction of nitrogen peroxide and carbonic oxide under the influence of finely-divided platinum, he had observed that platinum caused the separation of carbon from carbonic oxide.

L. Mond said that though aware of the possibility of considering their discovery applicable in the directions indicated, seeing, however, that the compound was only formed at low temperatures, and was unstable, as shown, at a temperature below 180°, they had refrained from discussing such matters.

PATENTS.

Improvements in and Apparatus for the Separation of Gold and Silver from Ores or Materials containing them. W. D. Bohm, Acton. Eng. Pat. 3246, February 28, 1890. 8*d*.

The powdered ore or material containing gold or silver is placed in a vessel or vat provided with a perforated false bottom covered with coarse canvas, upon which the pulverised ore is placed, and below which a coil of pipe admits the leaching solution. The leaching solution, previously heated, is forced through the ore by a pump, and then through a filter at the top. The solution is then passed into a second vessel, in which it is treated with the precipitating agent. From this vessel the solution is forced up by a pump through a vessel having a filtering arrangement, such as a porous diaphragm, at the top, so that the solid matter is thereby retained, the liquid passing off to be heated again and to be strengthened by the addition of the necessary further quantity of leaching chemicals, and passed back to the leaching vat for use again.

The pressure under which the liquids are forced up through the leaching vat and precipitant vessel should be at least 18 lb. per square inch. At intervals the solid matter retained by the last-named filtering vessel is passed into a filter press or equivalent apparatus, whereby it is deprived of the greater part of its moisture. The ore which has been leached is then drained of all solution and washed free from the last traces with water, and can then be washed out of the vat with acidulated water and passed over zinc or alloy of zinc with other suitable metal, so that hydrogen is evolved, which reduces any precious metal still remaining in the ore to the metallic state, or to such a state that it is taken up when the ore is passed over mercury. Two leaching vats are, preferably, arranged side by side, so as to be washed alternately.—J. B. C.

An Improved Process of Manufacturing Iron and Steel. A. Turner, Greenock; A. Baird and M. B. Baird, Glasgow. Eng. Pat. 5545, April 12, 1890. 4*d*.

The inventors propose to manufacture various grades of iron and steel by mixing ordinary pig iron with the requisite quantity of pure iron obtained by the reduction of a pure ore by means of an electric current. The mixing may be effected either in the furnace or in a ladle, &c.

—S. B. A. A.

Improvements in the Manufacture of Iron and Steel. J. H. Lancaster, New York, U.S.A., and M. R. Conley, Brooklyn, U.S.A. Eng. Pat. 6645, April 30, 1890. 1*s*. 3*d*.

This is essentially a direct reduction process in which the ore is reduced to a metallic sponge in a closed vessel by means of hydrocarbon gas, and subsequently smelted in the open-hearth furnace. The reduction vessel is a horizontal retort of suitable materials, supported within a furnace and communicating at the rear with an auxiliary chamber the bottom of which contains openings terminating in a passage-way leading to an open-hearth furnace.

The well-crushed and purified ore is charged from above into the retort previously heated to 1,500° F., treated with hydrocarbon gas and stirred at intervals (for about 3 or 4 hours) until the flame at the mouth of the gas outlet pipe subsides; the ore is then discharged through a door in the back of the retort into the auxiliary chamber where it is allowed to remain for a time with occasional stirring to facilitate its agglomeration into balls, and then either removed through the openings in the floor to trucks running in the passage below, or directly transferred to the open-hearth furnace by means of a grappling shovel.

A modification is described in which there is no auxiliary chamber, but the ore is treated in the retort with constant agitation rather longer (3 to 6 hours), and the sponge is withdrawn through a partially covered opening in the front of the retort into a closed vessel. Granulated charcoal or coke may also be used as the reducing agent. Twenty-three claims are made for the mechanical details, which are illustrated in five sheets of drawings attached to the specification.—S. B. A. A.

Improvements in Converting Iron into Steel or the Steelifying of Wrought Iron Objects in a Manufactured or Partly Manufactured State. W. Hodge, Yatton. Eng. Pat. 7253, May 9, 1890. 6*d*.

This process is a modification of the ordinary method of cementation and differs from it in the substitution of carbonised or partially charred spent tan for the charcoal generally used. It is claimed that the resulting steel is not blistered and that the grain of the iron bars is not deleteriously affected so that the reheating or remelting is unnecessary. Articles of wrought iron may also be case-hardened by this process.—S. B. A. A.

Improvements in the Manufacture of Iron and Steel. J. von Langer, Leeds. Eng. Pat. 8159, June 6, 1890. 8*d*.

The inventor proposes to reduce rich iron ores by injecting reducing gases bearing finely divided carbon into a bath of molten ore and flux in a basic lined open-hearth furnace.

A mixture of ore and charcoal finely crushed and mixed with a corresponding quantity of quicklime is introduced on one of the hearths of preferably a Pietzka's reversible duplex furnace (Eng. Pat. 6399 of 1889) heated to a high temperature, and a mixture of water, gas, and finely powdered charcoal or other form of carbon injected at a high pressure. The charcoal originally added to the ore reduces a portion of the iron which subsides in a highly carburised condition, and subsequently, when the temperature is raised, reduces a further proportion of the iron in the ore at the expense of its carbon; the gas and finely divided carbon reduces a further portion and recarburises the remainder of the iron, on again raising the temperature the carburised iron and ore again react. The slag must be kept basic if necessary by the addition of lime. Pig iron may also be added to the bath, but not more than 20 per cent. of the weight of the ore should be used. The waste gases are used for heating the furnace.—S. B. A. A.

A New Process for Recovering Tin from Tin-Plate in which Zinc-White is produced as a Product. A. McDougall, Southport. Eng. Pat. 10,783, July 11, 1890. 6*d*.

According to this specification tin plate is stripped by treating it with a saturated solution of litharge in caustic soda, metallic lead being precipitated and tin passing into solution. The treatment is continued until the solution is free from lead, and the tin is then precipitated in the pure state by means of scrap zinc or galvanised iron scrap. The zinc is recovered from the liquors by passing a stream of carbonic anhydride through them or by adding a soluble bicarbonate, zinc-white being formed.—S. B. A. A.

Improvements in Machinery or Apparatus for Coating Metal Plates or Sheets with Tin, Lead, or other Metals or Alloys. P. Rogers, Swansea, and J. Player, Clydach. Eng. Pat. 11,606, July 24, 1890. 8*d*.

These improvements are in the construction and arrangement of the apparatus described in Eng. Pat. 15,040 of 1886. A machine of this kind comprises a pot for the molten tin or alloy; a flux-box; a grease-box containing several pairs of finishing rolls; a cradle for directing the plates; a spring clip which receives the plates to be coated one at a time through the flux-box, carries them down into the molten metal and delivers them through a guide-box and a grease-box into the finishing rolls; a pick-up apparatus provided with mechanical fingers and adapted to automatically remove the finished plates one at a

time, and deposit them on a rack or other suitable receptacle; and mechanism for operating the several parts. The improvements described include a new form of guide, a modification of the cradle to adapt it for use in manufacturing to the plates, an improved clip for working small plates, a modified form of pick-up apparatus, and lastly a new circular rack for receiving the finished plates. For the mechanical details of these variations the specification must be consulted.—S. B. A. A.

Improvement in Aluminium Alloy and in the Manufacture thereof. J. Johnson, Liverpool. From J. W. Langley, Edgewoodville, U.S.A. Eng. Pat. 18,508, November 17, 1890. 6*d*.

The author finds that if pure aluminium be alloyed with between one half per cent. and 10 per cent. of titanium the product is harder than aluminium, nearly as incorrodible, and capable of acquiring by hammering or rolling a degree of elasticity and hardness much superior to pure aluminium. These alloys are fusible below the melting point of steel, the temperature required depending upon the percentage of titanium. When the proportion of titanium is less than 2 per cent. the alloy is nearly as malleable as pure aluminium. The presence of iron and silicon in this alloy are injurious, tending to render it brittle and non-malleable, but a small proportion of chromium is of substantial benefit in increasing the elasticity of the product. The alloy is prepared by the action of metallic aluminium on titanic oxide; the method used is also claimed for the preparation of alloys of aluminium with any more electro negative metal and is as follows:—

A bath of preferably pure fluoride of aluminium and sodium is prepared in a carbon crucible, the oxide or other salt of titanium added, well mixed and allowed to dissolve; when the mass is thoroughly incorporated and quite fluid, metallic aluminium is charged in, the relative proportions of aluminium and oxide or salt being such that the percentage of oxide shall be about twice the percentage of metal required in the alloy. The temperature of the bath rapidly rises on the introduction of the aluminium, and as soon as this ceases, the reaction is completed and the mass is teemed into a suitable vessel, allowed to cool somewhat, and the fluid slag run off from the metal. The latter is remelted before use.

The proportion of fluoride used is from one to four times the weight of the aluminium; fluoride of sodium, fluoride of aluminium, sodium and calcium or generally a fluoride of any metal or metals more electro positive than aluminium, may be used for the bath but cryolite is disadvantageous on account of the iron it contains.

The process must not be conducted in a siliceous crucible, a portion of the silicon being reduced and entering the alloy. Chromium may be introduced as oxide into the fluoride bath, or an alloy of chromium and aluminium may be mixed with the manufactured titanium alloy.—S. B. A. A.

Improvements in the Reduction of Iron Ores. J. Johnson, Pittsburg, U.S.A. Eng. Pat. 19,164, November 25, 1890. 6*d*.

This is a direct reduction process, and is alleged to be applicable to ores containing a high percentage of sulphur and phosphorus. The ore is crushed to the size of nuts, charged on to the hot hearth of a preferably cinder-bottomed reverberatory furnace, and subjected to the action of a strong reducing flame for some time. From 20 to 40 per cent. of finely pulverised coke or charcoal is now shovelled on to the ore, the whole mass well rabbled, covered with a light coating of pulverised carbon, and the heat raised until the iron becomes pasty. It is then balled and removed from the furnace. An addition of iron or steel scale may be made before introducing the carbon, and manganese, or the manganiferous slag from open hearth furnaces, may be added when highly carburised iron is required.—S. B. A. A.

A New Method of Untinning the Waste of Tin-Plates by Heating it with Fused Nitrate of Potash or Soda. H. C. W. Harmsen, Hamburg, Germany. Eng. Pat. 21,129, December 27, 1890. 4*d*.

According to this invention, scrap or waste tin-plate is stripped by heating it with molten saltpetre or sodium nitrate at a temperature not exceeding 400° C., the products of the reaction being insoluble oxide of tin and sodium nitrite. The operation is conducted in a large hemispherical vessel, in which about a ton of potassium or sodium nitrate is melted and kept as nearly as possible at a temperature of 400° C. An iron cage containing the waste tin is then lowered into the vessel, moved about in the molten mass for some time, then lifted out, and its contents discharged into a capacious drum or cylinder containing water and capable of revolving round an axis. When the whole of the saltpetre is converted into nitrite, the contents of the melting vessel are also thrown into the cylinder, the whole raised to the boiling temperature by injecting steam and slowly rotated. By this means the oxide of tin is completely detached from the iron, which is, however, again washed before being rejected. The nitrite of potassium or sodium is recovered from the liquors by crystallisation, &c.—S. B. A. A.

An Improved Amalgamator. H. Cook, Philadelphia, U.S.A. Eng. Pat. 2345, February 9, 1891. 8*d*.

This amalgamator consists of a rotating cylinder about 40 ft. long, in the interior of which an amalgamating surface is formed extending from the charging end for one-third of its length, and further fitted with a spiral retarding blade running from end to end. The discharge end of the cylinder is connected with the amalgamating tables by means of a chute, a trap for the amalgam fitted with an adjustable gate being interposed. The tables are provided with splash plates, accumulating wells for the amalgam, and a tailings indicator. The edges of the wells are lined with non-amalgamating plate, thereby breaking the continuity of the amalgamating surface and arresting the motion of the amalgam. For placer work the dirt is screened before charging by means of a suitably mounted transverse drum with concentric screens. The details of the above appliances, together with a modification available for use with coarse material, are described in the specification, 15 claims being made.—S. B. A. A.

Improvements in Apparatus for Treating Ore. J. R. Hallowell, Chicago, U.S.A. Eng. Pat. 3333, February 24, 1891. 8*d*.

This specification describes a combination of pulverising, concentrating, and dust-saving appliances, arranged so as to be capable of being worked continuously. The pulverising machine, which may be of any suitable construction, is supplied with hot air from a furnace chimney, and the ore, dried during crushing, is then drawn up through a screen into a chamber containing a number of partial vertical partitions, gradually increasing in height, by means of a suction fan situated at the top and back end of the chamber. The ore is thus graded by the successive partitions, the particles of ore being intercepted in the order of their specific gravity. Between each pair of partitions a hopper is disposed, communicating with a set of three or more automatically working screens, by which the ore is further concentrated. The fine powder and dust is drawn over by the fan into a dust chamber divided by sifting cloths into a series of concentric compartments. The dust which escapes from the chamber is further condensed in an adjoining tower provided with screens, movable shelves, &c.—S. B. A. A.

An Improved Alloy for Hermetically Closing Glass Tubes and other Purposes. F. Walter, Vienna, Austria. Eng. Pat. 7159, April 25, 1891. 4*d*.

It is claimed that an alloy consisting substantially of 95 per cent. of tin and 5 per cent. of copper may be used for connecting metals with glass, for electrical and other purposes, hermetically sealing glass tubes, &c.

The alloy is prepared by pouring the proper proportion of melted copper into the molten tin, stirring round with a wooden stirrer, casting or granulating and remelting. It adheres strongly to clean glass surfaces, and has nearly the same coefficient of expansion as glass; it melts at about 360° C. By alloying it with 0·5 to 1 per cent. of lead or zinc, it may be rendered softer or harder or more or less easily fusible as required. The alloy may also be used for coating metals or wires, as it imparts to them a silvery appearance.—S. B. A. A.

XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

PATENTS.

Improvements in Mandrils for Electrolytically-Deposited Tubes. F. E. Elmore, Leeds. Eng. Pat. 7932, May 22, 1890. 6*d*.

The mandrils are thin but stiff metallic tubes coated with a metal or other substance that is easily fusible by heat. This coating is preferably applied to the mandril by feeding the material between it and a second one also revolving close to and parallel with it, the first being kept cold and the second hot; the fusible material then adheres in a smooth polished coating to the cold mandril. If an insulating compound is used for the coating, the surface is covered with plumbago, and the whole is pricked through with numerous small holes reaching to the metal of the mandril, or the composition itself contains a salt which can be dissolved out, leaving the remainder porous. Gelatinous or gummy material mixed with plumbago may also be used. The deposited tube is easily removed by melting out the coating.—E. T.

A New or Improved Process for Obtaining, by Electrical Decomposition, Metallic Zinc from Solution of Sulphite of Zinc. E. Edwards, London. From T. Lange, Brieg, Germany. Eng. Pat. 8716, June 5, 1890. 4*d*.

Zinc sulphite is used instead of zinc sulphate as electrolyte, as the difficulty of keeping the bath neutral is thereby obviated, and the metal obtained of better quality. Less power is required for the decomposition of zinc sulphite than for that of zinc sulphate to the extent, it is stated, of 30 per cent.—E. T.

Improvements in Electric Reduction of Metals, and in Apparatus therefor. T. L. Willson, Brooklyn, U.S.A. Eng. Pat. 9361, June 17, 1890. 11*d*.

In the ordinary processes of electrical reduction the electrodes and crucibles are attacked and rapidly wasted, and the oxygen liberated from the ore. To prevent this waste, the inventor forces in (preferably through the electrodes, which are made hollow for this purpose) some easily oxidisable material, such as illuminating gas, which combines with the oxygen as soon as the latter is liberated.—E. T.

Improvements in or connected with the Manufacture of Iron by Electrolysis. T. Parker, Wolverhampton. Eng. Pat. 9991, June 27, 1890. 4*d*.

The inventor employs *spongy* iron as made in such processes as that described in Eng. Pat. 11,393 of 1889 (this Journal, 1890, 812). Such spongy iron is made by subjecting hæmatite or other good iron ore to the action of carbon or carbonaceous material at such a temperature as will effect reduction.—E. T.

Improvements in the Electrolytic Treatment of Metals. A. Watt, London. Eng. Pat. 10,038, June 28, 1890. 4*d*.

To prevent the formation of irregular deposits of metal round the edges of the cathodes, resulting in "trees," which sometimes short-circuit the cell, the plates are enclosed in suitable frames of insulating material, which prevent any deposit from being thrown down at the edges.—E. T.

Improvements in Primary Batteries, and in Apparatus connected therewith. Sir C. S. Forbes, London. Eng. Pat. 18,180, November 11, 1890. 11*d*.

This specification describes very elaborated arrangements for supplying liquor to the cells, regulating discharge, &c., involving the use of flexible tubes. It also refers to re-oxidation of spent liquors by blowing a suitable gas or gases through them.—E. T.

Improvements in Electric Batteries. H. H. Lake, London. From W. B. H. Dowse, Boston, U.S.A. Eng. Pat. 3589, February 27, 1891. 6*d*.

The inventor prefers to use two or more porous pots containing zincs, the whole group being surrounded by a common electrode of copper. The solution used for the latter is copper sulphate; for the zincs, a solution containing sal-ammoniac and chromic acid, free or in combination, as essentials, and mercury bisulphate and hydrochloric acid if desired. With such solutions there is said to be no local action, even if the zincs are unamalgamated.—E. T.

Improvements in Electric Accumulators. H. H. Lake, London. From G. Gandini, Lodi, Italy. Eng. Pat. 5021, March 20, 1891. 6*d*.

The electrodes are of lead oxide mixed with crushed carbon, the mixture being kept in place by suitable porous plates or pots, metallic conductors being interspersed. The carbon is used to increase the porosity of the plates.—E. T.

Improvements in Apparatus for Smelting or Casting. E. Taussig, Bahrenfeld, Germany. Eng. Pat. 6323, April 13, 1891. 6*d*.

This improved apparatus permits the smelting and casting to be conducted in a partial vacuum. It consists of an air-tight rectangular box with insulated electrodes fixed in the end walls, between which an electric current of sufficient intensity is passed through the charge of granulated metal. The moulds are similarly contained in an air-tight vessel moving on rails beside the furnace and having an adjustable air-tight connexion with the metal discharge pipe of the furnace. An air-pump connected with the discharge pipe exhausts both furnace and moulds.—S. B. A. A.

An Improved Alloy for Hermetically Closing Glass Tube and other Purposes. F. Walter, Vienna, Austria. Eng. Pat. 7159, April 25, 1891. 4*d*.

See under X., *preceding page.*

XII.—FATS, OILS, AND SOAP MANUFACTURE.

On New Derivatives of Palmitic Acid. C. Hell and C. Jordanoff. Ber. 24, 939–943.

Bistrom Oudemans's monobromostearic acid obtained by heating stearic acid with bromine and water to 140° C.) and Hell and Twerdomedoff's bromohydroxy amide and amidohydroxy myristinic acids nothing is known of the derivatives of the higher members belonging to the fatty acid series. In order to fill up part of this gap, the authors have prepared and studied some derivatives of palmitic acid. This latter was obtained by Krafft and Schmidlin's method (Ber. 21, 2260) from Japanese wax; repeated distillation gave a yield of 50 per cent. palmitic acid, melting at 62° C.; palm oil by saponification, &c., only yielded 20 per cent. of an acid inferior in purity.

α *Bromopalmitic Acid* is obtained by the combined action of bromine and amorphous phosphorus on palmitic acid, then pouring the resulting fluid into water; the acid now forms an opaque yellow paste, having taken up over 3 times its own weight of water which cannot be removed mechanically. The crystals deposited from the solution of the paste in ether or petroleum ether are pure bromopalmitic acid, and melt at 51·5°–52° C.; they are insoluble in water and have now lost the property of absorbing water, and do not form an irritant to the skin. The *ethyl ether* of this acid boils at 221·5° C. (15 mm. pressure) is of a light red colour and fruity smell.

α *Hydroxypalmitic Acid* is obtained by boiling bromopalmitic acid with excess of alcoholic potash and decomposing the potash salt with acid. If heated slightly with water the acid forms an emulsion, which, with increase of temperature presently separates, swimming on the water as a yellow jelly, which solidifies on cooling. By dissolving in ether and recrystallisation from alcohol white crystals are obtained, melting at 82°–83° C. The *copper*, *lead*, and *barium salts* are easily formed, also the *acetyl-derivative*, the crystals of which melt at 62·5° C., and form on solidifying yellowish porcelain like mass.

α *Amidopalmitic Acid* is best obtained on heating a solution of bromopalmitic acid in alcoholic ammonia under pressure to 130°–140° C., then distilling off the excess of both ammonia and alcohol, and separating the acid with water. The *acetyl derivative* of this acid also is easily obtained, forming a dark red resin, soluble in ether and alcohol, while the amidopalmitic acid forms a crystalline powder, insoluble in ether and alcohol.

α *Anilidopalmitic Acid* is obtained by heating to boiling bromopalmitic acid with excess of aniline for 3–4 hours. If boiling is continued till the whole mass is of uniform appearance the *palmitic anilide* is formed, which latter substance may be distilled without decomposition, at 282°–284° C. K. T. M.

PATENT.

Improvements in Apparatus for Decolorising and Sterilising Waste Animal Substances to obtain Manure, and for Extracting Fat therefrom. H. H. Lake, London. From L. de la Croix, Antwerp, Belgium. Eng. Pat. 9176, June 13, 1890. 8*d*.

See under XV., *page* 649.

Improvements in the Continuous Distillation of Hydrocarbon and other Oils and Liquids. C. M. Pedstacker, Harlesden. Eng. Pat. 1408, January 21, 1891. 8*d*.

See under III., *page* 641.

XIII.—PAINTS, PIGMENTS, VARNISHES, AND RESINS.

The India-rubber Tree. Demerara Argosy, May 9, 1891.

The india-rubber tree cannot stand shade, and unless the seedlings are fully exposed to light and well drained they cannot grow. Owing to this, it is found that in the depths of the forest, where light and air are shut out by the dense crowd of trees of many species, natural reproduction takes place by the germination of seeds carried by birds high up in the crowns of other trees, aerial roots descending in process of time to the ground, and developing into a huge hollow cylinder round the foster stem, which is soon killed. The descent of the roots may take years, but once they have taken hold of the ground the further growth is exceedingly rapid. In cultivating, the seeds are found to grow much better than cuttings, and these are tended in large nurseries until they are 10 ft. high, when they are transplanted into clearings made in the forest, in strips of 10 ft. wide, alternating with 60 ft. of natural forest, this being found necessary to furnish the necessary moisture, while narrower clearings do not give air and light enough. Trees grown in grass land were found on tapping to yield scarcely any rubber, the difference being attributed to absence of the moisture afforded by the forest. Plants of 1874·5 were found, in April 1889, to have attained an average height of 64 ft. 11 in., and a girth of 11 ft. 5 in., thus having grown at the very rapid rate of 6 ft. 1 in. in height and 9 in. in girth per year.

XIV.—TANNING, LEATHER, GLUE, AND SIZE.

PATENTS.

Process for Preparing an Elastic Caoutchouc-like Leather for Belts, Straps, and other Use. C. Kuhne, Schoeneberk, Germany. Eng. Pat. 8302, May 28, 1890. 4*d*.

The method of manufacturing the improved leather is as follows. The hide to be treated is first soaked in water, then carefully pared, unhaired and rinsed, after which it is immersed in a weak lime and subsequently washed in clean water. The hide is next immersed in a bath of "light argil milk" (a weak mixture of alumina and water), then smoothed, scraped and trimmed. In this cleaned condition the hide is brought into "a good sour-water" and again worked on the beam. When the hide is air-dry it is lightly brushed on both sides with a mixture of glycerol and linseed oil, which must be so applied as to properly soak into the hide. The drying and oiling are repeated and the hide is finally dried. The whole process is so conducted as to last for about 10 days. B. H.

Improvements in Machinery for Working Leather, Hides, and Skins. E. Wilson, Exeter. Eng. Pat. 9609, June 20, 1890. 8*d*.

This invention relates principally to improvements on the machines described in the specifications of Eng. Pats. 5228 of 1880, and 3444 of 1887, and its main object is to simplify the construction, reduce the cost and diminish the wear and tear of such machines. The specification is unsuited for abstraction, and would be unintelligible without the accompanying drawings. B. H.

Improvements in Machines for Colouring Leather. S. Skucek and F. Jelen, Prague, Austro-Hungary. Eng. Pat. 5786, April 3, 1891. 8*d*.

This invention is for a leather-colouring machine the characteristics of which are a rotatory roller upon which the leather to be coloured is stretched and covered with a cloth suitably clamped, the colouring being effected by special brushes charged with colour, which force the ink or colour through the meshes of the cloth on to the leather. Drawings are given and the specification must be consulted for a description of the mechanism.—B. H.

An Improved Substitute for Leather. E. Drew, London. Eng. Pat. 6852, April 21, 1891. 4*d*.

The basis of the leather substitute consists of specially prepared boards of wood. The board, preferably selected American ash, is reduced by sawing to an equal thickness throughout of about an eighth of an inch, and the surfaces are left quite rough so that the covering material will adhere firmly. The wood is then dried to prevent its splitting and is subsequently coated on each surface with a special adhesive preparation, which being waterproof prevents the wood from being affected by moisture. The surfaces of each side of the wood are then covered with waterproof canvas or other suitable material, which adheres by means of the glue. The whole is then pressed and dried at a temperature of 60°. The adhesive preparation referred to above is composed of the following ingredients:—10 lb. of best Scotch glue, 3 lb. of marine glue, and 1 lb. of plaster of Paris, and is made by melting and well mixing them.

—B. H.

XV.—MANURES, Etc.

Culture of the Colza-Oil Plant. E. Louise and E. Picard. Compt. Rend. **112**, 903—906.

The authors have made experimental cultivations of the colza-oil plant, with the object of determining the exigencies of its growth in ordinary ground; and the nature of the manure best suited for its development. A variety of colza seed was chosen which is most commonly employed in Calvados. The seed was sown in ground of known composition. Towards February the plants began to vegetate, and samples were taken monthly for analysis, the roots, stems, and leaves being examined separately. The analytical results showed that during the period of growth from February to June 28th, when the plants reached maturity:—

1. The percentage of *nitrogen* decreased continuously in the roots and stems, but increased in the leaves.
2. The *phosphoric* acid decreased in a similar manner in the roots and stems, whilst in the leaves it attained a maximum on June 8th.
3. The *potash* diminished continuously in the roots and leaves, but remained constant in the stems.
4. The *lime* increased continuously in all parts of the plant, and reached its maximum on June 8th.
5. The *magnesia* also increased in all parts of the plant.

The total weight of the dry plants was also determined, so that the total amount of mineral matter removed from the soil could be calculated. The results also show that although the percentage of ash in the plants decreased during their period of growth, yet the total amount of mineral matter absorbed from the soil increased continuously. Of the various mineral substances pre-existing in the soil the following amounts were removed by colza crop:—

Phosphoric acid	$\frac{1}{13}$
Nitrogen	$\frac{1}{50}$
Potash	$\frac{1}{58}$
Magnesia	$\frac{1}{80}$
Lime	$\frac{1}{3.7}$

It appears, therefore, that the colza plant impoverishes the soil chiefly of phosphoric acid, nitrogen, and potash, and that phosphatic manures will be of considerable importance in the cultivation of the colza plant.—H. T. P.

PATENTS.

Improvements in Apparatus for Desiccating and Sterilising Waste Animal Substances to obtain Manure, and for Extracting Fat therefrom. H. H. Lake, London. From F. de la Croix, Antwerp, Belgium. Eng. Pat. 9176, June 13, 1890. 8*d*.

The object of this invention is to extract the fat from meat unfit for consumption, bad fish, and all kinds of refuse from slaughter-houses. The apparatus employed consists of a closed cylinder in which the meat, bones, &c. rest on a perforated false bottom covered with cloth or fine wire gauze. The cylinder is provided with a steam jacket and also with a number of steam inlets to the body of the apparatus, chief of which is a pipe perforated in numerous places placed in the centre of the cylinder. The apparatus being charged and the cover fastened down, steam is at first only admitted to the jacket in order to heat the charge and prevent, as much as possible, the extraction of the water soluble constituents of the meat, &c. by condensed steam. When sufficiently heated, superheated steam is admitted to the cylinder through the central tube and other inlets. After some time, the fat which filters through the false bottom is drawn off into a reservoir partially filled with cold water. Steam is then shut off from the interior of the cylinder and the charge is dried by the heat from the steam-jacket. The residue is finally withdrawn through a man-hole near the bottom of the cylinder, and completely dried, if necessary, in the ordinary way. The dried mass after grinding forms manure. The vapours arising from the charge during steaming are passed into the boiler flue, by which means all bad smells are obviated. For details and drawing of the apparatus the original specification must be consulted.—H. T. P.

Improved Apparatus for Drying and Mixing Bones and other Substances. A. H. Hobson, London. Eng. Pat. 10,562, July 8, 1890. 6*d*.

See under 1., *page* 625.

Improvements in Process for Making Superphosphatic Manure. O. Jaehne, Vienenburg, Germany. Eng. Pat. 5111, March 21, 1891. 4*d*.

Raw ferruginous phosphates are ground up with a weak solution of sodium bisulphate and the solution of monocalcium phosphate thus produced is evaporated to dryness. Or the same materials may be ground up with less water to form a pulp, ready when solidified for use as manure. The application of bisulphate instead of sulphuric acid has the advantage that an excess may be used without risk of the pulp not becoming solid.—G. H. B.

XVI.—SUGAR, STARCH, GUM, Etc.

Gum Arabic and its Modern Substitutes. S. Rideal and W. E. Youle.

See pages 610—622.

The Role of "Mechanical" Filtration in the Manufacture of Raw Sugar. E. Donath. Zeits. f. angew. Chem. 1891, 233—238.

The quantity of raw sugar manufactured without animal charcoal has increased year by year since the introduction of improved methods of treating the juice, and in the place of the battery of char cisterns, mechanical filters of various construction are used. The author has made the experiments described below to ascertain the precise part played by the latter; he has examined certain muddy deposits from the filter bags, as well as portions of the stained cloths. The deposits were carefully scraped off and dried.

A. Muddy coating, consisting essentially of defecation-mud, from the outside of filter-bags used for thin juices. In the moist condition it fermented after some days. Analysis:—

	Per Cent.
Ash (containing impurities 0·71 per cent.)	7·12
[illegible]	2·45
Calcium fatty acids	0·90
CO	39·41
Substances reducing CO	52·31
	99·99

The ash consisted chiefly of calcium oxide and carbonate.

B. Very dark greasy deposit from the outside of filter-bags used for concentrated juices; on drying a fatty odour was recognised. Analysis:—

		Per Cent.	Per Cent.
CO_2 and [illegible]	Sugar	44·68	71·70
	Fat	9·16	
	Fatty acids	1·67	
CO			8·58
Ash (not reducing CO)			19·68

The ash contained:—

	Per Cent.
SiO_2	47·12
CaO	2·10
Al_2O_3	2·73
Fe_2O_3	1·59
MgO	1·42
K_2O	18·52
P_2O_5	0·39
SO_3	1·64
Na_2O	18·79
Cl	3·21
Carbonic acid, combined and uncombined	Traces

C. A piece 32·18 grms. of the filter fabric from which B. was obtained; it was a deep chestnut brown colour, weighed 17·9 grms. and yielded 3·079 grms. of ash; when treated with hydrochloric acid chlorine was evolved; whilst a similar strip of the unused material weighed 14·38 grms. and gave 0·42 grm. of ash. The ash of the stained material had the composition:—

	Per Cent.
SiO_2	7·14
CaO	0·17
Fe_2O_3	32·84
Al_2O_3	3·50
MnO	1·21
MgO	0·24
CuO	4·49
CO, &c.	Not determined.

D. Very greasy grey deposit, evolving on drying the odour of rancid fat, from the outside of a filter, used for concentrated juices. Its volatile constituents amounted to 58·07 per cent., including sugar, 5·45 per cent.; fat, 7·14 per cent.; fatty acids, 8·67 per cent.; and CO_2, the amount of which was not determined. The ash had the following composition:—

	Per Cent.
SiO_2	36·30
CaO	2·22
Al_2O_3	11·82
Fe_2O_3	1·70
CaO	26·15
MgO	0·70
K_2O	1·95
Na_2O	7·50
P_2O_5	7·61
CO_2	4·55

E. Ash of the filter-fabric from which D. was separated; 10·8 per cent. was obtained and it was of a light brown colour. It gave the following results on analysis:—

	Per Cent.
SiO_2	87·64
CO_2	0·27
CaO	0·2
Al_2O_3 and Fe_2O_3	1·98
CaO	0·59
MgO	5·60
Mn_3O_4	0·48
SO_3 and P_2O_5	Not determined.

The alkalis set free by the lime used in defecating, probably react with the silicates which the latter contains, and this accounts for the high percentage of SiO_2, as also for the Al_2O_3 found in the ash of the muds and of the fabric E., whilst the solubility of calcium phosphate in sugar solutions probably accounts for the P_2O_5 found. The aqueous extract from A. gave on addition of an equal volume of 85 per cent. alcohol, a small quantity of a curdy precipitate, which after purification by repeated redissolving in water and reprecipitating with alcohol appeared to contain dextran.

From his results the author is inclined to think that this process of filtration with thin juices is purely a mechanical one; with concentrated juices, however, which during concentration have dissolved out certain oxides by contact with corroded metallic surfaces, it appears different, as these oxides are afterwards taken up by the filter-fabric and act as mordants (see below). The manganese which precipitates on the fibres from the hot concentrated juices seems to undergo oxidation, so that a manganic compound resembling the Weldon mud results; hence the fact that chlorine was evolved on treating the coloured fabric with hydrochloric acid. Since, however, the coloured fabrics contain more organic substances than the unused material, it would appear that the colouring matters of the concentrated juices are taken up by the former through the agency of the above-mentioned metallic oxides, the process being similar to that of dyeing, and in this respect the part played by the mechanical filter may be regarded as a chemical one. By the protracted boiling which the concentrated juice has undergone, the fat is saponified and to some extent decomposed by the lime, and is retained by the filter-fabric together with the precipitated sheaths.—A. R. L.

On the Dissociation Hypothesis; on Cryoscopic Method; and on the Freezing Points of Aqueous Solutions of Cane Sugar. J. Traube. Ber. **24**, 1321—1327.

See under XXIII., *page* 660.

XVII.—BREWING, WINES, SPIRITS, Etc.

PATENTS.

Method of and Appliances for the Collection and Utilisation of the Carbonic Acid Gas and other Products given off during the Process of Fermentation. C. R. C. Tichborne, A. E. Darley, M. F. Purcell, and S. Geoghegan, Dublin. Eng. Pat. 9183, June 13, 1890. 8*d*.

The inventors have previously taken out a patent (Eng. Pat. 3707, of 1889; this Journal, 1890, 537) for the general process, and this patent relates to improvements of it.

The gas is collected from an open fermenting vessel by a funnel or bell so arranged that its lower edge may be just above the fermenting head or just dipping into it, as most convenient. A diaphragm is suspended over the funnel to prevent a vortex being formed in the upper atmosphere of the vessel during the withdrawal of the carbonic acid, which would cause air to follow and become mixed with the carbonic acid.

The carbonic acid may also be extracted by a funnel placed *in* the fermenting liquid so that its upper edge is just above the level of the liquid, or by pipes placed at different heights in the side of the fermenting vessel.

The gas thus collected is passed through a cotton-wool filter or a heated tube to remove or destroy all ferment germs; then through a washing tower containing water free from oxygen to absorb the small quantity of oxygen which is invariably present; then through another tower containing sulphuric acid to remove all alcoholic and ethereal vapours: and the purified gas is then condensed by a series of stage condensing pumps.—A. L. S.

Improvements in Apparatus to facilitate the Fining of Beer. L. C. Best, London. Eng. Pat. 9442, June 18, 1890. 6*d*.

The apparatus consists of a small bowl-shaped funnel, the narrow end of which fits the bunghole of the cask.

A small quantity of beer is drawn from the cask in the usual manner, and the finings are added. The bowl is then fitted to the bunghole, when the beer withdrawn from the cask or other beer is run into the bowl till it is about half full; as the fining action proceeds, the finings rise and displace the beer in the funnel. At the completion of the action, a small plug is inserted into the neck of the funnel, and the spent finings removed.—A. L. S.

Improvements in or connected with Apparatus for Drying Granular Substances. J. H. R. Dinsmore, Liverpool. Eng. Pat. 10,888, July 12, 1890. 8*d*.

See under I., *page* 625.

A Novel Preparation for Fining and Frothing or imparting a Foam to Beer and other Fermented Beverages. T. Reade, Wolverhampton. Eng. Pat. 11,613, July 24, 1890. 6*d*.

A solution which is both a frothing and fining agent is prepared by extracting one hundredweight of quillaia bark by three successive quantities of 40 gallons of water, each for 24 hours. The whole extract is used to dilute a strong solution of isinglass to 300 gallons; the strength of the isinglass solution being such that when diluted to this bulk it is of the ordinary strength used for finings.—A. L. S.

Improvements in Malt Liquors, Wines, and Spirits. F. T. Simpson and J. Cox, London. Eng. Pat. 16,942, October 23, 1890. 4*d*.

Kola, or the active principle thereof (caffeine) is added to malt liquors, wines, or spirits with the object of imparting to them or strengthening the property of retarding the wear of the tissue of the human body.

The proportions recommended are: To a gallon of malt liquor 16—32 grains of caffeine; to a gallon of wine or spirit, 72—144 grains.—A. L. S.

Improvements in the Method of and Apparatus for Purifying and Refining Alcoholic Liquors and other Fluids. S. Mason, jun., Manchester. Eng. Pat. 7140, April 25, 1891. 6*d*.

In order to oxidise the fusel oil in spirits and other impurities of various liquors, the liquid is exposed in the form of a spray to a current of air, and the air passing through the spray allowed to escape. This is repeated until the desired result is produced. The description of an apparatus for this purpose is included in the specification.

—A. L. S.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

(A.)—CHEMISTRY OF FOOD.

PATENTS.

Improvements in the Manufacture of Aërated or Mineral Waters and Beverages. H. C. Saunders, Penge. Eng. Pat. 9100, June 12, 1890. 4*d*.

Tubes containing soda and tartaric acid in a compressed state, along with flavouring materials, are introduced into bottles or other closed vessels containing water, for the production of aërated drinks.—G. H. B.

Improved Process for Sterilising Milk. F. A. Raedler, Westerrade, Germany. Eng. Pat. 10,563, July 8, 1890. 4*d*.

Fresh cows' milk is placed in a digester and cooled to 10—15° C. The vessel is then closed and the milk is rapidly heated to 115°—150° C., and maintained at this temperature for 15—60 minutes. If only required to keep sound for a few days the milk is heated to 115° C., but when intended for transport or long storage it should be heated to 150° C. for one hour. A small quantity of sugar is added to the milk to prevent the separation of butter during transport.—H. T. P.

Improvements in Sterilising Apparatus. J. F. H. Gronwald and E. H. C. Oehlmann, Berlin, Germany. Eng. Pat. 3902, March 4, 1891. 6*d*.

The improvements relate to that kind of apparatus in which bottles contained in a closed vessel are closed by means of a presser operated on from the outside. This may be effected in two ways, either the tray carrying the bottles may be forced upward against the presser, or the presser may be drawn or forced down upon the bottles. The power employed may be liquid, steam, air, or other fluid pressure controlled by suitable external appliances. The two methods are shown on the drawing attached to the specification.—E. S.

Improvements in Food Preservation. H. Warry, Weston-super-Mare. Eng. Pat. 7185, April 30, 1891. *4d.*

Meat, fish, game, &c. are preserved by wrapping them in muslin, calico, paper, or any other suitable fabric impregnated with boracic or salicylic acid, or with a mixture of the two. The fabric to be employed is soaked in or sprinkled with a solution prepared in either of the three following ways:—

1. Commercial boracic acid, 1 lb.; water 5 galls.
2. Commercial salicylic acid, 1 lb.; water, 5 galls.
3. Salicylic and boracic acids, of each 1 lb.; water, 10 galls.

The fabric, being charged with one of these solutions, is dried by exposure to air, or by heat, and is then ready for use. H. T. P.

(*B.*)—SANITARY CHEMISTRY.

PATENT.

Improved Means for Deodorising, Disinfecting, Oxidising, and for Absorbing Secretions of the Human Body. J. W. Dougal, Lanlithgow. Eng. Pat. 8861, June 7, 1890. *4d.*

Carbon in the form of charcoal, bone black, or prussiate charcoal is incorporated with the various materials of which articles of clothing are made. The carbon may be introduced more particularly into the in-soles, &c. of boots and shoes, into arm pit and other pads, and into chest protectors, &c. In manufacturing the material for in-soles, &c., zinc and copper wires, and some suitable salt may be introduced along with the carbon in order to produce electrical effects.

The inventor also employs carbon in combination with other substances, such as magnetic oxide of iron, fuller's earth, magnesium silicate, kieselguhr, talc, starch, salicylic acid, phenol, cresol, salt, alum, boracic acid and its salts, metallic nitrates, chlorides, and sulphates, and other bodies.

—H. T. P.

XIX.—PAPER, PASTEBOARD, Etc.

Estimation of Mechanical Wood Pulp in Paper. W. Herzberg. Mitt. Königl. tech. Versuchs. 1891, 11—59.

See under XVIII., *page* 661.

PATENT.

Improvement in and Relating to Processes and Apparatus for Disintegrating Vegetable Substances for the Production of Fibres therefrom. A. Selkirk, Albany, U.S.A. Eng. Pat. 5597, March 31, 1891. *8d.*

Fibres suitable for the manufacture of paper and similar articles are obtained from wood, straw, grasses, and other vegetable substances by introducing the materials to be treated into a strong iron or steel digesting vessel in the form of a cylinder with semi-spherical ends, and provided with a perforated chamber in the centre, and with perforated plates at the top and bottom for regulating the supply of the digesting liquor. This vessel, when filled with the raw material, is tightly closed, and the liquor introduced into it from the top and bottom simultaneously. After thoroughly impregnating the whole mass of the material, the liquor passes out through the central chamber. While in the digester it is kept in circulation by a pump and a series of pipes connected with an apparatus for heating it, when required. The degree of heat and pressure within the digester, and the rapidity of the circulation of the liquor vary considerably according to the nature of the material to be treated. When the latter is properly disintegrated, the operation is finished by drawing off the liquor and removing the substance from the digesting vessel.

—H. S.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES AND EXTRACTS.

The Physiological Action of the Paraffinic Nitrites considered in Connexion with their Chemical Constitution. Part I. The Action of the Paraffinic Nitrites on Blood Pressure. J. T. Cash and W. R. Dunstan. Proc. Royal Soc. 1891, **49**, 314—319.

Previous investigators on the physiological action of the organic nitrites have dealt almost exclusively with amyl nitrite, and the results obtained therewith are, in the opinion of the authors, vitiated by the facts that insufficient pains have been taken to procure the nitrite in a chemically pure state, and also that the mode of administration has been such that it is impossible to determine exactly how much of the compound has actually been inhaled.

Both these sources of error have been obviated, the nitrites employed having been analysed in all cases, and specially devised forms of apparatus having been employed for ensuring, without loss, the inhalation of a definite amount of nitrite, through the trachea in animals and through the nostrils in the human subject. The nitrites were prepared by the action of sodium nitrite, in presence of dilute acid, on the corresponding alcohol. The product of the reaction after washing and drying was purified by fractional distillation, in some cases under reduced pressure.

Details of the method of administration and of the apparatus employed are given. The experiments were conducted on cats, rabbits, and on the human subject. All the nitrites examined produce, in whatever way administered, a reduction of blood pressure, the extent of the reduction, when equal volumes are administered to animals by inhalation, being in the following order:—(1) Secondary propyl, (2) tertiary butyl, (3) secondary butyl, (4) isobutyl, nearly equal to 3, (5) tertiary amyl, (6) α-amyl, (7) β-amyl nearly equal to 6, (8) methyl, (9) butyl, (10) ethyl, (11) propyl. This order is somewhat modified when the nitrites are given by intra-vascular injection. When the duration of the sub-normal pressure is considered, the order is nearly the reverse of that given above, the effect of methyl nitrite being the last, and that of the secondary propyl nitrite one of the first to appear. The pulse acceleration produced by these nitrites does not follow in the above order, the amyl nitrites, in particular, being more active. The experiments on the human subject go to show that there is a considerable variation on the part of individuals to nitrite effect, the acceleration of the pulse in the case of those of neurotic tendency being much greater, and the time of its continuance much less than in that of a lymphatic subject. The order of activity (extent of acceleration) of the various nitrites was found to be as follows: (1) α-amyl, (2) β-amyl, (3) isobutyl, (4) secondary butyl, (5) primary butyl, (6) secondary propyl, (7) primary propyl, (8) ethyl, (9) methyl. The extent of the acceleration appears to be less in the case of cats than in the human subject.

In subsequent communications the authors intend to discuss the action of these nitrites on striated muscle and the relationship of all these physiological effects to the chemical constitution of the nitrites employed.—C. A. K.

Derivatives of Salol. W. Knebel. J. Prakt. Chem. 1891, **43**, 378—389.

Acetyl Salol, $C_6H_4(O.CO.CH_3)CO.OC_6H_5$, is prepared by the action of acetyl chloride or of acetic anhydride on salol. It forms star-like crystals melting at 97° C.

Nitro-derivatives of salol.—α-mono-nitrosalol—

$$C_6H_3(NO_2)(OH)CO.OC_6H_5.$$

$$(CO.OC_6H_5 : OH : NO_2 \quad 1:2:5)$$

results when salol in glacial acetic acid solution is treated with nitric acid of sp. gr. 1·525, and the mixture allowed to stand. Crystals of the nitro-compound separate, which, when recrystallised from glacial acetic acid, form

colourless needles, which melt at 150°—151° C. On saponification with alkali, phenol, and nitro-salicylic acid ($CO.OH : OH : NO_2 = 1 : 2 : 5$) result. The same nitro-compound is formed by nitrating salicylic aid and treating the nitro-acid formed with phenol and phosphorus oxy-chloride as in the preparation of salol. *β*-nitro-salicylic acid ($CO.OH : OH : NO_2 = 1 : 2 : 3$) similarly treated forms *β*-nitro-salol which crystallises from alcohol in prisms melting at 101° C. It is not obtained by the direct action of nitric acid on salol. Both *α*- and *β*-nitro-salol yield acetyl compounds, the former melting at 118°, the latter at 95°. When acetyl-salol is nitrated the acetyl group is removed and *α*-nitro-salol results.

By the further action of nitric acid either upon salol or upon acetyl-salol *di-nitro-salol*, $C_6H_2(NO_2)_2(OH)CO.OC_6H_5$, is formed, which, recrystallised from glacial acetic acid, forms fine needles, melting at 183°. When saponified dinitro-salicylic acid and phenol result. It yields an acetyl compound, melting at 118°. Together with the dinitro acid, some picric acid is formed in the reaction.

When further nitrated two trinitrosalols are formed, in which the nitro groups enter the phenyl group of the carboxyl phenyl. Some picric acid also results.

(1.) 1 : 2 *nitrophenyl dinitrosalicylic acid*—

$$C_6H_2(NO_2)_2(OH)(CO.OC_6H_4.NO_2)$$

Salol is added to nitric acid of sp. gr. 1·525 mixed with concentrated sulphuric acid. The reaction is violent. The nitro compound is separated by pouring the product of the reaction into water and recrystallising the separated trinitro-salol from alcohol after repeated boilings with water. It forms glittering plates which melt at 100°. When saponified 1 : 2 nitrophenol and dinitrosalicylic acid result.

(2.) 1 : 4 *nitro-phenyldinitrosalicylic acid*—

$$C_6H_2(NO_2)_2(OH)CO.OC_6H_4.NO_2$$

This is formed together with the 1 : 2 compound in the above reaction, and is separated from it by extracting the mixed nitro-compounds after precipitation with water, with glacial acetic acid, the 1 : 2 compound being left behind. It crystallises in pale yellow needles, melting at 176°, and on saponification forms 1 : 4 nitro phenol and dinitro-salicylic acid. It yields an acetyl compound which melts at 156°.

The author was unable to prepare these trinitro-salols either from salicylic acid or from salol by direct nitration.

—C. A. K.

On some Derivatives of Benzoic Sulphinide (Saccharine or Benzoyl Sulphonic Imide), and the Changes caused in their Taste by Changes in Composition. K. de Roode. Amer. Chem. J. **13**, 217—232.

The most characteristic property of parabromosulphinide is that it possesses two distinct tastes, a bitter and a sweet, and the corresponding chlorine compound has the same peculiarity in even a more marked degree. The author has therefore investigated the other para-halogen-sulphinides, and the substances from which they are made, and observed their effect upon the nerves of taste.

The starting point for their preparation was paradiazo-toluene-orthosulphonic acid, which was converted into para-fluortolueneorthosulphonic acid by heating with concentrated hydrofluoric acid in a platinum dish until the decomposition was complete, evaporating to a syrupy consistence, diluting with a large quantity of water, and neutralising with barium carbonate (the calcium salt not being easily crystallisable). From the barium salt the potassium compound was obtained by treatment with potassium carbonate. This latter salt crystallises from water in large glistening scales, containing two molecules of water of crystallisation. The corresponding chlorine and bromine salts were prepared in a similar manner, potassium chlortoluenesulphonate crystallising in light yellow needles containing no water, and the bromtoluenesulphonate in thin lustrous scales containing 1 mol. of water of crystallisation. For the preparation of the iodo-salts the diazo compound was decomposed by hydriodic acid in presence of alcohol, the flask being kept cool: after the evolution of nitrogen had ceased the contents were warmed and the alcohol distilled off. The residue was diluted with a large quantity of water, neutralised with lead oxide and filtered hot. The lead salt being insoluble could not be easily freed from the excess of oxide, and was converted into the potassium salt, which crystallised from aqueous solution in transparent "whetstone-shaped" crystals containing 1 mol. of water and corresponding to the potassium salt of the *β*-iodotoluenesulphonic acid described by Glassner (Ber. **8**, 561). Accompanying the insoluble lead salt was another which was very soluble; it was not examined as such, but was converted into the potassium salt, and on analysis gave figures corresponding to potassium tolnenesulphonate.

From these four potassium salts, the corresponding amides were prepared by the action of phosphorous pentachloride, followed by aqueous ammonia. The solutions were evaporated to dryness on the water-bath, alcohol added, and after treatment with animal charcoal crystallised out. With the exception of the iodo salt, all are easily soluble in hot water and alcohol, sparingly soluble in cold water. The melting point of the fluorine salt is 155°, of the chlorine salt, 145°; and of the iodine salt, 185°—187° (uncorrected). From these amides, the sulphinides (sulphonic imides) were prepared by oxidation with alkaline permanganate, the most successful method of working being found to be as follows:—20 grms. of the amide and 8 grms. of caustic potash were dissolved in two litres of water in a large flask, and placed on the water-bath. A concentrated solution of 35 grms. of potassium permanganate was then added by degrees, the flask being kept hot until only a slight pink colour remained, an operation lasting about six or eight hours. A little alcohol was then added and the liquid filtered and evaporated to about 75 cc. While still hot, the sulphinide, together with some unaltered amide was precipitated with strong hydrochloric acid; to separate them the mixed precipitate was boiled with water, neutralised with chalk, filtered and allowed to cool, the amide crystallising out in long white needles. On further evaporation the calcium salt of the sulphinide was obtained. These all crystallise in radial groups of white needles, having the same tastes as the sulphinides themselves, and containing 7½ molecules of water of crystallisation. From these calcium salts the pure sulphinides were obtained by precipitation with strong hydrochloric acid.

Parafluorosulphinide, thus prepared, crystallises from hot water in long white needles, which break up on drying into granules; from a dilute solution it may be obtained in small transparent rhombs. Its melting point is 200°—202° (uncorrected). Its taste is almost purely sweet, a slight bitter after-taste being perceptible. It is probably as sweet as benzoic sulphinide.

Parachlorosulphinide crystallises in thin pearly scales, melting at 218°. It is slightly less soluble than the fluorine compound. It has both a sweet and a bitter taste, the latter being the more intense.

Parabromosulphinide also possesses both tastes, but in a less marked degree, and *para-iodosulphinide* has only a slight bitter taste. The latter crystallises in fine white needles and melts at 230°—232°. On boiling with dilute hydrochloric acid, *p*-chlorosulphinide is converted into the acid ammonium salt of *p*-chlorothiosulphobenzoic acid, just as benzoic sulphinide is, into that of orthosulphobenzoic acid.

With regard to the tastes of these halogen derivatives it is found difficult to describe the differences accurately; they have been tasted by several, the majority of whom agree with the author in his description. "It is, however, impossible to make accurate comparison between a sweet and a bitter taste as regards the relative intensity of the two."—F. H. L.

Studies of the Terpenes and Allied Compounds. The Nature of Turpentine Oils, including that obtained from Pinus Khasyana. H. E. Armstrong and W. J. Pope. Journ. Chem. Soc. **343**, 1891, 311—320.

The crystalline substance of the formula $C_{10}H_{15}O_2$ briefly described by Sobrero in 1851 (Compt. Rend. **33**, 66; Annalen, **80**, 106), was obtained by exposing oil of turpen-

tine together with moist oxygen to sunlight. Sobrero stated that, when boiled with dilute sulphuric acid, it was converted into a volatile product having a strong odour resembling that of camphor as well as that of turpentine.

Probably Sobrero had worked with French oil of turpentine, and therefore this was first submitted to air-oxidation in sunlight, the results obtained were in complete accordance with the account given by Sobrero. On substituting American for French turpentine a substance was obtained identical with that resulting from the oxidation of the French hydrocarbon, except in its optical characters.

These results led the author to study the behaviour of oils from various sources containing $C_{10}H_{16}$ hydrocarbons, in the hope that information might be gained which would serve to elucidate the complex problem presented by the existence of an apparently infinite variety of essential oils.

It was soon ascertained that a clear atmosphere and a bright, high sun were requisite for the formation of the crystals. It has rarely happened that crystals began to form until late in May, and each exposure has usually lasted from two to three months. Necessarily, therefore, the information has been acquired at a slow rate.

"The hydrocarbons of the formula $C_{10}H_{16}$, derived from plants, may be divided into two classes, viz., (1) those boiling at about 156°, which are conveniently termed *terpenes*, as they are the chief constituents of ordinary turpentine oils; and (2) those boiling at about 176°—178°, which may be termed *citrenes*, as they are the chief constituents of the oils derived from the various species of *Citrus*. The terpenes and citrenes are all capable of rotating the plane of polarisation of light, but no two plants furnish terpenes or citrenes of identical rotatory power, and often different parts of the same plant yield different products. The different terpenes appear, however, to agree in all other physical properties, and also in their chemical properties, and the same is true of the different citrenes. It is probable that the number of isomerides of the formula $C_{10}H_{16}$ is very much smaller than has been supposed, and that the differences observed in the rotatory powers of the hydrocarbons from various sources are due to their being mixtures in varying proportions of two or more isomerides."

In a paper read before the Society of Chemical Industry in 1888 (this Journal, 1888, 178), detailing the results of the examination of a very large number of samples representing many thousand barrels of different kinds of commercial turpentine, after calling attention to the almost absolute conformity of the French oil and the wide variation which was noticeable on comparing the rotatory powers of different samples of the American oil, the author stated that he had been led to think it not unlikely that the low dextro-rotatory power of American turpentine is due "to the presence of a lævo-rotatory terpene; this would serve to explain the difference in optical character of products from different localities." That this is actually the case he has no longer any doubt. The crystalline product from French turpentine is all but inactive, that from American turpentine is but rarely so. The earlier crystallisations usually consist of a substance which may be said to be the image of that from the French oil, but although the crystals in later fractions may exhibit the same melting point as those separated at an early stage, the rotatory power of the fraction as a whole is lower. The explanation of the difference was discovered in the course of the examination of a very beautiful turpentine oil from British Burmah, the produce of *Pinus Khasyana*. This oil appears to be in every respect the counterpart of French turpentine but its optical image, and it could be obtained in quantity would form a most valuable article of commerce. The air-oxidation product of the Khasyana terpene is the image of that from French turpentine, and identical with that obtained from American oil, the difference in the Burmese and American oils being that the former, like the French oil, affords a more or less uniform product.

When the two varieties of equal opposite rotatory power of the oxidation product are mixed, or more correctly, a substance is obtained of much lower melting point, and it is this substance which is present in considerable quantity in the product from American oil along with the dextro-rotatory active form. The melting point observed in the case of the later fractions of the product from American turpentine is a matter of accident, for if the crystal used in the determination be not specially selected from the mass, it may be either the active or the inactive substance.

As the relation of the crystalline oxidation product to the parent hydrocarbon cannot yet be determined, and as it is not improbable that, as in other cases, a molecular change has attended its formation, and that it is not a simple derivative of the hydrocarbon, the author suggests that in giving it a name (as one or both of its oxygen atoms possess alcoholic functions), to recognise its discovery by Sobrero, it be termed *sobrerol*.

The author thinks that sobrerol is only obtainable from the terpenes proper, and that, according as an oil yields either dextro- or lævo-sobrerol, or a mixture of either modification, with the inactive form, it is to be regarded as containing one or other of the corresponding terpenes, or, as in the case of American turpentine, a mixture of the two. In other words, *that there are but two terpenes*, viz., those represented by the essential components of the French and Burmese oils.

Bearing in mind that we are indebted to Berthelot for the first systematic study of the varieties of turpentine oil, and that he proposed the name *terebenthene* for the characteristic hydrocarbon of such oils, it is proposed to term the two optically different varieties *dextro-terebenthene* and *lævo-terebenthene*.

The oil which Sobrero obtained by distilling the crystalline oxidation product with acid has proved to be identical with the isomeride of camphor which Wallach and Otto obtained by the interaction of turpentine and nitrous acid (Annalen, **153**, 249), which they have named *pinol*. Being a strict adherent to the view that the *ol* termination should be reserved for hydroxy-derivatives exhibiting alcoholic functions, as the compound does not appear to be of this class, the author has suggested that it should be named *sobrerone*, to indicate its relationship to sobrerol. Having succeeded in re-converting "pinol" into the crystalline oxidation product, $C_{10}H_{18}O_2$, Wallach (Annalen, **259**, 313; this Journal, 1890, 1117) proposes to name the latter *pinol hydrate*. This name is considered inappropriate, for the reason that it is desirable to restrict the term hydrate, as far as possible, to compounds containing so-called water of crystallisation.

The "sobrerone" obtained from the two active modifications of sobrerol is optically inactive, and when reconverted into sobrerol by Wallach's method, yields the inactive form of the latter.

The proportion of crystalline oxidation product obtained is relatively very small, the greater part of the turpentine being converted into the well-known non-volatile viscid oil. Much better results would probably be obtained if the oxidation were effected under the influence of a tropical sun. As it appeared possible that the viscid oil might contain some sobrerol, it was digested with dilute sulphuric acid and steam-distilled; a considerable amount of volatile oil was obtained, but hitherto all attempts to separate "sobrerone" from this have failed. Notwithstanding that the greater part of the hydrocarbon is converted into products other than sobrerol, as dextro- and lævo-terebenthene are apparently oxidisable at the same rate under similar conditions, it is to be supposed that when a mixture is oxidised the crystalline product will regularly betray its origin, unless, indeed, pressure have a perceptible influence on the rate of oxidation. On oxidising American turpentine fractionally, that is to say, if when the oxidation has gone on for some time, the crystals are collected and the unoxidised oil is separated by steam-distilling and re-exposed to oxidation, a series of products is obtained, the first of which has a higher dextro-rotatory power than subsequent fractions. This is exactly what should happen if dextro-terebenthene be the chief constituent of American turpentine.

It appears not unlikely that sobrerol may occur frequently; the authors, however, only on one occasion met any evidence of its presence. In the course of the oxidation of so-called terebene which was carried out several years ago, one of the authors had occasion to distil a large quantity of American turpentine which had been received in a wooden barrel. The most volatile portion was collected separately, and put away

in a blue Winchester quart, in a dark cellar; after a time the sides and bottom of the bottle were found to be encrusted with crystals, which were collected and recrystallised from alcohol. Only a very few grammes of the crystals were thus obtained from 10 gallons of turpentine. This substance has proved to be *inactive* sobrerol, chiefly mixed with some dextro-sobrerol.

Camphor Industry in Florida. Pharmaceutical Era, June 1, 1891; Pharm. J. 1891, 1153.

The possibilities for the establishment of a paying industry in the line of camphor production in the Southern States, notably Florida, are very promising. Last year attention was called to the fact that the camphor tree can be profitably grown in the south, and at the recent meeting of the A.P.A. further statements to this effect were made.

Messrs. A. J. Beach and Son for some time have been experimenting at Palatka, Flo., and from them is gathered some interesting information.

For the growth of the camphor tree the preparation of the soil is very easy and simple, the tree growing with very little care after first starting. All timber should be cut and piled, not burned, and left to rot on the ground. The soil is thoroughly grubbed where the tree is to stand. The tree is planted and carefully staked to prevent the wind from swaying it when it is first set out. For three or four years the ground should be carefully worked around the trees and kept clean, the growth of timber being kept down and grubbed out, but after this time the tree will take care of itself.

The first trimming of the camphor tree is to a sufficient height for the body of the tree; after that thin out the top and shear off the outside of the top, as the young wood is the most productive of camphor

The extraction of the gum is very simple. There is used for the purpose a still consisting of an iron pot holding about five pailfuls, and provided with a wooden cover into which is fitted a one-inch pipe leading to the condenser. The top of the kettle and cover are plastered with clay to prevent the escape of camphor vapour during the process. From the kettle the pipe turns and runs horizontally into a wooden trough about eight feet long, and then turns down and discharges into a tin can which catches any water condensing in the pipe. To charge the still the cover is removed from the kettle, which is then filled with small limbs and leaves of the camphor tree. A few quarts of water are then added to keep the leaves from burning (they burn very easily). The cover is then fitted on securely and under the kettle is placed a very small fire, and the pipe connected with the pipe in the trough, which is kept full of cold water supplied through a hose. As soon as the water produces the least steam, the camphor volatilises, passing over very rapidly. As it leaves the still it follows along until it comes in contact with the cold portion of the condenser where it condenses and sticks to the inside of the pipe in the shape of fine crude camphor. The condenser pipe is slanted a little so that any water condensed may be delivered into the can. Long before the water reaches boiling point the camphor is nearly all volatilised, but the water is allowed to form a little steam that all the camphor vapour may be driven into the condenser. Every portion of the still must be securely sealed to prevent the escape of the vapour.

To remove the gum from the condenser pipe the pipe is removed from the trough, stood upon end, and struck sharply with a hammer, when the gum will rattle out of the lower end.

Messrs. Beach and Son have carried on the camphor industry in a very small way as yet. They have only a few trees which are too small to cut much from. Nearly all the wood for experimenting has been obtained from other places. All the trees, except what were imported, were provided by the Department of Agriculture several years since, and consequently are now quite large. Other experiments are to be undertaken as fast as the wood can be procured. The yield, as nearly as can be estimated by weighing limbs and leaves, is almost 1 to 25, that is, 1 lb. of crude gum to 25 lb. of limbs and leaves.

Synthetic Musk. American Druggist; Chemist and Druggist, 1891, 868.

Experiments by Ungerer with artificial musk show the effect of its combination with such other substances as are used in the manufacture of perfumes and toilet soaps, since these combinations furnish a more reliable test of its value than the simple method prevailing among perfumers of judging by the odour given by blotting-paper moistened with a solution or tincture. Ungerer's experiments thus far show the disappearance of the odour of synthetic musk in the presence of benzoated tallow, soapstone, chalk, cacao butter, Peru and tolu balsams, and all fatty acids. He thinks that a considerable limitation of its usefulness will result from its paralysing influence upon the olfactory nerve and its remarkable tendency to assert itself and overpower all other odours and destroy their combinations. It has an unfortunate disposition to stand alone without blending—or "marrying," as perfumers express it—with others, as is likewise the case with the amorphous precipitate called Neroline, which has caused it to be a failure in the hands of perfumers. Another fact noted by Ungerer is the absence of by-products. In the case of natural musk, the odour is almost inexhaustible, and the substance not only yields by percolation a second and third tincture, but the dried residues are available for sachets, toilet-powders, or soaps. Perfumers have come to depend largely upon this valuable property of natural musk, and look to it as a necessity for lucrative manufacturing.

PATENTS.

The Manufacture of Salicylate of Phenyldimethylpyrazolone. H. Lüttke and L. F. Riedel, Berlin, Germany. Eng. Pat. 10,432, July 5, 1890. *6d.*

Suitable quantities of phenylhydrazine, aceto-acetic ester, methyl salicylic ester, methyl alcohol, and hydriodic acid are heated in a digester to 160°—180° C. for 10—12 hours, corresponding to a pressure of 9—15 atmospheres. The resulting thick brownish mass is washed with petroleum ether, to remove the excess of methyl salicylate, the methyl alcohol distilled off, the residue left to crystallise, and purified by recrystallisation from alcohol. The salicylate forms hexagonal tables having the composition—

$$C_{11}H_{12}N_2O.C_6H_4.OH.CO.OH$$

It is readily soluble in alcohol, benzene, and acetone, less so in ether, and very sparingly soluble in water. It melts at 91·5° C., and is decomposed by sulphuric acid with separation of salicylic acid, and by caustic soda with the separation of phenyldimethylpyrazolone. The yield of the new product amounts to 95 per cent. of the theoretical quantity. The hydriodic acid used in the preparation can be replaced by other halogen hydracids. The salicylate can also be obtained directly from salicylic acid and phenyldimethyl pyrazolone by melting the two bodies together in presence of water. It possesses considerable antiseptic and preservative qualities, and is called "*Salipyrin*."—C. A. K.

Improvements relating to the Preparation of Hydrochlorides, Hydrobromides, or Hydriodides of Peptone and Double Salts thereof. R. Lake, London. From Kalle and Co., Biebrich, Germany. Eng. Pat. 11,189, July 17, 1890. *6d.*

The hydrochlorides, hydrobromides, and hydriodides of peptones are prepared by treating ordinary peptones or albuminoid substances like gelatin, albumen, casein, and serum with hydrochloric, hydrobromic, or hydriodic acid on the water-bath until the product is almost perfectly soluble in alcohol. The product of the reaction is then extracted with alcohol and the solution obtained evaporated to dryness in vacuo. The hydrochloride of gelatin thus prepared contains 11—12 per cent. of HCl, and by longer treatment of the gelatin with acid, a product is got almost perfectly soluble in alcohol and containing 15 per cent. of HCl. Albumen, after treatment with acid, when the mixture quickly assumes an intense violet or black colour, due to

the action of the oxygen of the air, is diluted with water and saturated with carbonate of lead, filtered, the lead in the filtrate removed by means of sulphuretted hydrogen, and the resulting solution evaporated to dryness, the residue taken up with alcohol and hydrochloric acid, and the solvent removed as in the case of gelatin. In preparing the hydrochlorides of albumen peptones the treatment with lead carbonate can be omitted.

The products thus obtained from the different raw materials have the same properties and almost the same composition. The aqueous solutions of the salts when precipitated by phospho-molybdic acid, and the precipitate decomposed by baryta, yield the true peptones, identical in every respect with the peptones obtained by the artificial digestion of albumen and pepsin substances. These decomposition products when treated with halogen acids yield first products insoluble in alcohol, which become soluble when the treatment with the acids is prolonged for some hours. The cold aqueous solutions of the salts give the biuret reaction, and are precipitated by phospho-molybdic acid, phospho-tungstic acid, and by mercuric potassium iodide. They are not precipitated by tannic acid, by a concentrated aqueous solution of ammonium sulphate, or by potassium ferrocyanide and acetic acid. Mercuric chloride precipitates the hydrochlorides only yielding reddish yellow bodies, very insoluble in alcohol and in water.

The patent also covers methods for the preparation of double salts of the hydrochlorides of peptones with mercuric and ferric chlorides. Two mercuric chloride double salts are described, one insoluble in alcohol and containing 50 per cent. of mercuric chloride, and the other soluble in alcohol and containing 35—45 per cent. of mercuric chloride. The double ferric chloride forms yellowish hygroscopic scales readily soluble both in water and in alcohol. All the above salts are intended for medicinal purposes.—C. A. K.

Improvement in the Manufacture of Phenyldimethylpyrazolone. L. Schulvon and L. F. Riedel, Berlin, Germany. Eng. Pat. 11,869, July 28, 1890. *6d.*

SEPARATE quantities of phenylhydrazine, aceto-acetic ester, sodium methyl sulphonate, sodium iodide, hydriodic acid, and methyl alcohol are heated together in a digester for 10—12 hours at 160—180° C., corresponding to a pressure of 10—12 atmospheres. The phenylhydrazine and aceto-acetic acid ester react to form phenylmethylpyrazolone with elimination of a molecule of water and a molecule of alcohol, whilst the sodium methyl sulphonate and sodium iodide react to form methyl iodide and sodium sulphate. The hydriodic acid accelerates the latter reaction; the methyl alcohol added to the mixture serves as a diluent only. The methyl iodide then acts upon the phenylmethylpyrazolone to form the phenyldimethylpyrazolone, which is separated from its hydriodide by means of caustic soda and then extracted with chloroform. The chloroform solution is concentrated and treated with petroleum ether when the phenyldimethylpyrazolone separates in crystals. It is purified by recrystallisation from toluene, acetone, or alcohol. The iodine used in the process can be quantitatively recovered as sodium iodide. The sodium methyl sulphonate may be substituted by other salts of methyl sulphonic acid, the sodium iodide by other haloid alkali salts, and the hydriodic acid by other halogen hydracids. Also ethyl alcohol may be employed instead of methyl alcohol as the diluting liquid.

The process may be further modified by omitting the sodium iodide and employing a larger proportion of hydriodic acid, when the latter forms methyl iodide and acid sodium sulphate with the sodium methyl sulphonate. Methyl iodide and phenylmethylpyrazolone formed as above from phenylhydrazine and aceto-acetic ester yield the dimethyl compound and regenerate hydriodic acid, whilst the acid sodium sulphate acts upon the phenylmethyl-pyrazolone at the temperature employed in the reaction to form a sulphate of the base together with normal sodium sulphate. The free base is separated from the product of the reaction in the manner described above.—C. A. K.

Improvements in Packages for the Packing or Putting-up of Chloride of Lime, Carbonate of Ammonia, and other Volatile and Deliquescent Substances. T. Needham, Huddersfield. Eng. Pat. 19,121, November 25, 1890. *4d.*

See under VII., *page* 642.

A Method of Utilising Waste Chips and Dust of Rhubarb Root. A. Barthoff, New York, U.S.A. Eng. Pat. 4555, March 13, 1891. *4d.*

THE sound chips and sawings produced in the cutting of rhubarb root are ground or granulated, moistened, then treated with gum arabic or other suitable adhesive material, and the whole thoroughly mixed. The mass while still in a moist state is then pressed and moulded into the desired shapes, or may be spread and rolled out into a sheet and this when dried, cut up. The product thus obtained is hardly to be distinguished from the ordinary solid root; the above treatment does not impair the medicinal qualities of the rhubarb in any way, and when thus prepared it will keep in any climate and is not subject to the ravages of insects.—C. A. K.

Improvements in Methods for the Recovery and Utilisation of certain Vaporised Solvents. J. R. Whiting, New York, and W. A. Lawrence, Waterville, U.S.A. Eng. Pat. 6405, April 14th, 1891. *8d.*

THIS is an improvement on a previous patent (U.S.A. Pat. 170,424 of 1875) and refers to the recovery of that portion of the solvent used in the extraction of hops which remains behind in the extractor, mechanically entangled with the leaves and woody fibre and which is not removed with the mass of the extract when the latter is drawn off. A special steam pipe and exit tube, the latter connected with a condenser, are attached to the lower part of the extractor, and after the extract has been run off, the pipe leading to this extra exit tube is opened when a portion of the residual solvent passes, by virtue of its own pressure, to the condenser. Superheated steam is then admitted into the extractor, when the remainder of the solvent is completely removed and condensed. The condensed liquid, consisting of solvent and water is collected in a suitable cylinder, provided with an overflow pipe leading to a second cylinder whereby the specifically lighter solvent is run off and the water left behind. Suitable arrangements are made for the complete condensation of any escaping vapours of the solvent. A sketch of the apparatus is given.—C. A. K.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

The Action of Light on Silver Chloride. R. Hitchcock, Amer. Chem. J. **13**, 273—277.

PREVIOUS experiments by the author have shown that the action of light may cause a loss of 6·0 per cent. of the chlorine, and although the present results show a loss of 8·5 per cent., it is doubtful whether this represents the total effect, as the investigation was interrupted before its conclusion.

A number of films of silver chloride were prepared by allowing the freshly precipitated substance to deposit on microscope cover glasses in a dark room, and after 10 days washing them by decantation. The plates were then dried and weighed and exposed to sunlight under glass for about six months, during which time they were weighed at intervals, and were found to be constantly losing weight.

Three films were found to weigh before exposure (nett) 0·02386, 0·02821, and 0·03981 respectively, and during exposure lost as follows:—

4 days.	6 days.	13 days.	5 months.	6½ months.
0·00489	0·00637	0·00700	0·00758	0·00821
0·00468	0·00620	0·00673	0·00779	0·00822
0·00414	0·00575	0·00638	0·00871	0·00929

The average loss being 8·57 per cent. of the silver chloride used.

With regard to the constitution of the altered substance, preliminary experiments show that warm dilute nitric acid dissolves from it, an amount of silver corresponding to the chlorine set free, the well-darkened chloride containing 22·5 per cent. of soluble silver—rather less than one-third of the metal present in the unaltered salt. The various films prepared as above gave a total loss in weight of 0·01393, and in their nitric acid solution silver was present in amount equal to 0·01382 of chlorine, thus seeming to prove that the action of light is merely to separate the chloride into its constituents. While the altered substance is in all probability only a mixture of silver and silver chloride, its composition approximates to the formula $(AgCl)_2Ag$.—F. H. L.

The Bisulphite Compounds of Alizarin Blue and Cærulin as Sensitisers for Rays of Low Refrangibility. G. Higgs. Proc. Royal Soc. 1891, **49**, 345—346.

Alizarin blue S possesses in a high degree sensitising properties for rays throughout the region comprised between λ 6,200 and 8,000 and it does not, like Cyanine, lower the sensitiveness to the violet and ultra violet. Plates immersed in a 1 : 10,000 solution of the dye and a 1 per cent. solution of ammonia give the most perfect results the day after preparation, but they deteriorate rapidly unless kept perfectly dry. Well defined lines were thus photographed in the region of the great A of the second order of the spectrum, many of which were previously not known to exist. Cærulin S gives almost identical results.

It is, however, necessary that the dyes used for this purpose should be quite free from the minute crystallisable impurities with which the commercial products are in both cases contaminated. One of the processes employed to prepare pure Alizarin blue S was to treat Alizarin blue paste with a saturated solution of sodium bisulphite and water and allow the mixture to stand in a well-stoppered vessel for 5—6 weeks, the whole being shaken daily except for the last 8 or 10 days. The filtered solution is then treated with alcohol to precipitate the excess of sodium bisulphite and water and sodium chloride added. After 7 or 8 days the dye is deposited in a crystalline form together with calcium sulphite, which latter can, owing to its insolubility, be removed by redissolving and filtering when any unchanged Alizarin blue is also left behind. The final purification is effected from alcohol containing a small percentage of water. The crystals obtained are of a deep red colour; dilute solutions are pale sherry coloured and change successively on addition of ammonia to green, magenta, purple, and finally to blue. The absorption spectrum of this blue solution is strongest in the least refrangible end of the spectrum and appears to extend into the infra-red region. Cærulin S was prepared on similar lines; the pure substance is almost white. Its aqueous solution passes rapidly from pale yellow to bright green; a trace of ammonia produces an olive-green colour.—C. A. K.

XXII.—EXPLOSIVES, MATCHES, Etc.

PATENT.

Improvement in the Manufacture of Nitrate of Ammonium and of Resulting By-products. C. A. Burghardt, Manchester. Eng. Pat. 5442, April 10, 1890. *6d.*

See under VII., *page* 640.

XXIII.—ANALYTICAL CHEMISTRY.

APPARATUS.

Determination of the Specific Gravity of Viscous Substances. C. Scheibler. Ber. **24**, 357—358.

A method for determining the specific gravity of viscous substances has recently been described by J. W. Brühl (Ber. **24**, 182), but the author points out that 12 years ago he described a method for determining the specific gravity of beetroot molasses—an extremely viscous substance—at a meeting of the *Verein für die Rübenzucker Industrie*, which is simpler and more accurate than that of Brühl.

The apparatus consists of a pipette having glass taps at each end, to which glass tubes are fitted by grinding. The capacity is determined by filling the pipette—including the holes of the taps—with water at any given temperature, and weighing, and the actual determination is then made as follows:—When both tubes have been adjusted, the substance is sucked up into the pipette until it is beyond the upper tap; the lower tap is then closed and its tube removed. The apparatus and its contents are then brought to the required temperature by immersing in water, after which the upper tap is closed, and the other tube detached; any of the substance adhering to the two short tubes beyond the taps is removed with water or alcohol according to its nature, and the apparatus is dried and weighed. The apparatus may be used for determining the specific gravity of all liquids, and it possesses the advantage that the determination may be made at any temperature; it may be of any desired size.—A. R. L.

Boiling Point Determinations with small Quantities of Material. A. Schleiermacher. Ber. **24**, 945—947.

The substance is introduced into the closed limb of a U-tube, which is then sufficiently filled with mercury to prevent ingress of air into the closed portion. The whole is exposed along with a thermometer in a suitable bath, and the temperature read off as soon as the mercury column is the same height in both limbs. The reading corrected for pressure is the boiling point required.

The U-tube is constructed, rendered free from air and charged with substance in the following manner:—A piece of tubing 6—8 mm. in diameter and 50 cm. long, is drawn out to a moderate capillary at one end, and this capillary at its junction with the main tube is again drawn out to a hair-like capillary 50 mm. long, and the wider portion is cut off so as to leave only a small piece; the tube is then bent, making the open end twice as long as the closed one, and allowing the tube to contract to half its diameter at the bend. The substance is then introduced, poured in if a liquid, shaken and transferred to the closed limb if a powder, and mercury is admitted so as to fill the tube within 2 cm. of the closed end; heat is then applied to the closed limb with the object firstly of melting a solid substance to enable it to collect on top of the mercury, and secondly of causing the substance to boil slightly in order to drive out any air. Mercury is now poured into the open limb so as to cause the liquid or melted solid to rise through the narrow capillary into the piece of the wider capillary at the top, the narrow capillary is then fused

together before a small blow pipe, the mercury above the bend is poured from the open limb and the apparatus is then ready for use. The small quantity of gas left or produced by fusing up the capillary so far from being detrimental is useful in accelerating boiling and preventing its becoming violent.—D. A. L.

INORGANIC CHEMISTRY.—QUANTITATIVE.

New Apparatus for the Volumetric Estimation of Carbonic Anhydride, especially of Combined. G. Lunge and I. Marchlewski. Zeits. f. angew. Chem. 1891, 229—235.

The authors review the various methods which have been proposed for the estimation of carbonic anhydride, and point out that while some are in themselves too complex and lengthy for technical purposes, others are not sufficiently accurate in their original forms, and only become so when rendered so complicated as to exclude them from these. The method to be described may be employed for the estimation of both large and small quantities, and is in some respects similar to that of Petterson (this Journal, 1890, 897), but much simpler, temperature and pressure corrections being unnecessary, a single boiling sufficient and the number of readings reduced to two instead of six or eight; their concomitant errors are thus partially annulled. Fig. 1 represents the apparatus one-ninth the actual size, and the decomposition flask A is shown also in Fig. 2, one quarter its actual size; for the analysis of solid substances it should not exceed a capacity of 30 cc., but for the determination of carbonic anhydride in solution or of carbon in iron, may be larger and fitted with a condenser. It has a side tube *a* provided with a glass stop-cock *b* terminating in a funnel *c*; its neck is 18 cm. wide, and is fitted with a well-ground hollow stopper drawn out to a capillary tube 35 cm in length, bent at a right angle, and leading to the small side tube *e* (Fig. 1) of a gas volumeter on Lunge's principle (this Journal, 1890, 517). The apparatus may be employed with slight modification for measuring other gases, but when used exclusively for the estimation of carbonic anhydride as required in the cement or sugar industries, it is best constructed as shown in the figure. The top portion of the measuring tube B is a bulb of 100 cc. capacity, and is fitted with a Friedrich's stop-cock immediately under which is the 100 division, the calibration being continued to 150 down the cylindrical tube in divisions of 0·1 cc. The stop-cock *f* communicates with the capillary tubes *e* and *g* which run at a right angle to one another; *g* is connected by rubber tubing to another capillary tube provided with a stop-cock *h*, and communicating with the Orsat tube E which is filled with 1:3 soda-lye, and has a soda-lime tube *i* on the open end; all the rubber joints are wired. C is the reduction tube which terminates in a fused capillary, and D the pressure tube; the latter should be 3·5 cm. wide, and both are supported by the forked clamp (shown in the figure). In adjusting the apparatus it is necessary to observe the temperature and pressure (for which it serves as its own barometer) once for all, as follows:—The gas is expelled from B by raising D, the stop-cock *f* is then closed, and D lowered until the distance of its mercury level is over 760 mm. from *f*, when a partial vacuum will be formed in the top portion of B (D should be lowered sufficiently that the mercury sinks below the bulb in B); D is then made fast and the distance in millimetres between the two mercury levels in B and D ascertained. 1 mm. is deducted from this for the tension of mercury vapour at temperatures under 12° C., 2 mm. for 13° – 19°, and 3 mm. for 20° – 25°, and this, the pressure in millimetres is denominated *b*. The space which 100 cc. of dry air would occupy under these conditions is then calculated by the formula—

$$\frac{100.(273 + t).760}{273.(b - f)}$$

in which *f* is the tension of aqueous vapour which may be taken approximately as $(t - 2)$ for temperatures between 12° and 25°, thus—

$$\frac{100.(273 + t).760}{273.(b - (t + 2))}$$

The stop-cock *f* is next opened, the mercury in C adjusted to that division corresponding with this calculated volume, the columns in B and D being brought to the same height; a drop of water to saturate the air with moisture is then introduced into C, the capillary carefully sealed with a spirit flame, and after ascertaining that the enclosed volume of air has remained constant, the apparatus is ready for use.

A blank experiment is then made as follows:—0·1 grm. of fine aluminium or iron wire is introduced into A; B is filled with mercury by raising D, and is made to communicate with A by the stop-cock *f*, *h* being closed; D is then lowered, the stop-cock *h* opened, and D again raised so that the air in B is expelled through E; after this has been done on all three times the apparatus is considered sufficiently exhausted. Sufficient pure hydrochloric acid, diluted with four times its volume of *boiled* water, is introduced by *c* into A until it is three-quarters full; it is then gently heated when a brisk stream of hydrogen gas is evolved, care being taken that the pressure tube D has been sufficiently lowered. When the wire is dissolved and the

Fig. 1.

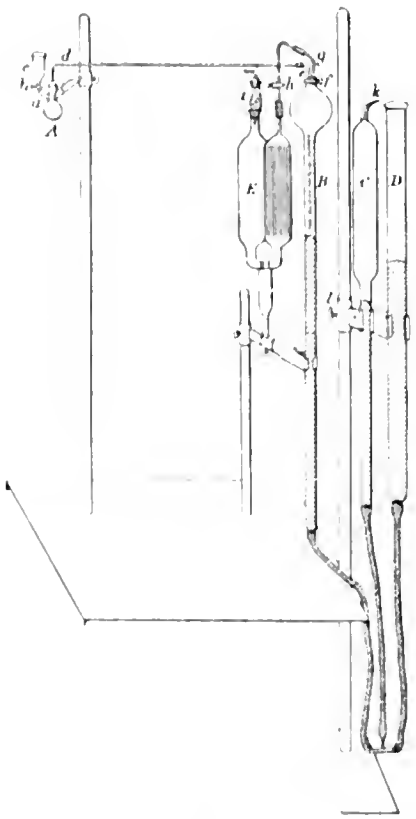
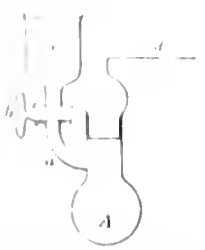


Fig. 2.



THE DETERMINATION OF CARBONIC ACID.

liquid has become clear, sufficient acid is run into A until it reaches the neck of the capillary *d*, and the stop-cock *f* is closed. The three tubes are adjusted to the same level, the mercury in C standing at the 100 division, and allowed to remain for 10 minutes to equalise their temperatures. During this the soda-lye is forced by blowing through *i* as far as the stop-cock *h*, which is then closed. A is now detached from the hollow stopper, washed free from acid, and prepared for the actual estimation. After adjusting, if necessary, the levels of the tubes, the volume indicated by B is read off; the cock *f* is now turned so that B communicates with *g* and *h* is opened; D is then raised, the gas driven from B into E, and again lowered; this is repeated several times. Finally the soda-lye is blown up as far as *h*, which is closed, and the tubes again brought to the same level, C standing at the 100 division. If the apparatus is quite perfect the reading indicated by B should be the same before and after the treatment with soda-lye. An error, so small that it is without influence on the result, is caused by the neglect of compressing the air contained in the capillary *g* to the standard condition before the gas is treated with soda-lye.

In the actual determination the gas is driven completely out of B by raising D, a weighed portion of the substance is introduced into A, together with sufficient aluminium wire (say 0·08 grm., 0·2 mm. in thickness), that just over 100 cc. of hydrogen are evolved. The stopper is placed in A, B is exhausted as described above, a little acid (sufficient for the decomposition of the carbonate), is introduced into A, and it is gently warmed with a spirit lamp for two minutes; after repeating the addition of acid three times more, enough is added to dissolve the aluminium, gentle warming being continued until the solution is quite clear, after which acid is run in until it reaches the capillary *d*, or better almost to the stop-cock *f*, and the remainder of the operation is conducted as in the blank experiment. The difference between the readings before and after treatment with soda-lye, gives the volume of carbonic anhydride *n* at 0° and 760 mm., and when *g* grms. of substance are taken the weight per cent. is found by the following formula:—

$$\frac{n \cdot 0{\cdot}1916}{g}$$

One experiment occupies 15—20 minutes, but during this time a fresh portion of substance can be weighed for another determination. The authors give a number of examples which show that the method gives good results.

—A. R. L.

On some Constants of Ammonia. H. von Strombeck. Reprint from J. Franklin Inst. 1890 and 1891.

See under VII., *page* 637.

New Method for the Quantitative Separation of Zinc and Manganese. P. Jannasch and J. F. McGregory. J. Prakt. Chem. 1891, **43**, 402—406.

The authors avail themselves of the fact that manganese is completely precipitated by hydrogen peroxide from alkaline solution as hydrated peroxide, in order to separate this metal from zinc. The solution containing the mixed salts is acidified with dilute hydrochloric acid, at least 100 cc. of a 15—20 per cent. of ammonium chloride solution added, and then 60—100 cc. of ammonium hydrate (conc.), so that the whole is strongly alkaline. An excess of hydrogen peroxide (which must be free from barium chloride) is then added; the complete precipitation of the manganese is indicated by the sudden frothing up of the solution, due to the liberation of oxygen. The precipitated hydrate is heated on the water-bath for 10—15 minutes, filtered, washed first with boiling ammonia water and then with boiling water only, and finally dried and weighed as Mn_3O_4 as usual. The filtrate from the manganese contains the zinc which can be determined either by precipitating it as sulphide, dissolving the latter in hydrochloric acid and re-precipitating as carbonate, or the solution can be evaporated to dryness, the residue heated for an hour to 125°—150° C. in an air-bath and then gently over the free flame so as to drive off the ammonium salts. The residue thus obtained is taken up with water, a few drops of hydrochloric acid added, the solution filtered and precipitated with sodium carbonate.

Two analyses are given in which the accuracy of the separation is satisfactorily shown.—C. A. K.

Detection of Mercury in Poisoning Cases. M. T. Lecco. Ber. **24**, 928—929.

The author calls attention to the fact that mercury is not readily dissolved by hydrochloric acid and potassium chlorate, and therefore when mixed with organic matter, as in the stomach in poisoning cases, the digestion with warm hydrochloric acid and potassium chlorate should be continued, with frequent shaking, for some hours after the organic matter has been oxidised, otherwise any mercury present would not all pass into solution, and not only could not the quantity present be determined but it might even escape detection altogether.—D. A. L.

ORGANIC CHEMISTRY.—QUALITATIVE.

Reaction of Dinitro-derivatives. J. V. Janovsky. Ber. **24**, 971—972.

When 10 per cent. aqueous potash is added drop by drop to a solution of a dinitro-derivative in pure acetone, and the whole shaken and allowed to stand, a characteristic colouration develops, which is not yielded by mononitro-derivatives, and therefore serves for the detection of dinitro-derivatives in their presence. Under the stated conditions, meta-dinitrobenzene gives a red-violet solution which attains the depth and appearance of permanganate, and is changed to dark red by acetic, and yellow by hydrochloric acid; potash does not restore original colouration but produces a dark red solution.

Dinitrotoluene (3, 2—4 meta) gives a blue solution turning violet-red with acetic acid. α-dinitronaphthalene gives a bluish-red solution, changed to eosin red by acetic acid, but completely restored by potash. Experiments are in progress to elucidate the cause of these reactions.

—D. A. L.

ORGANIC CHEMISTRY.—QUANTITATIVE.

The Use of the Calorimetric Bomb for Determining the Heat of the Combustion of Coal. M. Scheurer-Kestner. Compt. Rend. **112**, 233—236.

Berthelot's calorimetric bomb is well adapted for measuring the heat of combustion of coal, and has many advantages over Favre and Silbermann's calorimeter. The author, however, draws attention to two points: (1.) That Berthelot has advised that a correction should be made for the nitric acid which is always formed during the combustion; this is measured by titrating the water used for washing out the apparatus. Now coal always contains a certain quantity of sulphur, which is converted into sulphuric acid during combustion, and, in titrating after the combustion, both acids would be present. Hence in strictly scientific investigations it would be necessary to determine beforehand the amount of sulphur present. But in industrial work this is not necessary; both corrections may be neglected, for the heat evolved owing to the formation of nitric acid scarcely amounts to 1 per 1,000; whereas the production of sulphuric acid increases the heating effect in the furnace as well as in the calorimeter. (2.) It is impossible to weigh the ash of the substance burnt in the calorimeter; it is therefore necessary to work with average samples. Berthelot advises the use of pastilles; and these do well for determining the ash. The coal is first powdered finely and then well mixed: it is made into pastilles, and a certain number of these are used for determining the ash. The limits of error are at most 4 per 1,000.

The above drawbacks are amply compensated by the ease of manipulation and the precision of the results. The author finds, however, that the heats of combustion of coal as determined by the calorimetric bomb are from 1 to 3 per cent. lower than those determined by himself and M. Meunier Dollfus in their earlier work with the calorimeter of Favre and Silbermann. He attributes the difference not only to the use of the new apparatus, but also to the adoption of various corrections advised by Berthelot and latter methods of calorimetric work introduced by that experimenter.—D. L.J.

On the Influence exerted by the Extractive Matters in Spirituous Liquids on the Density Determinations. C. Blarez. Compt. Rend. **112**, 585—588.

The astringent and colouring matters of brandies and rums do not usually amount to more than 2 to 3 grms. per litre, and do not sensibly affect the specific gravity, but saccharine matters are frequently present in much larger quantities and necessitate a resort to distillation in order to determine the amount of alcohol present. The author proposes to avoid the necessity for this distillation by making a correction for the amount of residue found on evaporation, and adding this to the amount of alcohol corresponding to the actual specific gravity of the liquid. In order to simplify this calculation, the not unreasonable assumption is made that the solid residue left on evaporation consists chiefly of sugar, and in the case where glycerol can be shown to be present in any quantity, a separate table of corrections is provided. The only determinations required are the actual specific gravity of the liquid and the amount of solid residue left on evaporation to dryness, and from these the proportion of real spirit present is calculated. As the calculation to be adopted varies somewhat with the quantity of alcohol present and with the nature of the solid residue, the conditions to be observed are somewhat complicated, and make a reference to the original article desirable.—G. H. B.

The Estimation of Acetone in Denatured Spirit. L. Vignon. Compt. Rend. **112**, 873—875.

The author finds that if certain precautions be taken, acetone may be determined in denatured spirit by conversion into iodoform. It is essential to dilute the spirit largely and to employ an enormous excess of iodine. The details of the process are as follows. The alcohol to be examined, previously freed from aldehyde by Bardy's method, is diluted, say, 50 times with distilled water. 5 cc. of the dilute liquid (corresponding to 0·1 cc. of alcohol) are treated with 10 cc. of lunormal soda, and then with cc. of lunormal iodine, the iodoform being collected and weighed. A second test is made, using 20 cc. of soda and 10 cc. of iodine, and so on, the volumes of soda and iodine being doubled each time, until the results of two consecutive experiments are identical. These last figures are accepted as the correct result. (See this Journal, 1890, 670.)—H. L. F.

On the Dissociation Hypothesis; on Cryoscopic Methods; and on the Freezing-Points of Aqueous Solutions of Cane-Sugar. J. Traube. Ber. **24**, 1321—1327.

The author has already enumerated several objections to Arrhenius' hypothesis of electrolytic dissociation (see Ber. **23**, 3519, 3582; **24**, 737), and he now adds to these the results of his cryoscopic investigations with aqueous solutions of cane-sugar, which he considers well adapted to demonstrate the entire untenableness of the hypothesis.

Van't Hoff, in 1887, compared the osmotic pressure at different temperatures of a 1 per cent. aqueous solution of cane-sugar, calculated from Pfeffer's observations, with that of a gas containing an equal number of molecules in the same space; in other words, he sought to demonstrate that Avogadro's law may be applied to dilute solutions. In the case of certain salts whose osmotic pressure is abnormally large, it has been necessary to assume that these were (in dilute solutions), dissociated into their ions. According to Raoult's cryoscopic determinations, however, the osmotic pressure of a 1 per cent. solution of cane-sugar is very near to that of a basic salt; the same chemist also finds that the molecular depression increases inversely as the concentration.

Arrhenius, on the other hand, finds that there is a complete regularity of the lowering of the freezing point even with the most dilute solutions of cane-sugar. The author then points out that Arrhenius' determinations do not appear to be so trustworthy as those of Raoult; for example, the former employed his thermometer as a stirrer, and neglected to determine the freezing-point of the water he used, yet he states that during an experiment the zero-point of his thermometer rose 0·015°; and as he considered this rise to be proportional to the duration of the experiment, he corrected the zero-point accordingly. But an error in the latter of 0·015 would cause a difference of 20 per cent. with the most dilute sugar solutions.

The author has obtained concordant results with the use of an open beaker, and also with Beckmann's apparatus; but the latter seems to be specially adapted to hygroscopic solutions, and the value of an air-bath appears doubtful, as errors are occasioned as much by cooling too slowly as too quickly. The beaker employed had a capacity of 125 cc.; the thermometer was graduated in divisions of 0·02°, and had a range of 0° to 5°; it could easily be read to 0·002° by the aid of a cathetometer; the stirrer was of platinum. The utmost attention was paid to the determinations of the zero-point, which were made before and after each series of experiments. By keeping the thermometer in continual vibration, a constant reading is obtained in five minutes, but when the stirring is discontinued the mercury rises 0·1° or more above the zero-point; on resuming the stirring, however, it sinks to its original position. The error in the determination of the freezing-point of water was not above 0·002°, whilst in the case of dilute solutions it was below 0·005°. Raoult employed solutions which contained weighed portions of the substance in 100 grms. of water; whilst Arrhenius used gramme molecular proportions per litre of water, and the following table contains results obtained with both:—

Cane-sugar Solutions as used by Raoult.

Grms. in 100 grms. of Water. P.	Lowering of the Freezing Point = C.	Molecular Depression M. $\frac{C}{P}$
20·418	[illegible]	18·4
9·442	0·[illegible]	[illegible]
29·265	1·[illegible]	18·4
10·7[illegible]	0·5[illegible]	18·7
9·8564	0·[illegible]1	18·2
2·8508	0·[illegible]	18·6
2·7950	0·[illegible]5	18·0
1·879[illegible]	0·[illegible]	18·6
1·0146	0·0[illegible]	[illegible]
0·559	0·0[illegible]	[illegible]
0·372	0·0[illegible]	[illegible]

Cane-sugar Solutions as used by Arrhenius.

Grms. in 100 cc. of Solutions. P.	Lowering of the Freezing Point = C.	Molecular Depression M. $\frac{C}{P}$
5·[illegible]391	0·[illegible]300	19·4
2·[illegible]278	0·[illegible]098	18·5
1·[illegible]015	0·[illegible]290	18·2
0·[illegible]502	0·[illegible]092	18·6
0·[illegible]25	0·[illegible]042	18·5
0·[illegible]125	0·[illegible]0285	18·8
0·[illegible]0625	0·[illegible]0160	18·6
0·[illegible]0312	0·[illegible]0088	18·2
0·[illegible]0156	0·[illegible]0054	18·2
0·[illegible]0078	0·[illegible]0029	18·4
..	..	..

When the error in the determination of the freezing-point is taken as 0·01, thus four or five times greater than it really is, the results which are in agreement with those of Raoult are not altered, and the values which apply also to other organic substances serve to confirm the author's view that the osmotic coefficients of all organic compounds in sufficiently dilute solutions are the same, or nearly the same as those of many salts. The results are also in complete accord with the author's measurements of electrolytic conductivity and of capillarity, and it would seem that the dissociation of the molecular aggregates of organic compounds commences where that of salts ends. Pickering believes that in most non-electrolytes the depression is abnormally large, and that the differences between these and electrolytes are of degree only and not of kind.—A. R. L.

Estimation of Mechanical Wood Pulp in Paper.
W. Herzberg. Mitt. König. tech. Versuchs. 1891, 44—50.

No really exact method for the quantitative determination of mechanical wood pulp in paper is yet known (see also this Journal, 1890, 1068). The author describes the following methods, which are either colorimetric or gravimetric tests.

1. In Gaedicke's method (Sitz. d. polyt. Gesellsch. Berlin, 1882), a series of papers containing known quantities of mechanical wood pulp is treated with an aniline sulphate solution of a certain concentration, which produces yellow colourations. These are imitated by painting similar shades on paper, whereby the different percentages of mechanical wood pulp are indicated. Papers to be tested must be treated with the same aniline sulphate solution, and the yellow colours resulting are compared with the artificial colour scale. The degree of accuracy of this test is not stated.

2. Gottstein (Papierzeitung, 1884, 132) proposes to count under the microscope the number of wood fibres contained in a fixed area in papers of known percentages of mechanical wood pulp, after the said fibres have been rendered visible by a treatment with an alcoholic phloroglucinol solution and hydrochloric acid. This is made the basis for a comparison with the papers to be tested, which must be treated in the same way. The author is of opinion that this method can only be used if not more than about 10 per cent. of mechanical wood pulp are present, as larger quantities of wood fibres can hardly be counted with accuracy.

3. Wurster (Ber. 20, 808—810; Papierzeitung, 1887; this Journal, 1887, 565) has proposed to treat filter-paper with dimethylparaphenylenediamine. This paper is moistened with one or two drops of water or vinegar and brought in contact with the paper to be tested. The latter, if mechanical wood pulp is present, assumes a red colouration, and after being dried, the colouration is compared with a scale of standardised red colours as in Gaedicke's method. The author has found, however, that this method often gives inaccurate results.

4. Regarding Teclu's method, the author confirms the view of Benedikt and Bamberger (compare this Journal, 1891, 576), but has not sufficient data to base an opinion of its accuracy.

5. By A. Müller's method (A. Müller, Die qualitative und quantitative Bestimmung des Holzschliffs im Papier), the paper to be treated is moistened with a solution of salt, and then treated for 10 minutes with a cuprammonium solution of a certain concentration. The mechanical wood pulp is hereby little affected, whilst the pure cellulose fibres are dissolved. The loss is ascertained gravimetrically. Müller himself states that the errors of this method are 3 per cent. or more, and the author considers it unsuitable for practical purposes.

6. With reference to Godefroy's and Coulon's method, see this Journal, 1891, 576. The author is of opinion that this is the most accurate of all existing methods, and that modified may become a test of technical importance.

7. As regards the new method of Benedikt and Bamberger (see this Journal, 1891, 576—577), the author remarks that it is not less tedious than Godefroy's method, and probably in various details more difficult, *e.g.*, in ascertaining from what sort of wood the mechanical wood pulp has been manufactured.

The author himself, for technical purposes, uses a colorimetric method similar to those of Gaedicke and Wurster, but without employing an artificial colour scale. Any reagents for mechanical wood pulp, such as phloroglucinol, aniline sulphate, &c., may be employed in varying concentrations, and for comparison a complete set of papers of different thicknesses and known percentages of mechanical wood pulp is used. A preliminary test is made with phloroglucinol to see whether the paper in question contains little or much mechanical wood pulp, in order to make a selection among the necessary comparison papers. Then these, as well as the paper to be tested, are cut into small pieces of about 1·25 in. square and soaked from two to five minutes in a solution of phloroglucinol or any other reagent. The colouration then indicates to which of the comparison papers of known percentage of mechanical wood pulp the paper to be tested corresponds. The author recommends that the papers be examined in transmitted as well as reflected light. This method is stated to be more accurate than the other colorimetric tests, and is of special value for papers which contain but a small quantity of mechanical wood pulp, *e.g.*, less than 10 per cent. It is of course unsuitable for coloured papers, but may be used in cases where the colours can be easily removed or destroyed, *e.g.*, by dilute acids, alkalis, alcohol, &c. It must be mentioned that it is at present difficult to obtain a proper set of standard papers for comparison. The more complete such a collection is, the more accurate will be the result of the test.

The microscopic examination of the papers to be tested materially assists all the methods above described, and the author recommends comparisons with papers or paper pulps the composition of which is known. He does not, however, recommend the counting of fibres under the microscope, but prefers to judge from the general microscopic appearance. The before-mentioned preliminary test with phloroglucinol will be found useful also for the microscopical examination.—H. S.

Determination of Resin Oil in Mineral and Fatty Oils.
Holde. Mitt. König. tech. Versuchs. 1891, 51—52.

The following table contains the reactions which are characteristic and requisite for the detection of resin oil in mineral and fatty oils:—

—	Appearance.	Specific Gravity at 15·6° C.	Indices of Refraction at about 18° C.	Solubility in Alcohol at ordinary Temperatures. (1 Vol. of Oil to 2 Vols. of Alcohol.)	Colour when vigorously shaken with Sulphuric Acid of 1·624 Sp. Gr.	Morawsky's Test with Anhydrous Acetic Acid and Sulphuric Acid of 1·530 Sp. Gr.
Resin oils	Yellow or yellowish-brown. Smell and taste of resin.	0·97—0·98	1·535—1·549	50—73 per cent. volumetrically.	Red.	Violet red or red.
Mineral oils.....	Different shades, from yellow to black. Fluorescence.	0·89—0·92	1·500—1·507 (light-coloured mineral oils only).	2—15 per cent. volumetrically.	Yellow or brown.	No characteristic colour, different shades from green to brown or red.
Rape and olive oils....	Yellow or green. Characteristic smell.	0·913—0·917	Rape oils: 1·4725—1·4749 Olive oils: 1·4681—1·4696	....	Yellow.	No characteristic colour, different shades from green to brown.

If, however, only small quantities of resin oils are supposed to be present, or if mineral oils of dark colours have to be tested, the alcoholic extract mentioned in this table has to be evaporated, and the residue, if resin oil be present, will show all the reactions as well as the characteristic smell and taste of resin oil. (Compare this Journal, 1889, 572—573; 1890, 112, 419; 1891, 166, 276.)—H. S.

ANALYTICAL AND SCIENTIFIC NOTES.

The Action of Heat on Carbonic Oxide. Berthelot. Compt. Rend. **112**, 594—597.

On heating carbonic oxide to temperatures varying from 500° to a bright red-heat, it is found that a small amount of decomposition sets in, carbonic acid being formed. This decomposition, however, does not increase in amount as the temperature rises, the only difference being that at the lower temperatures no free carbon is formed. The action takes place even when traces of moisture and other impurities are rigorously excluded. For these reasons, the decomposition cannot be of as simple a nature as is usually represented, but is probably of the nature of a polymerisation, carbonic oxide being a formic anhydride, thus:—

$$10\,CO = C_5O_5 + 2\,CO_2.$$

This suboxide is apparently permanent at temperatures of 500°—550°, but at a red heat is split up into free carbon.—F. H. L.

A Reaction of Carbonic Oxide. Berthelot. Compt. Rend. **112**, 597.

If a few bubbles of carbonic oxide are passed into a weak and cold solution of ammoniacal silver nitrate, the liquid immediately assumes a brown colour, and at the boiling point the silver is quickly reduced. The action takes place also with an aqueous solution of the gas and is extremely delicate, not being hindered even by the admixture of a large amount of air. This property of carbonic oxide is the more interesting, seeing that the solution is not reduced by alkaline formates, nor by pure hydrogen.—F. H. L.

PATENT.

Improvements in and relating to Pyrometers or Thermometers. J. Murrie, Glasgow. Eng. Pat. 10,380, July 4, 1890. 8*d*.

See under I., *page* 625.

New Books.

The Chemistry of Illuminating Gas. By Norton H. Humphrys, Assoc. M. Inst. C.E., F.C.S., &c. London: Walter King, Office of "The Journal of Gas Lighting," &c., 11, Bolt Court, Fleet Street, E.C. 1891.

Octavo volume, bound in cloth, price 6*s*. It comprises Preface stating that the matter of the book consists mainly of articles written for the *Journal of Gas Lighting*, and published therein. The subject-matter fills 248 pages, is preceded by a Table of Contents, and followed by a carefully arranged Alphabetical Index. The text is subdivided as follows:—Introduction. Chap. I. Relative cost of Light from Gas, Oil, and Candles. II. Products of Combustion. III. The Sulphur Question. IV. The Composition of Illuminating Gas. V. Water Gas. VI. Various Gas-making Processes. VII. Oil Gas. VIII. Properties of Fluid Hydrocarbons. IX. Tar for Gas Making. X. Destructive Distillation. XI. Condensation. XII. Purification.

A few Notes on Varnishes and Fossil Resins. By R. Ingham Clark, F.L.S., F.R.G.S., &c. Illustrated by James West. London: Chas. Letts and Co., 3, Royal Exchange.

Elegantly bound quarto volume price 10*s*. 6*d*. The style is antique, though the type used for the general subject matter is the ordinary. The work is profusely and elegantly illustrated and the division of the matter is into two parts, viz., Part I. Varnish; and Part II. Resins. Under these two divisions the subject is sub-divided somewhat as follows:—

Part I. Varnish.—Definition: Etymology; Early Origin, &c. Growth and Commercial Extension. Japanese Lacquer: Japanese Lacquer unsuitable for European use: Probable large future consumption of European Varnishes in Japan and China. Modern Varnish making. Amber impracticable for Varnish purposes. Literature; Continental Works. Recent extension of the Trade. High esteem of English Varnish.

Part II. Resins.—Amber. Animis. Madagascar Animi. Demerara Animi. Copals. Sierra Leone Copals. Accra, Congo, Gaboon, and Loango Copals. South American Copals. Manila Copals. Kauri. Gum Damar. Mastic. Bastard Animis and Copals.

Tabellarische Uebersicht der Künstlichen Organischen Farbstoffe. Von Gustav Schultz und Paul Julius. Zweite verbesserte und vermehrte Auflage. Herausgegeben von Gustav Schultz, 1891. Berlin: R. Gaertner's Verlagsbuchhandlung, Hermann Heyfelder, Schönebergerstrasse 26, S.W. London: H. Grevel and Co., 33, King Street, Covent Garden.

This admirable work, a model of useful condensation and classification of a wide and diffuse subject, is dedicated to Professor A. W. Hofmann on the occasion of his 70th birthday as a mark of high esteem and veneration by the author. It is a quarto volume bound in cloth and gilt, and containing besides the Dedication already referred to, Preface to the first edition, a short one to the second edition, in which it is claimed that the present edition contains over 100 new colouring matters added to those described in the first edition, Table of Contents and List of Abbreviations. The tabulated Review covers no less than 723 pages, and is followed by an Alphabetical Index, and the work ends with a small list of Corrigenda. In the tabulated list of Colours no less than 392 of these are referred to.

The following Classes of Colours are described in this work:—I. Nitrofarbstoffe. II. Azoxyfarbstoffe. III. Hydrazonfarbstoffe. IV. Azofarbstoffe. V. Nitrosofarbstoffe, Chinoximfarbstoffe. VI. Oxyketonfarbstoffe. VII. Diphenylmethanfarbstoffe. VIII. Triphenylmethanfarbstoffe. IX. Indophenole. X. Oxazine und Thiazine. XI. Azine. XII. Künstlicher Indigo. XIII. Chinolinfarbstoffe. XIV. Acridinfarbstoffe. XV. Thiobenzenylfarbstoffe. XVI. Farbstoffe von unbekannter Constitution. The price of the work is 14*s*.

Encyclopedic English-German and German-English Dictionary. Uniform in plan and arrangement with Sachs Villatte's French-German and German-French Dictionary. Giving the Pronunciation according to the phonetic system employed in the method of Toussaint-Langenscheidt. English-German. By Professor Dr. Ed. Muret. Unabridged Edition. Part 2. Berlin: Langenscheidt'sche Verlagsbuchhandlung (Prof. G. Langenscheidt), 1891. New York: The International News Company. London: H. Grevel and Co., 33, King Street, Covent Garden.

Part 2 is now issued, in paper cover, large 8vo size. It extends from ALU to BAN. Price 1*s*. 6*d*. It may be added that this great work includes technical terms; in the words of the compiler it is "For the general public, and consequently for all classes of society, the man of science no less than the man of the people." It is written "To serve the great Anglo-Germanic family of nations, branches of which are now established in all parts of the world, as a practical means of understanding each other." The Preface alone of this work is a study, and indeed a wonder, of condensed and well classified information.

Trade Report.

(*From the Board of Trade Journal.*)

TARIFF CHANGES AND CUSTOMS REGULATIONS.

Norway.

Tariff Changes.

Note.—Krone = 100 Öre = 1*s.* 1½*d.* Kilog. = 2·204 lb. avoirdupois. Litre = 0·22 imperial gallon.

Mr. T. Michell, Her Majesty's Consul General at Christiania, in a report to the Foreign Office, dated the 19th June last, encloses the following list of the principal alterations made in the Norwegian tariff during the present session of the Storthing, and which came into force on the 1st July :—

Tariff No.	Articles.	New Duty.		Old Duty.
			Kr. Öre.	Kr. Öre.
46—52	Spirit of every kind :— When by admixture spirits shall be made unfit to be prepared for drink, or if the Customs Department shall be satisfied that the spirit is guaranteed against use as a drink, they may charge a lower duty, viz. :—			
	(*a.*) Spirits.....	Litre	0·10	Free.
	(*b.*) Spirit varnish.....	Kilog.	0·10	2·00
76—79	Vinegar and acetic acid :—			
	(1.) In casks :—			
	(*a.*) Not over 10 per cent. of acid :—			
	Up to and including 31st December 1891.	Kilog.	0·16	0·16
	From 1st January 1892.	„	0·05	
	(*b.*) Over 10 per cent. of acid :—			
	Up to and including 31st December 1891.	„	1·60	1·60
	From 1st January 1892.	„	0·10	
	Tare under 1 (*a*) and (*b*) 16 per cent. :—			
	(2.) In bottles or jars :—			
	(*a.*) Under 10 per cent. of acid :—			
	Up to and including 31st December 1891.	Litre	0·17	0·17
	From 1st January 1892.	„	0·10	
	(*b.*) Over 10 per cent. of acid :—			
	Up to and including 31st December 1891.	„	1·60	1·60
	From 1st January 1892.	„	0·10	
357	Oils. I. :—			
	(*c.*) Castor oil (*oleum ricini*)	„	0·01	Free.
358	Oils. I. :—			
	(*d.*) Colouring for butter ...	„	0·04	Free.
360	Oils. II. :—			
	(*a.*) Camphine, paraffin, photogen, wood oil, and similar illuminating oils, American mineral oil and petroleum.	„	0·05	0·10
450	Stone, and manufactures of :—			
	(2.) Emery.....	Free		0·07
356	Sugar and syrup :—			
	Sugar of every kind, including dissolved and other liquid sugar (and therefore also juice in which the sugar has been separated) which cannot be classified under ordinary syrup or molasses; grape and starch sugar and grape and starch syrup.	Kilog.	0·30	0·40

Morocco.

Export of Essences.

Note.—The real = 2½*d.* about. Quintal = 220·4 lb. avoirdupois.

Mr. H. E. White, Her Majesty's Chargé d'Affaires at Tangiers, in a despatch to the Foreign Office dated the 30th May, transmits copy of circular letter, together with its enclosure, addressed by the French Minister to the representatives of foreign powers at Tangiers, announcing that he had obtained from the Sultan permission for the distillation and exportation of the following essences on payment of the undermentioned duties :—

Carraway essence, 100 reals per quintal: thyme essence, 40 reals per quintal; peppermint essence, 40 reals per quintal; wormwood essence, 100 reals per quintal; arbutus essence, 20 reals per quintal.

Distillation can only take place in towns such as ports, to the exclusion of the country districts.

Merchants must confine themselves to the distillation of the five products mentioned above, to the exclusion of all others. Every other essence found in their possession will be treated as contraband goods, and confiscated.

Switzerland.

Classification of Articles in Customs Tariff.

Note.—Quintal = 220·4 lb. avoirdupois. Franc = 9$\frac{6}{10}$*d.*

The following decisions affecting the classification of articles in the Swiss Customs tariff were given by the Swiss Customs authorities in the month of April last :—

"Lux luxuria" (waxing for furniture).—Category 9. Duty, 10 francs per quintal. This product when made with alcohol pays further a monopoly tax (*finance de monopole*) of 3·50 frs. per quintal gross weight.

Acetone (*spiritus pyroacetieus*, spirits of pyroligneous vinegar).—Category 17. Duty, 1 fr. per quintal.

Explosives of all kinds, such as melinite bombs, &c., loaded.—Category 20. Duty, 50 frs. per quintal.

Alloys of aluminium, hammered, rolled, drawn, in bars, sheet, tubes, wire.—Category 137. Duty, 3 frs. per quintal.

United States.

Customs Decisions.

The following decisions respecting the construction to be given to Acts of Congress relating to the classification of articles in the Customs tariff, and the application of the Customs laws of the United States, have recently been given by the Customs authorities in that country :—

Celluloid tags or labels to be used in designating the names of various plants are dutiable at 60 cents a pound and 25 per cent. *ad valorem* under the provision of paragraph 21, Act of October 1890, for finished articles made of collodion.

Chloral hydrate is dutiable under paragraph 74, N. T., as a "medicinal preparation" of which alcohol is a component part, or in the preparation of which alcohol is used, not specially provided for in this Act.

Bicarbonate of potash is dutiable as a chemical salt not specially provided for, under the Act of the 1st October 1890, at 25 per cent. *ad valorem* under paragraph 76 of said Act.

Resoreine being a preparation of coal tar, not a colour or dye, and so commercially known, is specifically provided for in paragraph 19, N.T., and subject to duty at 20 per cent. *ad valorem.*

EXTRACTS FROM DIPLOMATIC AND CONSULAR REPORTS.

Mining in Oregon.

Mr. Vice-Consul Laidlaw supplies the following particulars of mining in Oregon :—

Copper is found in Baker and Josephine counties, but the deposits are not worked. Chrome ore is found in Southern

Or gon, and nickel in Douglas, Josephine and Jackson counties. Manganese has been found in quantity in Columbia county. There are coal-fields in Coos, Columbia, Clatsop, and Washington counties, but none of the deposits have been worked, except those of Coos bay, which have been worked for years and yield a very superior quality of coal.

About five miles north of this port, at Oswego, large deposits of brown hematite are found, the thickness of the vein varying from 6 ft. to 15 ft. These mines have been worked for some years by the Oregon Iron and Steel Company. The ore analyses are as under:—Metallic iron, 44·51 per cent.; phosphorus, 0·656 per cent.; phosphorus in 100 parts iron, 1·490 per cent. There are other deposits of similar ore in other portions of the State, but they are not worked.—(*No. 906, Foreign Office Annual Series.*)

GENERAL TRADE NOTES.

Petroleum Production in the United States.

A bulletin on the production of petroleum in the United States has been issued by the Division of Mines and Mining of the Census Office. This shows that petroleum was produced in 11 States in 1889, namely, Pennsylvania, New York, Ohio, West Virginia, Colorado, California, Indiana, Kentucky, Illinois, Kansas, and Texas. The total production is shown to be 31,820,306 barrels, valued at 26,554,052 dols. It also shows the annual production of petroleum in the United States from 1859 to 1889 inclusive.

The returns show that of the total product of petroleum 109,801 barrels were disposed of for lubricating, 12,330,843 for fuel, and 22,379,602 for illuminating purposes. Nearly the entire amount produced in California, Indiana, and Ohio, was used for fuel, while nearly the entire amount produced in Colorado, New York, Pennsylvania, and West Virginia was used for illuminating purposes.

Spanish Imports of Alcohol.

The *Monde Economique* quotes from official statistics recently published to the effect that the export of German alcohol to Spain has within the last few years diminished very largely. In 1882 the exports of this product only totalled 189,000 metric quintals, whilst they increased for each of the years 1883, 1884, 1885, and 1886, to 248,000, 353,000, 410,000, and 512,000 metric quintals, respectively. For 1887 there were only registered 274,000 metric quintals, 142,000 for 1888, and 138,000 for 1889. This diminution should, says the *Monde Economique*, enable French producers to regain in Spain their old ascendency.

The Minor Mineral Industries of the West.

Much attention is now being given in the Rocky Mountain States to the mining of many of the minor, but still important minerals. In nearly all of these States there are extensive deposits of useful and valuable minerals, the existence of which has been known for many years, but which have hitherto been comparatively neglected, the greater profit possible in gold and silver mining being more attractive to mining men, while unfamiliarity with the uses and markets of the minor minerals has caused them to be passed over in many instances by prospectors. The fact that they are now exciting more interest is evidence of the business like manner in which the mining industry in the West is at present being conducted.

Several of these comparatively new undertakings have attained considerable magnitude. Thus, the stone quarrying industry, commenced to meet local demands, has become an important source of wealth to a number of the States. Colorado, for instance, shipping its product to all parts of the country. A recent bulletin issued by the Census Office on the sandstone quarrying industry in the United States showed that Colorado had risen during the past decade to the third position in the list of States producing this stone. The petroleum industry in Colorado and California is of much importance and is growing, the product having increased in Colorado from 297,042 barrels in 1888 to 316,476 barrels in 1889. In California, however, there was a considerable decrease during the same time.

Extensive deposits of borax were discovered in California and Nevada many years ago; and in the early days upon the Comstock lode, when there was a demand for this chemical for certain milling processes in use there, the marshes were worked upon a small scale. Some time afterwards it was found that the product, which was of excellent quality, could be shipped to England at a profit, and a business of considerable importance was thus established. The borax marshes of California are now being systematically worked, and the proprietary companies are paying substantial dividends.

The large deposits of asphaltum and kindred minerals in California and Utah are now attracting considerable attention, as is shown by the fact that their production has grown from 4,000 tons in 1887 to 53,800 tons in 1888 and 51,735 tons in 1889. The asphaltum minerals of California and Utah are of widely different kinds, ranging from the semi-liquid brea and hard gilsonite, suitable for the manufacture of varnishes, to bituminous rock used in concrete; much of the latter is of excellent quality, comparing favourably with the asphaltum of Trinidad. This industry has not yet attained such large proportions in Utah as in California, the deposits in the territory being situated far from railways. They are of great extent, however, and several companies have been organised during the present year to undertake their development.

Utah, whose mineral resources are extremely diverse in character, also contains large beds of sulphur, which have been worked somewhat extensively although allowed to lie idle during the past two years, but we are informed these mines are about to be reopened. A recent discovery of nitre has been made in the territory.

Nevada also contains beds of sulphur, which are now being worked upon a small scale. Nickel exists in the State, and a small amount has been produced, but these deposits do not seem to be of great importance. A more promising industry has been established in Nevada during the present year in the mining of antimony ore, large veins of which have been found. One of these was acquired about five months ago by an English company, which proposes to operate it energetically, and has already commenced shipment of its products to Liverpool. The ore is undoubtedly of excellent quality, and it would seem that the industry might be profitably prosecuted.—*Eng. and Min. Journal.*

The Salt Trade of British India.

A significant feature in the returns of the salt trade of India for the past year is the steadily increasing import of crushed salt from Hamburg, Aden, and the Sulkea Golahs. The *Englishman* of Calcutta says that in the course of three years the amount of Liverpool salt passing through the Calcutta Customs has decreased by about 17 per cent., while the Hamburg imports have increased by 700 per cent. In 1888 no salt was received from Aden or the Sulkea Golahs; in 1890 the import amounted to nearly a lakh and a half of maunds. In the opinion of the collector, the Hamburg salt, which is steadily winning a market, will eventually be displaced in its turn by the crushed kurkutch of Aden and Golah. At present, however, the chief difficulty with which both varieties of crushed salt have to contend in their competition with Liverpool is that of bulk. In the wholesale trade this difficulty does not arise, since salt is bought only by weight; but the native consumer is accustomed to purchase in small quantities and by measure, usually by the handful. Since Liverpool salt is bulk for bulk lighter than its rivals, the retailer can afford to give a larger handful; and some time must elapse before the consumer can be brought to see that a small handful of kurkutch is equivalent in salting property to a considerably greater measure of the Liverpool product. The rapid introduction of kurkutch is due to the fact that the dealer can afford at present prices to undersell the lighter variety, not only weight for weight, but bulk for bulk.

The Platinum Speculation.

The Siberian Commercial Bank at Jekaterinenburg announces its readiness to advance holders of platinum

metal from 300 to 371 roubles per kilo. (= about 16*l.* to 19*l.* per lb.) on their stocks. The object of this announcement is said to be to counteract the schemes of English speculators who have organised a strong movement for the depression of the platinum prices.—*Chemist and Druggist.*

German Photographic Dry Plates.

The annual report of the Frankfort-on-the-Main Chamber of Commerce complains of the adverse influence of the high Customs duties on glass upon the German industry of photographic dry plates. Principal among the raw materials of that industry, which is a considerable one in Germany, are nitrate of silver and window glass. Silver has considerably advanced in price recently, and window glass has likewise risen. Dry plate manufacturers can use only English, or, in case of need, Belgian glass. German glass is unsuitable, because it is too unequal in thickness and not sufficiently straight. But the German glass manufacturers are protected by a high duty, and hence they do not take the trouble to produce as good glass as the foreign makers. In consequence of this, the price of glass in England has advanced 50 per cent., which difference has to come out of the pockets of the German dry plate manufacturers, who are already heavily handicapped in neutral markets by the great expansion of the dry-plate industry in England and Belgium. On these grounds the Frankfort Chamber of Commerce claims a reduction in the glass duties. It should be added that the Frankfort Chamber of Commerce is a body of pronounced free trade views, and that it is scarcely correct to describe the advance in the English glass prices merely or chiefly to the necessities of the German photographic dry-plate makers.—*Ibid.*

Recent Trade Blue Books.

United States Tariff. Return respecting the Customs Tariff of the United States, including a Tabular Statement comparing the Rates of Import Duty now levied with those which were in existence previous to the 1st October 1890, the "McKinley Administrative Act," and other documents. (*C.*—6381.) *Price* 1*s.*

This is a statement issued by the Commercial Department of the Board of Trade, showing in a comparative form the rates of import duty levied under the present and the previous Customs tariffs of the United States. It contains also the remaining provisions of the Tariff Act of the 1st October 1890, in full, as well as the text of the McKinley Administrative Act of the 10th of June 1890, together with the regulations and Treasury instructions to officers of Customs under the Act.

Mines and Minerals. Mineral Statistics of the United Kingdom of Great Britain and Ireland, with the Isle of Man, for the Year 1890. (*C.*—6364.) *Price* 1*s.* 4½*d.*

This is a return prepared under the direction of the Home Office. In the introduction it is stated that the present volume contains an account of the quantity and value of all minerals wrought in mines, the value of all minerals obtained from openworks, brineworks, &c.; a table of the mines inspection districts, with the names and addresses of inspectors of mines, assistant inspectors, secretaries to boards for examinations, and the clerk of mineral statistics; also an appendix showing the production of minerals in the British colonies and possessions.

The sources from which minerals are obtained in the United Kingdom are classed under three heads:—

1. Mines under the Coal Mines Regulation Act.
2. Mines under the Metalliferous Mines Regulation Act.
3. Openworks, brineworks, &c. which are not comprised by these Acts.

The introduction further states that an annual return is required to be sent from every mine to the inspector for the district specifying, under the Coal Mines Act, the quantity of minerals wrought during the year, and, under the Metalliferous Mines Act, the quantity of minerals dressed, and of the undressed minerals sold, treated, or used during the year.

The statistics of minerals wrought from mines are prepared from these statutory returns.

The statistics of minerals obtained from openworks, brineworks, &c., are obtained from information furnished to the inspectors of mines and to the Home Office, the total number of persons employed at openworks being taken from the census returns.

The exports and imports of each of the principal minerals, furnished by the Board of Customs, are given after the tables of production, and in several cases information as to distribution, supplied by railway and navigation companies, is added.

Lists of smelters of the principal metallic ores follow the export and import tables, and, in the case of iron, the make of pig-iron and the quantity of ore and coal used are given for each county, from statistics furnished to the Home Office by the owners of blast furnaces.

The general summary shows that coal, iron ore, and stone are the most important minerals worked in the United Kingdom.

An appendix is added showing the production of minerals in the British colonies and possessions, compiled from official reports and other sources.

British and Foreign Spirits. Report 210. *Price* 1*s.* 5½*d.*

This is the report of the Select Committee of the House of Commons appointed to consider whether, on grounds of public health, it is desirable that certain classes of spirits, British and foreign, should be kept in bond for a definite period before they are allowed to pass into consumption, and to inquire into the system of blending British and foreign spirits in or out of bond, and into the propriety of applying the Sale of Food and Drugs Act and the Merchandise Marks Act to the case of British and foreign spirits and mixtures of British and foreign spirits, and also into the sale of ether as an intoxicant.

The Committee in their present report, after reviewing the production and consumption of spirits, their distillation, together with their definition and classification, character and purity, state, with regard to the latter point, that they arranged with the Inland Revenue that about 50 samples of spirits should be collected from public-houses, shebeens, and fairs in various parts of the country, to ascertain whether adulterations of a pernicious character might be put into them by the retailer before being given out to the customers. It is pleasing to say that not a single case of such adulteration was found. They varied greatly in strength, being from 14 to 30 under proof, but the spirit was normal.

With regard to the blending of spirits, the Committee state that they do not recommend any increased restrictions on blending spirits. The trade has now assumed large proportions, and it is the object of blending to meet the tastes and wants of the public, both in regard to quality and price. The addition of patent-still spirit, even when it contains a very small amount of by-products, may be viewed rather as a dilution than an adulteration, and, as in the case of the addition of water, is a legal act within the limits of strength regulating the sale of spirits.

With regard to the bonding of spirits, the Committee state that their general conclusion from the evidence submitted is that compulsory bonding of all spirits for a certain period is unnecessary, and would harass trade.

With regard to the effect of spirits on public health the Committee is of opinion that as the public show a marked preference for old spirits, which the trade find more profitable, and as the practice has arisen of blending whiskies with patent spirits, to fit them for earlier consumption, it is not desirable to pass any compulsory law in regard to age, especially as the general feeling of the trade is that such an obligation would harass commerce and be an unfair burden on particular classes of spirits.

Potassium Salts.

For some time past the "Georg" Brown Coal Works Company has been making deep borings for rock salt at Aschersleben, and during the past year has discovered

layers of rock salt, for which the company has obtained the right of working. A discovery of potassium salts has recently been made at a depth of 1,050 ft., and some works have been erected there.—*Industries*.

Papers of Interest to Technologists and Manufacturers.

The following articles in the *Board of Trade Journal* for July will repay perusal:—

"The French Sport Industry," p. 11.

"Prospects of Rayon Production in the United States," p. 15.

"Trade Development and Prospects in Peru," p. 20.

BOARD OF TRADE RETURNS

Summary of Imports.

	Month ending 30th June	
	1890.	1891.
	£	£
Metals	2,031,864	2,195,346
Chemicals and dyestuffs	632,832	593,989
Oils	669,721	659,106
Raw materials for non-textile industries	3,663,124	3,963,939
Total value of all imports	32,926,295	56,850,124

Summary of Exports.

	Month ending 30th June	
	1890.	1891.
	£	£
Metals (other than machinery)	3,775,301	4,225,504
Chemicals and medicines	732,528	761,104
Miscellaneous articles	2,718,670	2,886,133
Total value of all exports	21,502,817	21,131,399

Imports of Metals for Month ending 30th June.

Articles.		Quantities.		Values.	
		1890.	1891.	1890.	1891.
				£	£
Copper —					
Ore	Tons	10,130	14,614	95,708	130,749
Regulus	„	11,040	11,014	317,205	263,589
Unwrought	„	4,913	4,147	225,127	253,078
Iron —					
Ore	„	99,436	215,458	253,667	247,282
Bolt, bar, &c.	„	7,720	8,275	109,587	89,976
Steel, unwrought	„	244	408	4,156	4,453
Lead, pig and sheet	„	14,615	14,884	175,871	207,742
Pyrites	„	80,021	94,144	109,284	86,325
Quicksilver	Lb.	143,007	162,240	55,216	68,424
	Cwt.	10,806	20,854	178,165	170,435
Zinc	Tons	6,144	8,749	164,049	164,781
Other articles	Value £	..	..	91,740	140,267
Total value of metals		..	..	2,031,864	2,195,346

Imports of Oils for Month ending 30th June.

Articles.		Quantities.		Values.	
		1890.	1891.	1890.	1891.
				£	£
Cocoa-nut	Cwt.	11,376	55,216	15,775	81,654
Olive	Tuns	4,132	1,958	160,010	78,837
Palm	Cwt.	73,319	92,233	77,828	109,150
Petroleum	Gall.	8,645,981	8,779,812	184,514	174,975
Seed	Tons	1,440	1,401	37,298	36,769
Train, &c.	Tuns	5,373	3,431	61,702	73,456
Turpentine	Cwt.	35,757	27,117	54,399	39,195
Other articles	Value £	..	..	81,195	66,150
Total value of oils		..	..	669,721	659,106

Imports of Raw Materials for Non-Textile Industries for Month ending 30th June.

Articles.		Quantities.		Values.	
		1890.	1891.	1890.	1891.
				£	£
Bark, Peruvian	Cwt.	10,737	7,113	32,186	15,091
Bristles	Lb.	231,341	286,159	36,610	42,326
Caoutchouc	Cwt.	14,529	26,898	103,846	329,245
Gum:—					
Arabic	„	6,006	4,388	16,704	12,944
Lac, &c.	„	1,454	10,511	19,067	36,843
Gutta-percha	„	3,134	4,382	26,909	47,036
Hides, raw:—					
Dry	„	31,095	41,445	84,765	111,728
Wet	„	62,079	48,375	142,240	114,525
Ivory	„	1,771	815	90,413	39,519
Manure:—					
Guano	Tons	5,257	2,162	31,830	10,713
Bones	„	4,519	4,772	23,105	22,522
Paraffin	Cwt.	35,206	56,269	43,024	80,312
Linen rags	Tons	3,753	3,019	34,812	30,505
Esparto	„	19,543	20,803	89,278	100,521
Pulp of wood	„	10,806	16,756	61,369	81,836
Rosin	Cwt.	216,057	269,187	50,000	69,118
Tallow and stearin	„	161,122	143,055	191,306	185,682
Tar	Barrels	6,563	3,918	6,396	2,394
Wood:—					
Hewn	Loads	190,229	236,281	433,100	442,356
Sawn	„	509,013	560,518	1,182,111	1,156,355
Staves	„	18,981	18,435	70,553	61,285
Mahogany	Tons	2,177	4,362	18,618	40,258
Other articles	Value £	..	..	812,462	939,705
Total value		..	..	3,663,124	3,963,939

Besides the above, drugs to the value of 77,567*l.* were imported as against 68,704*l.* in June 1890.

Imports of Chemicals and Dyestuffs for Month ending 30th June.

Articles.	Quantities.		Values.	
	1890.	1891.	1890.	1891.
			£	£
Alkali..... Cwt.	4,006	7,549	3,667	4,816
Bark (tanners, &c.) „	93,131	53,918	16,574	27,190
Brimstone..... „	64,494	58,830	14,136	17,710
Chemicals..... Value £	..	..	132,261	121,153
Cochineal ..... Cwt.	700	515	4,368	3,377
Cutch and gambier Tons	2,033	1,962	55,946	47,093
Dyes :—				
Aniline..... Value £	..	..	18,671	20,978
Alizarine..... „	..	..	25,922	31,230
Other ..... „	..	..	2,413	2,597
Indigo ..... Cwt.	1,976	1,167	26,308	23,902
Madder ..... „	728	1,038	903	1,238
Nitrate of soda.... „	111,527	169,224	45,728	74,515
Nitrate of potash . „	26,111	16,318	24,253	15,047
Valonia..... Tons	2,622	1,021	52,570	21,808
Other articles... Value £	..	..	188,875	184,252
Total value of chemicals	..	..	642,632	596,909

Exports of Miscellaneous Articles for Month ending 30th June.

Articles.	Quantities.		Values.	
	1890.	1891.	1890.	1891.
			£	£
Gunpowder..... Lb.	839,200	1,104,500	18,697	31,004
Military stores.. Value £	..	..	86,859	87,510
Candles..... Lb.	1,139,900	1,399,100	22,181	28,645
Caoutchouc ..... Value £	..	..	92,495	102,357
Cement..... Tons	50,954	62,785	104,489	124,510
Products of coal Value £	..	..	87,817	152,699
Earthenware ... „	..	..	171,286	164,212
Stoneware ..... „	..	..	16,827	15,342
Glass :—				
Plate..... Sq. Ft.	309,730	233,461	20,542	18,156
Flint..... Cwt.	8,221	8,801	20,285	20,604
Bottles..... „	70,201	63,772	33,093	30,547
Other kinds.... „	17,592	20,558	14,841	17,499
Leather :—				
Unwrought .... „	11,544	13,438	107,385	119,314
Wrought ..... Value £	..	..	23,621	28,262
Seed oil..... Tons	4,782	5,533	115,219	125,075
Floorcloth ..... Sq. Yds.	1,298,600	1,637,400	65,614	70,909
Painters' materials Val. £	..	..	126,352	143,646
Paper ..... Cwt.	86,337	90,141	144,541	154,607
Rags..... Tons	4,429	5,234	33,713	35,968
Soap..... Cwt.	42,703	50,960	45,122	51,887
Total value	..	..	2,718,670	2,886,133

Exports of Metals (other than Machinery) for Month ending 30th June.

Articles.	Quantities.		Values.	
	1890.	1891.	1890.	1891.
			£	£
Brass..... Cwt.	9,075	9,795	42,647	44,290
Copper :—				
Unwrought ..... „	69,720	60,915	199,805	169,993
Wrought..... „	25,147	27,798	84,908	90,526
Mixed metal .... „	38,334	25,311	105,845	71,234
Hardware ..... Value £	..	..	231,967	208,558
Implements..... „	..	..	105,200	114,783
Iron and steel..... Tons	346,704	358,895	2,616,564	3,068,000
Lead ..... „	5,276	5,252	74,952	73,734
Plated wares... Value £	..	..	20,023	31,079
Telegraph wires, &c. „	..	..	152,228	220,985
Tin ..... Cwt.	8,547	7,581	41,964	36,410
Zinc ..... „	18,697	15,057	18,230	15,032
Other articles .. Value £	..	..	80,488	80,970
Total value	..	..	3,775,311	4,225,594

Exports of Drugs and Chemicals for Month ending 30th June.

Articles.	Quantities.		Values.	
	1890.	1891.	1890.	1891.
			£	£
Alkali..... Cwt.	483,176	519,834	157,348	196,831
Bleaching materials „	109,430	134,915	30,829	16,618
Chemical manures. Tons	24,788	28,738	162,066	177,313
Medicines..... Value £	..	..	88,229	88,996
Other articles... „	..	..	293,656	251,346
Total value	..	..	732,528	761,104

Monthly Patent List.

* The dates given are the dates of the Official Journals in which acceptances of the Complete Specifications are advertised. Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the said dates.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

Applications.

10,181. T. Thorp and J. Birtwisle. *See* Class XVIII., *B.*

10,229. E. Theisen. Improved method of and apparatus for effecting the condensation of steam and other condensible vapours. June 17.

10,411. W. Bergins. *See* Class XVII.

10,456. H. L. Callendar. Improvements in pressure gauges, suitable especially as piezometers, barometers, thermometers, and the like. June 19.

10,516. The Manchester Oxygen (Brin's Patent) Co., Lim., and W. M. Jackson. Improvements in and in the mode of utilising the pressure in cylinders or reservoirs of compressed gases in the application or employment of such gases. June 20.

10,599. F. F. Bourdil. Improvements in apparatus for atomising or pulverising liquids. June 22.

10,616. E. Theisen. Improvements in apparatus for condensing steam and other condensibl. vapours. June 22.

10,651. G. Glydon. Regulators or governors for compressed gases or other fluids. June 23.

10,659. H. Wilson. *See* Class XVII.

10,738. C. H. Haußold. A centrifugal machine for incorporating together various substances. Complete Specification. June 24.

10,752. G. Grondal. Improved regenerative gas furnace. Complete Specification. June 24.

10,771. W. J. Tranter and S. Hale. An improved compound for preventing incrustation and corrosion in steam and other hot water boilers. June 24.

10,833. A. W. Ellis. An improved stand for chemical or other purposes. June 25.

10,902. J. F. Braidwood. *See* Class II.

11,031. R. Harvey. Improvements in and relating to evaporating apparatus. June 29.

11,043. G. W. Miller. Improvements in faucets for measuring fluids. Complete Specification. Filed June 29. Date applied for January 13th, 1891, being date of application in United States.

11,210. L. H. Armour. *See* Class II.

11,353. W. O. Taylor. The oxidising retort furnace. July 4.

11,443. H. D. Healey. Improvements in cauldrons for melting pitch and fatty substances. July 6.

11,556. C. F. Parsons. *See* Class VIII.

11,640. A. G. Southby and F. D. Blyth. Improvements in apparatus for making ice, refrigerating, evaporating, and desiccating. July 8.

11,690. J. A. Burley. From P. A. Muller and A. T. Lagniez, France. Improvements in analysing columns. July 9.

11,691. J. A. Burley. From A. T. Lagniez, France. Improvements in apparatus for the automatic regulation of pressures and temperatures. July 9.

11,779. H. L. Callendar. Improvements in thermometers and pyrometers. July 11.

Complete Specifications Accepted.*

1890.

4532. E. G. Lawrence.—From S. Pick. *See* Class VII.

10,721. W. L. Wise.—From Solvay and Co. Method and means for charging materials into apparatus such as cupolas, blast furnaces, limekilns, scrubbers, and absorption-towers. June 24.

11,714. D. Rylands and R. Morant. Glass-lined tubing. June 17.

12,535. E. Barlow and R. Cunliffe. Apparatus for drying, calcining, and evaporating. July 15.

13,322. R. Harburn. Apparatus for evaporating and distilling liquids. July 1.

13,390. J. Batten. Regenerating furnaces. July 1.

14,101. H. C. Shaw. Apparatus for heating boilers, evaporating pans, &c. July 15.

18,099. T. P. Hinde. *See* Class XVII.

18,596. E. J. Hardy. Production of cold, and apparatus therefor. July 8.

1891.

2916. G. Goodlet. Apparatus for compressing and accumulating fluids. July 1.

7187. S. M. Lillie. Evaporating apparatus. July 8.

7704. H. Burgess and C. H. Davis. Vacuum evaporating apparatus. July 15.

8517. W. H. Beck.—From G. Moreau. *See* Class II.

8809. W. J. Mirrlees.—From H. T. Yaryan. Evaporating and distilling apparatus. July 1.

II.—FUEL, GAS, AND LIGHT.

Applications.

10,452. E. Rischgitz and The Patent Mining and Financial Trust, Lim. Improvements relating to the treatment of peat. June 19.

10,545. T. Reynolds. Improvements in clay and asbestos fire-balls for use in gas fires. June 20.

10,667. F. Fanta. A new self-acting apparatus for the automatic production of oxygen. June 23.

10,866. F. J. Jones. An improvement in furnaces for reheating gases used in coke making. June 25.

10,902. J. F. Braidwood. Improvements in apparatus for charging retorts for the manufacture of gas and for other like purposes. June 26.

10,918. J. C. Chandler. Improvements in apparatus for washing or scrubbing gas. June 26.

11,210. L. H. Armour. Improvements connected with ovens, furnaces, retorts, or other structures, used in the making of coke or charcoal, or for distilling or roasting carbonaceous matter, or otherwise subjecting carbonaceous matter to the action of heat. July 1.

11,253. S. Alford. An improved method of combustion, applicable to coal, coke, and other inflammable material. July 2.

11,347. J. Hodgson and W. Myland. Improvements in gas lighting. July 3.

11,416. J. Bromilow. Improvements in gas producers. July 4.

11,740. J. H. R. Dunsmore. Improvements in the manufacture of gas for illuminating and heating purposes, and in or connected with apparatus therefor. July 10.

11,764. A. G. Jones. Improvements in the manufacture of artificial fuel, utilising sewage therein. July 10.

11,784. J. H. Hilton. Improvements in apparatus for carburetting gases. July 11.

COMPLETE SPECIFICATIONS ACCEPTED.

1890.

10,329. J. Love. Apparatus for manufacture of illuminating gas. July 1.

11,239. W. H. Buckland and G. Myers. Composition and manufacture of fuel from coal dust, &c. July 1.

11,514. W. Lacey. Manufacture of artificial fuel. July 15.

12,016. W. Foulis. Apparatus for stirring and drawing the charge of gas retorts. July 1.

12,580. C. W. Bartholomew and J. Oxley. Apparatus for drawing coke from coke ovens. July 1.

13,398. W. H. Nevill. Treatment of tar and pitch. July 8.

13,477. M. Fremont. Production of coke and apparatus therefor. July 1.

17,745. T. Cooke. Method of setting clay retorts for the manufacture of coal gas. June 24.

1891.

8068. T. Keetman and W. Bach. Scoop for discharging gas retorts. June 24.

8547. W. H. Beck.—From G. Moreau. Production and drying of compressed air, and usefully applying same. June 24.

9796. H. H. Lake.—From The Standard Coal and Fuel Co. Compound for treating fuel. July 15.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, ETC.

COMPLETE SPECIFICATION ACCEPTED.

1890.

13,398. W. H. Nevill. *See* Class II.

IV.—COLOURING MATTERS AND DYES.

APPLICATIONS.

10,619. J. Y. Johnson.—From The Badische Anilin and Soda Fabrik, Germany. The manufacture and production of new basic dyestuffs. June 22.

10,861. H. H. Lake.—From K. Oehler, Germany. Improvements in the manufacture of colouring matters. June 25.

11,017. J. Dawson and R. Hirsch. The production of artificial indigo. June 29.

11,031. R. Holliday and Sons, R. Holliday, and L. G. Paul. Improvements in the preparation of green colouring matters for dyeing animal fibres. June 29.

11,046. J. Y. Johnson.—From The Badische Anilin and Soda Fabrik, Germany. The manufacture and production of alpha-naphthoquinone dichlorimide, and of basic dyestuffs therefrom. June 29.

11,049. O. Imray.—From The Farbwerke vormals Meister, Lucis, and Brüning, Germany. Manufacture of meta-amidobenzaldehyde, and of salts thereof. June 29.

11,218. H. H. Lake.—From K. Oehler, Germany. Improvements in the manufacture of colouring matter. Complete Specification. July 1.

11,275. J. Y. Johnson.—From The Badische Anilin and Soda Fabrik, Germany. The manufacture and production of new dyes of the rosaniline series and of new materials therefor. July 2.

11,298. E. Schweich and E. Bueher. New or improved colouring matter or dye, and methods of extracting and utilising the same. July 3.

11,328. O. Imray.—From The Farbwerke vormals Meister, Lucius, and Brüning, Germany. Manufacture of yellow azo-colouring matters striking on mordants, and absolutely fast against the action of fulling, soap, and light. July 3.

11,395. R. Holliday and Sons, Limited, and A. G. Brookes.—From T. Holliday, United States. Improvements in the manufacture of azo colours. July 4.

11,472. W. B. Espeut. Improvements in the manufacture of extracts from logwood and other dye woods, also in preparing dyewoods for use in dying. July 6.

11,629. J. Y. Johnson.—From The Badische Anilin and Soda Fabrik, Germany. Improvements in the manufacture of basic naphthalene colouring matters and of sulpho-acids therefor. July 8.

11,663. B. Willcox.—From The Farbenfabriken vormals F. Bayer and Co., Germany. Improvements in the manufacture of colouring matters for dyeing and printing, derived from benzidine and its analogues. July 9.

COMPLETE SPECIFICATIONS ACCEPTED.

1890.

9825. A. J. Boult.—From G. Bouet, fils, Donard, and Contamine. *See* Class XII.

9923. O. Imray.—From C. F. Boehringer, Söhne. Manufacture of pyrazolones. July 1.

12,550. J. Y. Johnson.—From The Badische Anilin and Soda Fabrik. Production of new diphenyl derivatives and a new base for preparation of dyestuffs. June 24.

12,715. B. Willcox.—From the Farbenfabriken vormals F. Bayer and Co. Production of new derivatives of alizarine and its analogues. July 8.

13,010. W. Majert. Manufacture of colouring matters. July 8.

13,235. C. Willcox.—From The Farbenfabriken vormals F. Bayer and Co. Production of azo dyes. July 1.

13,443. B. Willcox.—From The Farbenfabriken vormals F. Bayer and Co. Production of new sulpho-acids of dioxynaphthaline or amidonaphthol, and of azo colouring matters therefrom. July 1.

13,565. H. H. Lake.—From A. Leonhardt and Co. Manufacture of colouring matters. July 1.

13,710. J. Dawson and R. Hirsch. Production of substituted benzidines (diamidotriphenyls) and colours therefrom. July 8.

14,620. J. Y. Johnson.—From The Badische Anilin and Soda Fabrik. Production of new substantive dyestuffs. July 15.

15,120. O. Imray.—From The Society of Chemical Industry, Basle. Manufacture of black colouring matters. July 8.

1891.

7803. A. Lembach, U. Schleicher, and C. F. Wolf. Manufacture of ortho-oxyquinoline and oxyquinoline derivatives. July 15.

V.—TEXTILES, COTTON, WOOL, SILK, ETC.

APPLICATIONS.

10,131. C. Masse. Improvements in and relating to chemically retting all kinds of textile substances. June 15.

10,134. G. L. P. Eyre and T. J. Hopkins. Improvements in apparatus for treating and scouring or cleansing wool and other materials, for removing therefrom greasy or other matters, and for analogous cleansing and separating operations. June 15.

10,543. W. R. Comings. Impregnating paper and other fibrous materials. June 20.

10,556. A. M. Clark.—From La Société La Ramen, France. An improved process of ungumming and decorticating textile materials. June 20.

10,611. R. Ingham. An improved compound or mixture for use in sizing yarn and fabrics. June 23.

11,391. A. Mitscherlich. New process of manufacturing from wood fibres capable of being spun, and by-products of the same, and apparatus therefor. July 4.

11,717. A. Frayssé. Improvements in the treatment of samples of crude wool for estimating purposes. Complete Specification. July 9.

11,721. J. J. Boyce. Sizing composition for cotton yarn. Complete Specification. July 10.

11,831. L. Lehnert. Improvements in the manufacture of artificial and mixed silk threads, and in apparatus therefor. July 11.

Complete Specification Accepted.

1890.

9711. J. Miller and J. Miller, jun. Method and apparatus for rendering textiles waterproof by one treatment. June 24.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

Applications.

10,173. E. B. Truman. An improved solution for use in dyeing black silk lace. June 16.

10,438. E. B. Truman. An improved solution for use in the dyeing of silk fabrics, yarns, and threads. June 19.

10,678. E. Sutcliffe and G. E. Sutcliffe. Improvements in the dyeing and treatment of cotton and other textile materials. June 23.

11,327. O. Imray.—From The Farbwerke vormals Meister, Lucius, and Brüning, Germany. Process of dyeing silk a solid black by means of alizarine, flavopurpurine, anthrapurpurine, and mixtures of these bodies. July 3.

11,692. J. Bertrand-Lejdat. Improvements in apparatus for dyeing or bleaching textile materials. July 9.

Complete Specifications Accepted.

1890.

11,372. A. Mitscherlich. Sizing paper. July 1.

12,907. E. Sykes, D. Sykes, E. Heppenstall, T. Greenwood, and J. W. Whiteley. Apparatus for scouring, dyeing, and drying hanks of yarn, &c. July 8.

11,372. J. Robertshaw. Dyeing, sizing, and washing machines. July 15.

14,829. F. Walton. Bleaching ground cork. July 15.

VII.—ACIDS, ALKALIS, AND SALTS.

Applications.

10,158. L. Lohmann. Improvements in the production of carbonic acid from bicarbonates of soda. Complete Specification. June 15.

10,168. J. H. Parkinson. See Class IX.

10,202. H. H. Lake.—From The Kayser Patent Co., United States. Improvements in the manufacture of caustic alkali, carbonates of the alkaline metals and muriatic acid, and of bricks, cakes, or blocks for use therein, and apparatus therefor. Complete Specification. June 16.

10,475. C. Braconier. Improvements relating to the conversion of crude phosphates and phosphated chalk into pure phosphates and carbonate of lime, and to the recovery of the substances used in such conversion. June 19.

10,476. Comte T. Brochocki. Improvements in the manufacture of compounds of barium and of peroxide of hydrogen. June 19.

10,617. W. Wolters. Improvements relating to the production of chlorine and hydrochloric acid. June 22.

10,626. A. C. Southwell. Improvements in the treatment of gases and vapours of metallic oxides and sulphides for the purpose of effecting their deoxidation, and in apparatus therefor. June 22.

10,629. E. Edwards.—From O. Guttmann and L. Rohrmann, Germany. Improvements in apparatus for the condensation of nitric acid. June 28.

10,630. A. Dupré.—From F. Dupré, Germany. Improvements in the manufacture of potassium carbonate. June 22.

11,099. G. D. Davis. Improvements in the manufacture of lactic acid. June 30.

11,311. T. Goodall.—From S. Peacock and H. A. Galt, United States. Improvements in obtaining chromates and bichromates of potash and soda. July 3.

11,469. T. H. Bell.—From T. Schloesing, France. Improvements in the manufacture of anhydrous chloride of magnesium, and the apparatus used therein. July 6.

11,470. T. H. Bell.—From T. Schloesing, France. Improvements in the manufacture of chlorine, and in the apparatus used therein. July 6.

11,484. L. L. Labois. Improvements relating to the refining of sulphur and the distillation of sulphur and other ores, and to apparatus therefor. July 6.

Complete Specifications Accepted.

1890.

1532. E. G. Lawrence.—From S. Pick. Apparatus for evaporating liquors containing salts, and for separating such salts when rendered insoluble by evaporation of the liquors. July 1.

4695. E. G. Lawrence.—From S. Pick. Apparatus for drying salt. July 1.

*3,504. T. J. Hutchinson. Obtaining useful products from bleaching-power dregs and lime mud from paper works. July 8.

13,863. B. E. R. Newlands. Treating phosphoric acid to facilitate its storage and transport. July 8.

18,835. J. Simpson. Manufacture of caustic soda, and recovery of reagents employed for repeated use. June 24.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

Applications.

10,208. J. P. Adams. A method of and apparatus for making balls or other articles from molten glass, or other molten or plastic material. June 16.

10,218. O. Boklen. Improvements in the manufacture of slabs or tiles. Complete Specification. June 16.

10,454. J. Armstrong. Improvements in the manufacture of tanks or boxes and other articles of glass, and in mechanism or appliances to be used in the said manufacture. June 19.

10,661. W. W. Pilkington. Improvements in and connected with kilns for annealing plate glass. June 23.

10,730. H. B. Baker. A process for sealing metallic wires, other than platinum, through glass. June 24.

10,817. I. Pennell and J. T. Harris. Improved apparatus or appliance for use in supporting ceramic ware in enamel kilns whilst being fired. June 25.

11,039. P. Sievert. Improvements in the process of producing glass articles with metal enclosures. June 29.

11,070. D. Rylands. Improvements in the process of glass manufacture. June 30.

11,165. C. Armstrong. Improvements relating to salt glazing of sanitary ware and the like. July 1.

11,205. H. J. Chappell. Improvements in machines for pressing and moulding plastic materials. July 1.

11,386. J. Slack. Apparatus for and method of producing sharp outline and relief in ceramic and other plastic substances. July 4.

11,401. W. B. Fitch. Improvements in the manufacture of glass bottles and similar articles. July 4.

11,509. J. Bilton. Decorating pottery. July 7.

11,556. C. F. Parsons. Improved manufacture of crucibles and similar vessels of plumbago, clay, earthenware, or other plastic material, and apparatus for this purpose. July 7.

11,607. T. M. Rymers-Jones. An improvement in the manufacture of refractory and non-conducting bricks, blocks, tiles, slabs, and pipes. July 8.

11,617. T. Severn. Improvements in kilns for heating or burning pottery and the like. July 8.

11,637. B. A. Spaull. Improvements in the manufacture of glass bottles and the like, and in apparatus therefor. July 8.

11,638. C. C. Bruff and T. J. Bott. The utilisation of worn out, defaced, and broken plaster of Paris moulds used in the manufacture of china and other tictile ware. July 8.

11,752. C. C. Bruff and T. J. Bott. Improvements in or connected with plaster of Paris moulds for use in the manufacture of china, earthenware, and the like. July 10.

Complete Specifications Accepted.

1890.

13,155. L. H. Jahn. Firing pottery. June 24.

13,351. J. Hamblet. Manufacture of ornamental tiles, and apparatus therefor. June 24.

1891.

7885. C. Blount, V. Ward, and A. Fisher. Translucent cloissonné enamel. July 8.

9220. H. Godwin and W. Hewitt. Fender, hearth, wall and other tiles. July 8.

9412. W. James. Ornamenting glass. July 15.

9745. L. Lederer. Producing coloured designs on mirrors. July 15.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

Applications.

10,137. H. H. Lake.—From H. B. Seely, United States. Improvements in the construction of floors. June 15.

10,168. J. H. Parkinson. Improvements in obtaining lime (CaO) from limestone ($CaCO_3$), and applicable also in the making of cement, whereby the recovery of the carbon dioxide evolved can be effected. June 16.

10,672. C. E. W. Young. Improvements in and connected with asphalt paving. June 23.

10,722. W. T. Ramsden. Improvements in seasoning timber. June 23.

10,767. J. Dent. Improvements in or relating to tiles for use in building or constructing concrete walls. June 24.

11,209. H. Aitken. Improvements in the treatment of stone, brickwork, plaster, or stucco, and the like, for preventing deterioration thereof. July 1.

11,259. E. E. A. Sorel. Improvements in materials for the manufacture of bricks and other articles, the building of fortifications, and the protection of vessels. Complete Specification. July 2.

11,642. H. Heartfield. An improved water and fireproof fibrous material suitable for the manufacture of plain or decorated wall, ceiling, or floor linings, electrical and other conduits, bases, and coverings, and numerous other purposes for which wood, paper, plaster, and cement are now used. July 8.

Complete Specifications Accepted.

1890.

10,427. W. Darling. Calcining carbonates for cements, &c. June 24.

13,105. A. McLean. Decorative artificial stone. July 8.

1891.

2911. F. G. Edwards. Combination of iron and concrete, &c., for building purposes. July 1.

8017. O. Imray. — From F. Zernikow. Apparatus employed in the manufacture of artificial sandstone. July 1.

8875. J. J. Mead. Lime grinding mill. July 1.

X.—METALLURGY, MINING, Etc.

Applications.

10,114. P. H. Bertrand. An improved method of forming magnetic oxide (Fe_3O_4) upon the surface of wrought or cast iron. June 15.

10,141. G. Bamberg. Improvements in extracting gold from ore. June 19.

10,587. Davies Bros. and Co., Limited, and M. Bayliss. Improvements in the method of and apparatus employed in coating metal sheets with spelter or other metal or metallic alloy. June 22.

10,761. C. W. Bildt, G. Ashworth, and E. Ashworth. Improvements in linings for Bessemer converters. June 24.

10,872. L. Cameron. Improvements in the manufacture of puddled iron. June 26.

10,984. F. H. Mason. A process for the extraction of tin from tin slags or tin refuse by founders' ashes, copper salts, carbonaceous matter, fluorspar, and other suitable fluxes. June 27.

10,985. F. H. Mason. A process for the extraction of tin from tin slags and tin refuse by lead or its salts, carbonaceous matter, fluorspar, and other suitable fluxes. June 27.

11,033. J. J. Meldrum, T. F. Meldrum, and E. Harris. Improvements in or connected with puddling and like furnaces. June 29.

11,083. J. Bowing. Improvements in the method of treating blue billy or purple iron ore, iron, sand, and similar substances, for the purpose of preparing them for the reducing furnace. Complete Specification. June 30.

11,095. J. S. Taylor and S. W. Challen. Improvements in the process or method of manufacturing metal tubes. June 30.

11,177. E. Polte. Improvements in or relating to the spinning of metal. July 1.

11,190. F. W. Harbord and W. Hutchinson, jun. The utilisation of tin plate scrap. July 1.

11,208. J. Turton. A process for extraction of metals from ores and minerals containing them. July 1.

11,247. L. Reuleaux. Improvements in the construction and working of smelting and melting furnaces. July 2.

11,279. C. James. An improved method or process for the production of zinc or spelter from ores or compounds containing the same. Complete Specification. July 2.

11,337. C. James. An improved method or process for the collection of refined copper. July 3.

11,342. H. Parkes and J. C. Montgomerie. Improvements in the extraction of gold and silver from ores or compounds containing the same. July 3.

11,373. The Manchester Oxygen (Brin's Patent) Co., Lim., and W. M. Jackson. Improvements in the application of oxygen and other gases to the welding and autogenous soldering of metals. July 4.

11,502. J. L. B. Higgin. Making hardware of a porous nature on the outside, and with a liquid resisting glaze on the inside, to be entitled "Pour us" or otherwise. July 7.

11,563. C. James. An improved method or process for the production of zinc or spelter from ores or compounds containing the same. Complete Specification. July 7.

11,646. H. E. Fry, A. Heimann, O. L. A. P. Diesel, R. H. Everitt, and H. A. Penrose. Improvements in or relating to the treatment of silver ores containing zinc, and gold ores containing zinc. July 8.

Complete Specifications Accepted.

1890.

11,328. G. Hilgenstock and J. Massenez. Separating sulphur from sulphurous pig iron. July 1.

12,432. T. Parker and A. E. Robinson. Production of zinc from oxidised ores of zinc. July 8.

12,912. G. Rodger. Apparatus for making steel. June 24.

13,356. H. G. Castner. Manufacture of sodium and potassium. July 1.

13,856. F. Burger and R. Mannheimer. Product or compound for preventing formation of pores in molten metals, and manufacture of same. July 8.

14,063. H. H. Lake.—From C. F. Claus. Annealing wire, sheet metal, &c. July 15.

16,107. J. O. Day. Alloys and compositions for covering metallic and other surfaces, to prevent corrosion and fouling when submerged. July 15.

1891.

673. O. B. Peck. Apparatus for centrifugally treating particles of metallic or mineral bearing substances of different degrees of specific gravity. July 15.

1208. H. H. Lake.—From J. H. Bevington. Shaping or forming and welding metal tubes, &c. July 15.

6080. J. D. Wilson. Cupolas. July 15.

8111. B. J. B. Mills.—From W. L. Brockway. Treating waste tinned steel or iron. June 24.

9143. A. Torkington. From N. K. Morris. Apparatus for use in the manufacture of lead tube. July 8.

XI.—ELECTROCHEMISTRY AND ELECTRO-METALLURGY.

Applications.

10,347. D. Fitzpatrick. Improved electric battery. June 18.

10,371. F. R. E. Branston. Improvements in the production of light and the generation of heat and electricity. June 18.

10,977. A. de Meritens. Improvements in galvanic batteries. Filed June 27. Date applied for 28th November 1890, being date of application in France.

10,978. Siemens Bros. and Co., Lim.—From Siemens and Halske, Germany. Improvements in insoluble porous anodes for electrolytical processes. June 27.

11,060. P. Girard. Improvements in thermo-electric batteries. June 30.

11,108. T. Coad. Improvements in or connected with electric primary batteries. June 30.

11,131. C. A. Faure. Improvements in apparatus for the electrolysis of aluminium. June 30.

11,225. F. J. Rebman. The improvement of production of electricity by means of a dry cell battery. July 2.

11,278. E. Hancock and A. J. Marquand. Improvements in the production of elements for electric or secondary batteries. July 2.

11,560. G. G. M. Hardingham.—From J. R. Hard and H. Connett, United States. Improvements in and relating to galvanic batteries. July 7.

11,620. E. E. Lever. Improvements in apparatus for preparing bleaching solution and bleaching powder by electrolysis. July 8.

11,712. H. C. Ball. Improvements in or connected with electric batteries. July 9.

Complete Specifications Accepted.

1890.

13,735. C. Hoepfner. Apparatus for use in electro-metallurgical operations. July 8.

1891.

5638. W. A. Crowdus. Electric batteries. July 15.

8573. J. Y. Johnson.—From J. Weir. Production of hydrocarbon products for use for insulating purposes. June 24.

8648. E. Bazin. Use of compressed air for producing electric light and cold. July 1.

9627. C. D. Abel.—From R. J. Gulcher and J. Pintoch. Thermo-electric batteries. July 15.

9928. G. A. Schoth. Galvanic batteries. July 15.

XII.—FATS, OILS, AND SOAP MANUFACTURE.

Applications.

10,132. C. Fink. Improvements in and relating to lubricants for machinery. June 15.

10,516. R. J. Jordan. An improved compound for cleansing purposes. June 20.

10,837. O. C. Hagemann and T. C. Palmer. *See* Class XIII.

11,477. J. Y. Johnson.—From P. Ribard, France. Improvements in filtering or expressing oils or liquids from seed or other materials, and in the construction of the apparatus employed therein. July 6.

11,799. N. M. Henderson. Improvements in treating or purifying paraffin wax, and in apparatus therefor. July 11.

Complete Specifications Accepted.

1890.

9825. A. J. Boult.—From G. Boulet, fils, Donard, and Contamine. Apparatus for extraction of fats or oils, sulphur, and other material, and for manufacturing extracts for dyes. July 1.

11,360. J. Baptista. Facilitating the use of mineral or other non-saponifiable oils in the manufacture of soaps. July 1.

17,275. C. R. Illingworth. Soaps for diseases of the skin.

1891.

2211. W. S. Somers. Producing and refining spirits from oils and apparatus therefor. July 8.

XIII.—PAINTS, PIGMENTS VARNISHES, AND RESINS.

Applications.

10,524. A. L. Rath. An improvement in the manufacture of india-rubber. Complete Specification. June 20.

10,528. A. F. R. Gomess. Improved process of de-vulcanising vulcanised india rubber, gutta-percha, and similar gums, and reclaiming the rubber therefrom for remanufacture, without the addition of pure rubber. Complete Specification. June 20.

10,822. C. N. Jackson. A compound preparation to be used as a substitute for gutta-percha and similar products for insulating and water-proofing purposes. June 25.

10,837. O. C. Hagemann and T. C. Palmer. Improvements in the manufacture or treatment of varnish, oils, and the like, and in apparatus therefor. June 25.

11,207. C. Henry. Manufacture of phosphorescent sulphide of zinc, and the application thereof to vehicles or substances used for washing, dyeing, painting, and printing. July 1.

11,613. F. G. Trehame and W. H. Eastwood. An improved process for the manufacture of white lead. July 8.

11,627. C. H. Bigland. Improvements in anti-fouling or other compositions or paints. July 8.

Complete Specifications Accepted.

1890.

12,414. E. V. Gardner. Manufacture of white lead and apparatus therefor. June 24.

1891.

8161. H. H. Lake.—From E. W. Dahl. Manufacture of white lead. July 15.

8347. C. Wittkowsky. Composition of matter consisting in casein cement. July 8.

XIV.—TANNING, LEATHER, GLUE, and SIZE.

Applications.

10,596. B. Cannon and W. J. Cannon. An improvement in or relating to the manufacture or treatment of size, the same being also applicable to the manufacture or treatment of glue and of gelatin. June 22

10,871. B. Whiteley. Improvements in the manufacture of mats, rugs, and similar articles from the skins of animals, such as sheep and the like. June 26.

XV.—AGRICULTURE and MANURES.

Application.

10,265. W. Newton. The production of a strongly basic phosphate of lime for use as a manure. June 17.

Complete Specification Accepted.

1891.

9348. C. Glaser. Treating phosphorites or other phosphatic materials. July 8.

XVI.—SUGARS, STARCHES, GUMS, Etc.

Applications.

10,313. W. B. Giles and C. E. Eastick. Improvements for the manufacture of sugars, glucoses, and other saccharine solutions. June 17.

10,414. W. Bergiüs. *See* Class XVII.

Complete Specifications Accepted.

1890.

10,331. A. Lefrane, L. Lefrane, and A. Vivien. Manufacture of sugar. July 8.

1891.

9115. J. C. Firth. Cleaning kauri gum. July 8.

9665. E. Ruescher. Separating impure sugar masses at one operation into crystallised sugar and molasses, avoiding all other products. July 15.

XVII.—BREWING, WINES, SPIRITS, Etc.

Applications.

10,135. P. M. Justice.—From A. W. Billings, United States. An improved method of and means for manufacturing beer and ale. June 15.

10,414. W. Bergiüs.—From C. Liessenberg, Germany. An improved composition for and process of clarifying liquids. June 19.

10,659. H. Wilson. An improvement in cooling or refrigerating appliances for cooling brewers' wort and other liquids. June 23.

11,123. M. A. Adams and C. S. Meacham. New or improved means for the preservation of hops. June 30.

11,153. A. Savigear and T. J. Scrutton. An improved fermenting vat. July 1.

11,183. F. Bollmann. Improvements in malting. Complete Specification. July 1.

11,237. T. White and J. Lee. Improvements in apparatus employed in the brewing of beer. July 2.

11,549. J. J. W. Peters. Improved process of manufacturing alcohol. July 7.

11,687. J. L. B. Higgin. Producing an "artificial condition" in ales, wines, and spirits by a process of heating them in winter, and cooling in summer. July 9.

Complete Specifications Accepted.

1890.

12,834. F. Sauer. Malt wine. June 24.

13,862. B. E. R. Newlands. Treatment of grain and malt, and production therefrom of a new product for use in brewing and distilling or as a food. July 8.

15,790. E. R. Budden. Method and apparatus for maturing wine and like beverages. July 8.

17,329. J. Rose. Brewing oatmeal stout and porter. June 24.

18,099. T. P. Hinde. Improved boiling coppers, and an arrangement of brewing plant for use therewith. July 1.

1891.

2241. W. S. Somers. *See* Class XII.

8512. C. Funk. Fermenting mash, dough, wort, &c. June 24.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, and DISINFECTANTS.

Applications.

A.—Chemistry of Foods.

10,279. R. Silcock. Improvements in or appertaining to the manufacture of food for animals. June 17.

10,415. A. Collingridge.—From V. Cornet and A. Jones, France. Improvements in the treatment of common salt intended to be used for curing food, such as meat, game, fish, and poultry. June 19.

11,045. E. Leconte. Improvements in the preparation of leaven for use in the manufacture of bread, pastry, and biscuits. June 29.

11,142. F. W. Crowther. A new or improved digestive condiment for human use. June 30.

11,557. O. Imray.—From Bonne Paraf-Javal nee Vanderheym, and J. A. J. Paraf-Javal, France. Application of compounds of strontium to alimentary hygienic and medicinal purposes. July 7.

B.—Sanitary Chemistry.

10,181. T. Thorpe and J. Birtwisle. Improvements in continuous precipitation apparatus for the treatment of sewage and other liquids having solid matters suspended therein. June 16.

10,563. A. Hossack and H. C. Bull. Improvements in the treatment of sewage, and in obtaining certain useful products thereby. June 20.

10,929. W. E. Adeney. Improvements in the treatment of sewage sludge. June 26.

11,557. O. Imray.—From Bonne Paraf-Javal nee Vanderheym, and J. A. J. Paraf-Javal, France. *See* Class XVIII., J.

11,716. E. Chrisfield. Improvements relating to the purification of sewage and the consumption of town refuse, and to the utilisation of sewage and town refuse for obtaining motive power, and to apparatus therefor. Complete Specification. July 9.

11,761. A. O. Jones. *See* Class II.

COMPLETE SPECIFICATIONS ACCEPTED.

1890.

10,313. T. Scudder. Treatment of refuse material for obtaining valuable products therefrom. July 8.

1891.

2729. J. E. Kierby. Apparatus for automatically regulating the supply of precipitating materials to sewage, and for analogous purposes. June 24.

XIX.—PAPER, PASTEBOARD, Etc.

APPLICATION.

10,543. W. R. Comings. *See* Class V.

COMPLETE SPECIFICATION ACCEPTED.

1890.

7816. J. A. London. Treatment of peat fibre for the manufacture of brown paper, millboards, &c. June 17.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES, AND EXTRACTS.

APPLICATIONS.

10,980. O. Imray.—From C. F. Boehringer and Soehne, Germany. Manufacture of dehydrodimethylphenylpyrazine. June 27.

11,833. B. Willcox.—From The Farbenfabriken vormals F. Bayer and Co., Germany. Improvements in the manufacture and production of pharmaceutical compounds. July 11.

11,844. J. F. von Mering. An improved anæsthetic and hypnotic. July 11.

COMPLETE SPECIFICATIONS ACCEPTED.

1890.

12,729. H. Cumler. A compound of sugar with the salts of phosphorus for dietetic purposes. July 1.

1891.

2241. W. S. Somers. *See* Class XII.

8541. P. A. Newton.—From the American Fullenrage Co. Manufacture of medical extracts. June 24.

XXI.—PHOTOGRAPHIC PROCESSES AND MATERIALS.

APPLICATIONS.

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Communications.

REPORT TO THE UNITED STATES INTERNAL REVENUE DEPARTMENT AS TO STANDARDS AND METHODS FOR THE POLARIMETRIC ESTIMATION OF SUGARS.

By C. A. Crampton, Chemist of U.S. Internal Revenue; H. W. Wiley, Chief Chemist of U.S. Department of Agriculture; and O. H. Tittmann, Assistant in Charge of Weights and Measures U.S. Coast and Geodetic Survey.

Section 1, paragraph 231, of the Act entitled "An Act to reduce revenue and equalise duties on imports and for other purposes," approved October 1, 1890, provides:

"231. That on and after July first, eighteen hundred and ninety-one, and until July first, nineteen hundred and five, there shall be paid, from any moneys in the treasury not otherwise appropriated, under the provisions of section three thousand six hundred and eighty-nine of the Revised Statutes, to the producer of sugar testing not less than ninety degrees by the polariscope, from beets, sorghum, or sugar-cane grown within the United States, or from maple sap produced within the United States, a bounty of two cents per pound; and upon such sugar testing less than ninety degrees by the polariscope, and not less than eighty degrees, a bounty of one and three-fourth cents per pound, under such rules and regulations as the Commissioner of Internal Revenue, with the approval of the Secretary of the Treasury, shall prescribe."

It is the opinion of this Commission that the expression "testing * * * degrees by the polariscope" used with reference to sugar in the Act, is to be considered as meaning the percentage of pure sucrose the sugar contains, as ascertained by polarimetric estimation.

It is evident that a high degree of accuracy is necessary in the examination of sugars by the Bureau of Internal Revenue, under the provisions of this Act, inasmuch as the difference of one-tenth of one per cent. in the amount of sucrose contained in a sugar, may, if it is on the border line of 80°, decide whether the producer is entitled to a bounty of $1\frac{3}{4}$ cents per pound (an amount nearly equivalent to the market value of such sugar), or to no bounty whatever. It is desirable, therefore, that the highest possible degree of accuracy should be secured in the work, for while many sugars will doubtless vary far enough from either of the two standard percentages fixed upon in the Act, viz., 80° and 90°, to admit of a wide margin of error without material consequences, yet a considerable proportion will approximate to them so closely, that a difference of a few tenths of a degree in the polarisation will change the classification of the sugar.

A very high degree of accuracy may be obtained in the optical estimation of sugars, if the proper conditions are observed. Such conditions are (1) accurately graded and adjusted instruments, weights, flasks, tubes, &c.; (2) skilled and practised observers; (3) a proper arrangement of the laboratories in which the work is performed; and (4) a close adherence to the most approved methods of manipulation.

On the other hand, if due observance is not paid to these conditions, the sources of error are numerous, and inaccurate results inevitable.

We will endeavour to point out in this report the best means of meeting the proper conditions for obtaining the highest degree of accuracy consistent with fairly rapid work. It would be manifestly impossible to observe so great a refinement of accuracy in this work as would be employed in exact scientific research. This would be unnecessary for the end in view, and impossible on account of the amount of time that would be required.

I.—Instruments and Apparatus.

It is of the greatest importance that the polariscopes and all apparatus used in the work shall be carefully and accurately adjusted and graduated, and upon a single and uniform system of standardisation. Recent investigations of the polarimetric work done in the Customs branch of the Treasury Department have shown that a very considerable part of the want of agreement in the results obtained at the different ports was due to a lack of uniformity in the standardisation of the instruments and apparatus.

(*a.*) *The Polariscope.*—There are many different forms of this instrument used. Some are adapted for use with ordinary white light, and some with monochromatic light, such as sodium ray. They are graduated and adjusted upon various standards, all more or less arbitrary. Some, for example, have their scales based upon the displacement of the polarised ray produced by a quartz plate of a certain thickness; others upon the displacement produced by an arbitrary quantity of pure sucrose, dissolved and made up to a certain volume and polarised in a certain definite length of column. It would be very desirable to have an absolute standard set for polariscopic measurements, to which all instruments could be referred, and in the terms of which all such work could be stated. This Commission has information that an investigation is now in progress under the direction of the German Imperial Government, having for its end and purpose the determination of such data as will serve for the establishment of an absolute standard. When this is accomplished, it can easily be made a matter of international agreement, and all future forms of instruments be based upon it. This Commission would suggest that the attention of the proper authorities should be called to the desirability of official action by this Government with a view to co-operation with other countries for the adoption of international standards for polarimetric work. Until this is done, however, it will be necessary for the Internal Revenue Bureau to adopt, provisionally, one of the best existing forms of polariscope, and by carefully defining the scale of this instrument, establish a basis for its polarimetric work which will be a close approximation to an absolute standard, and upon which it can rely in case of any dispute arising as to the results obtained by the officers of the bureau.

For the instrument to be provisionally adopted by the Internal Revenue Bureau, this Commission would recommend the "half shadow" instrument made by Franz Schmidt and Haensch, Berlin. This instrument is adapted for use with white light illumination, from coal oil or gas lamps. It is convenient and easy to read, requiring no delicate discrimination of colours by the observer, and can be used even by a person who is colour blind. This form of instrument is adjusted to the Ventzke scale, which, for the purposes of this report, is defined to be such that 1° of the scale is the one hundredth part of the rotation produced in the plane of polarisation of white light in a column 200 mm. long, by a standard solution of chemically pure sucrose at 17·5° C. The standard solution of sucrose in distilled water being such as to contain, at 17·5° C. in 100 cc., 26·048 grms. of sucrose.

In this definition the weights and volumes are to be considered as absolute, all weighings being referred to a vacuum.

The definition should properly be supplemented with a statement of the equivalent circular rotation in degrees, minutes, and seconds, that would be produced by the standard solution of sugar used to read 100° on the scale. This constant is now a matter of investigation, and it is thought best not to give any of the hitherto accepted values. When this is established, it is recommended that it be incorporated in a revision of the regulations of the Internal Revenue relative to sugar, in order to make still more definite and exact the official definition of the Ventzke scale.

The instruments should be adjusted by means of control quartz plates, three different plates being used for complete adjustment, one reading approximately 100° on the scale, one 90°, and one 80°.

These control quartz plates should have their exact values ascertained in terms of the Ventzke scale by the office of weights and measures by comparison with the standard quartz plates in possession of that office, in strict accordance with the foregoing definition, and should also

be accompanied by tables giving their values for temperatures from 10 to 35°.

(b.) *Weights.*—The weights used should be of solid brass, and should be standardised by the office of weights and measures.

(c.) *Flask.*—The flasks used should be of such a capacity as to contain at 17·5° C. 100·06 cubic centimetres, when filled in such a manner that the lowest point of the meniscus of the surface of the liquid just touches the graduation mark. The flasks will be standardised to contain this volume in order that the results shall conform to the scale recommended for adoption without numerical reduction of the weights to vacuo. They should be calibrated by the office of weights and measures.

(d.) *Tubes.*—The tubes used should be of brass or glass, 200 and 100 millimetres in length, and should be measured by the office of weights and measures.

(e.) *Balances.*—The balances used should be sensitive to at least one milligramme.

II.—Skilled Observers.

The Commission recommends that the work of polarising sugars be placed in the hands of chemists, or at least of persons who are familiar with the use of the polariscope and have some knowledge of the theory of its construction, and of chemical manipulations. To this end we would suggest that applicants for positions where such work is to be done should be obliged to undergo a competitive examination in order to test their fitness for the work that is to be required of them.

III.—Arrangement of Laboratories.

The arrangement of the rooms in which polarisations are performed has an important bearing upon the accuracy of the results obtained.

Polariscopic observations are made more readily and accurately if the eye of the observer is screened from diffused light; therefore, a partial darkening of the room, which may be accomplished by means of curtains or hangings, is an advantage. On the other hand, the temperature at which the observation is made has a very considerable influence upon the results obtained, so that the arrangements for darkening the room must not be such as will interfere with its proper ventilation. Otherwise the heat from the lamps used, if confined within a small room, will cause considerable variations in the temperature of the room from time to time.

The proper conditions will best be met, in our opinion, by placing the lamps either in a separate room from that in which the instruments are, and perforating the wall or partition between the two rooms for the light to reach the end of the instruments, or in a ventilated hood with the walls perforated in a like manner. By lining the wall or partition on both sides with asbestos paper, and inserting a plate of plate glass in the aperture through which the light passes the increase of temperature from the radiation of the lamps will be still further avoided. With the lamps separated from the instruments in this manner, the space in which the instruments are contained is readily darkened without much danger of its temperature being duly raised.

Some light, of course, is necessary for reading the scales, and if artificial light is employed for this purpose, the sources chosen should be such that as little heat as possible will be generated by them. Small incandescent electric lights are best for such purpose. Refinements of this kind can not always be used, of course, but the prime requisite with reference to the avoidance of temperature errors is that all operations—filling the flasks and tubes, reading the solutions, controlling the instrument with standard quartz plates, &c.—should be done at one and the same temperature, and that this temperature be a constant one, that is, not varying greatly at different hours of the day. For example, the room should not be allowed to become cold at night, so that it is at low temperature in the morning when work is begun, and then rapidly heated up during the day. The polariscope should not be exposed to the direct rays of the sun during part of the day, and should not be near artificial sources of heat, such as steam boilers, furnaces, flues, &c.

The tables upon which the instruments stand should be level.

IV.—Methods of Manipulation.

The methods of manipulation used in the polarisation of sugar are of prime importance. They consist in weighing out the sugar, dissolving it, clarifying the solution, making it up to standard volume, filtering, filling the observation tube, regulating the illumination, and making the polariscopic reading.

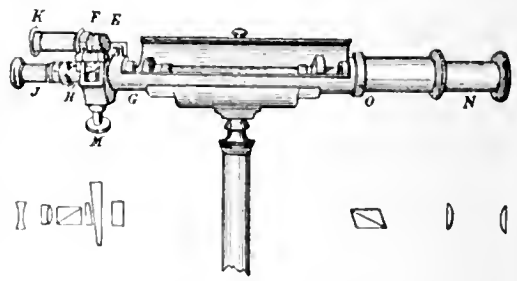
The proper conduct of these processes, in connection with the use of accurately graduated apparatus, is the only surety against the numerous sources of error which may be encountered. Different sugars require different treatment in clarification, and much must necessarily be left to the judgment and experience of the operator.

The following directions are based upon various official procedures such as the one used in the United States Custom houses, the method prescribed by the German Government, &c. They embody also the result of recent research in regard to sources of error in polarimetric estimation of sugar:—

Directions for the Polarisation of Sugar.

1.—*Description of Instrument and Manner of Using.*

The instrument employed is known as the half shadow apparatus of Schmidt and Haensch. It is shown in the following cut.



The tube N contains the illuminating system of lenses and is placed next to the lamp: the polarising prism is at O and the analysing prism at H. The quartz wedge compensating system is contained in the portions of the tube marked F, E, G, and is controlled by the milled head M. The tube J carries a small telescope, through which the field of the instrument is viewed, and just above is the reading tube K, which is provided with a mirror and magnifying lens for reading the scale.

The tube containing the sugar solution is shown in position in the trough between the two ends of the instrument. In using the instrument the lamp is placed at a distance of at least 200 mm. from the end; the observer seats himself at the opposite end in such a manner as to bring his eye in line with the tube J. The telescope is moved in or out until the proper focus is secured so as to give a clearly defined image, when the field of the instrument will appear as a round, luminous disc, divided into two halves by a vertical line passing through the centre, and darker on one half of the disc than on the other. If the observer, still looking through the telescope, will now grasp the milled head M and rotate it, first one way and then the other, he will find that the appearance of the field changes, and at a certain point the dark half becomes light, and the light half dark. By rotating the milled head delicately backwards and forwards over this point he will be able to find the exact position of the quartz wedge operated by it, in which the field is neutral, or of the same intensity of light on both halves.

The three different appearances presented by the field are best shown in the followiog diagram :—

With the milled head set at the point which gives the appearance of the middle disc as shown above, the eye of the observer is raised to the reading tube K and the position of the scale is noted. It will be seen that the scale proper is attached to the quartz wedge, which is moved by the milled head; and attached to the other quartz wedge is a small scale called a vernier, which is fixed, and which serves for the exact determination of the movable scale with reference to it. On each side of the zero line of the vernier a space corresponding to nine divisions of the movable scale is divided into 10 equal parts. By this device the fractional part of a degree indicated by the position of the zero line is ascertained in tenths; it is only necessary to count from zero, until a line is found which makes a continuous line with one on the movable scale.

With the neutral field as indicated above, the zero of the movable scale should correspond closely with the zero of the vernier unless the zero point is out of adjustment.

If the observer desires to secure an exact adjustment of the zero of the scale, or in any case if the latter deviates more than one-half of a degree, the zero lines are made to coincide by moving the milled head and securing a neutral field at this point by means of the small key which comes with the instrument, and which fits into a nipple on the left-hand side of F, the fixed quartz wedge of the compensating system. This nipple must not be confounded with a similar nipple on the right-hand side of the analysing prism H, which it fits as well, but which must never be touched, as the adjustment of the instrument would be seriously disturbed by moving it. With the key on the proper nipple it is turned one way or the other until the field is neutral. Unless the deviation of the zero be greater than 0·5°, it will not be necessary to use the key, but only to note the amount of the deviation, and for this purpose the observer must not be content with a single setting, but must perform the operation five or six times, and take the mean of these different readings. If one or more of the readings show a deviation of more than 0·3° from the general average, they should be rejected as incorrect. Between each observation the eye should be allowed 10 to 20 seconds of rest.

The "setting" of the zero having been performed as above, the determination of the accurate adjustment of the instrument by means of the "control" quartz plates is proceeded with. Three such plates will be furnished with each polariscope, which have "sugar values" respectively, approximating 80°, 90°, and 100°. These values may vary with the temperature, and tables are furnished with them which give their exact value at different temperatures, from 10° to 35° C.

One of these plates is placed in the instrument, and the field observed; it will be seen that the uniform appearance of the field is changed. The milled head is turned to the right until the exact point of neutrality is re-established, just as described above in setting the zero. The scale is read, the observation repeated, the reading taken again, and so on until five or six readings have been made. The average is taken, readings being rejected which show a divergence of more than 0·3, and the result corrected for the deviation of the zero point, if any was found, the deviation being added if it was to the left, and subtracted if to the right. If the adjustment of the instrument be correct, the result should be the value of the control plate used, as ascertained from the table, for the temperature of 20°. Each of the three plates is read in the instrument in this way. A variation of 0·3 from the established values may be allowed for errors of observation, temperature, &c., but in the hands of a careful observer a deviation greater than this with one of the three plates after a careful setting of the zero, shows that the instrument is not accurately adjusted.

The complete verification of the accurate adjustment of the polariscope by means of three control plates, as given above, should be employed whenever it is set up for the first time by the officer using it, whenever it has sustained any serious shock or injury, and whenever it has been transported from one place to another. It should also be done at least once a week while the instrument is in active use.

After the complete verification has been performed as described, further checking of the instrument is done by means of one control plate alone, the one approximating 90°, and the setting of the zero point is dispensed with, the indication of the scale for sugar solutions being corrected by the amount of deviation shown in the reading of the 90° control plate from its established value as ascertained from the table, at the temperature of the room

For example: A sugar solution polarises 80·5; the control plate just before had given a polarisation of 91·4, the temperature of the room during both observations being 25° C. According to the table the value of the control plate at 25° C. is 91·7; the reading is, therefore, 0·3 too low, and 0·3 is added to the reading of the sugar solution, making the corrected result 80·8. The temperature of the room should be ascertained from a standardised thermometer placed close to the instrument and in such a position as to be subject to the same conditions.

Preparation of the Sugar Solution for Polarisation.

If the sample is not entirely uniform it must be thoroughly mixed before weighing out, after all the lumps are broken up, best with a mortar and pestle. Then 26·048 grms. are weighed out on the balance in the tared German silver dish furnished for this purpose. Care must be taken that the operations of mixing and weighing out are not unduly prolonged, otherwise the sample may easily suffer considerable loss of moisture, especially in a warm room. The portion of sugar weighed out is washed by means of a jet from a wash-bottle into a 100 cc. flask, the dish being well rinsed three or four times and the risings added to the contents of the flask. The water used must be either distilled water or clear water which has been found to have no optical activity. After the dish has been thoroughly rinsed, enough water is added to bring the contents of the flask to about 80 cc. and it is gently rotated until all the sugar has dissolved. The flask should be held by the neck with the thumb and finger, and the bulb not handled during this operation. Care must be taken that no particle of the sugar or solution is lost. To determine if all the sugar is dissolved, the flask is held above the level of the eye, in which position any undissolved crystals can be easily seen at the bottom. The character of the solution is now observed. If it be colourless or of a very light straw colour, and not opalescent, so that it will give a clear transparent liquid on filtration through paper, the volume is made up directly with water to the 100 cc. mark on the flask. Most sugar solutions, however, will require the addition of a clarifying or decolourising agent in order to render them sufficiently clear and colourless to polarise. In such case, before making up to the mark, a saturated solution of subacetate of lead is added.

The quantity of this agent required will vary according to the quality of the sugar; for sugar which has been grained in the strike pan and washed in the centrifugals, from 3 to 15 drops will be required; for sugar grained in the strike pan but not well washed in the centrifugals, that is, sugar intended for refining purposes, from 15 to 30 drops will be required; for sugar not grained in the strike pan, that is, "waggon" or "string sugar," "second sugar," &c., from 1 to 3 cc. will be required. After adding the solution of subacetate of lead the flask must be gently shaken, so as to mix it with the sugar solution. If the proper amount has been added, the precipitate will usually subside rapidly, but if not, the operator may judge of the completeness of the precipitation by holding the flask above the level of the eye and allowing an additional drop of subacetate of lead to flow down the side of the flask into the solution; if this drop leaves a clear track along the glass through the solution it indicates that the precipitation is complete; if, on the other hand, all traces of the drop is lost on entering the solution, it indicates that an additional small quantity of the subacetate of lead is required. The operator must learn by experience the point where the addition should cease; a

decided excess of subacetate of lead solution should never be used.

The use of subacetate of lead should, in all cases, be followed by the addition of "alumina cream" (aluminic hydrate suspended in water) in about double the volume of the subacetate solution used, for the purpose of completing the clarification, precipitating excess of lead, and facilitating filtration. In many cases of high grade sugars, especially beet sugars, the use of alumina alone will be sufficient for clarification without the previous addition of subacetate of lead.

The solution is now made up to the mark by the addition of distilled water in the following manner. The flask, grasped by the neck between the thumb and finger, is held before the operator in an upright position, so that the mark is at the level of the eye, and distilled water is added drop by drop from a siphon bottle or wash bottle, until the lowest point of the curve or meniscus formed by the surface of the liquid just touches the mark. If bubbles hinder the operation, they may be broken up by adding a single drop of ether, or a spray from an ether atomiser, before making up to the mark. The mouth of the flask is now tightly closed with the thumb, and the contents of the flask are thoroughly mixed by turning and shaking. The entire solution is now poured upon the filter, using for this purpose a funnel large enough to contain all the 100 cc. at once, and a watch glass is placed over the funnel during filtration to prevent a concentration of the solution by evaporation.

The funnel and vessel used to receive the filtrate must be perfectly dry. The first portion of the filtrate, about 20 to 30 cc., should be rejected entirely, as its concentration may be affected by a previous hygroscopic moisture content of the filter paper. It may also be necessary to return subsequent portions to the filter until the liquid passes through perfectly clear.

If a satisfactory clarification has not been obtained, the entire operation must be repeated, since only with solutions that are entirely clear and bright can accurate polarimetric observations be made.

When a sufficient quantity of the clear liquid has passed through the filter, the 200 mm. observation tube is filled with it. The 100 mm. tube should never be used except in the rare cases, when, notwithstanding all the means used to effect the proper decolourisation of the solution, it is still too dark to polarise in the 200 mm. tube. In such cases the shorter tube may be used, and its reading multiplied by two. The zero deviation must then be determined and applied to the product. This will give the reading which would have been obtained if a 200 mm. tube could have been used, and it only remains to apply the correction determined by the use of the control plate as previously described.

Example:

Solution reads in 100 mm. tube	47·0
Multiplied by 2	2·0
Product	94·0
Zero reads plus 0·3	0·3
Solution would read in 200 mm. tube	93·7
Reading of control plate	99·4
Sugar value of control plate	99·5
Instrument too low by	0·1
Add 0·1 to	93·7
Correct polarisation of solution	93·8

* Prepared as follows: Shake up powdered common read alum with water at ordinary temperature until a saturated solution is obtained. Set aside a little of the solution, and to the residue add ammonia, little by little, stirring between whiles, until the mixture is alkaline to litmus paper. Then drop in additions of the portion left aside, until the mixture is just acid to litmus paper. By this procedure a cream of aluminum hydrate is obtained suspended in a solution of ammonium sulphate, the presence of which is not at all detrimental for sugar work when added after subacetate of lead, the ammonium sulphate precipitating whatever excess of lead may be present.

Before filling the tube it must either be thoroughly dried by pushing a plug of filter paper through it, or it must be rinsed several times with the solution itself. The cover glasses must also be clean and dry, and without serious defects or scratches. Unnecessary warming of the tube by the hand during filling should be avoided; it is closed at one end with the screw cap and cover glass, and grasped by the other end with the thumb and finger. The solution is poured into it until its curved surface projects slightly above the opening, the air bubbles allowed time to rise, and the cover glass pushed horizontally over the end of the tube in such a manner that the excess of liquid is carried over the side, leaving the cover glass exactly closing the tube with no air bubbles beneath it, and with no portion of the liquid upon its upper surface. If this result is not attained, the operation must be repeated, the cover glass being rubbed clean and dry, and the solution again brought up over the end by adding a few more drops. The cover glass being in position, the tube is closed by screwing on the cap. The greatest care must be observed in screwing down the caps that they do not press too tightly upon the cover glasses; by such pressure the glasses themselves may become optically active, and cause erroneous readings when placed in the instrument. It should therefore be ascertained that the rubber washers are in position over the cover glasses, and the caps should be screwed on lightly. It must also be remembered that a cover glass, once compressed, may part with its acquired optical activity very slowly, and some time must be allowed to elapse before it is used again.

The polariscopic reading may now be taken, an observation on the 0° control plate having been made immediately before as previously described. Then without altering the position of the instrument relative to the light, or changing the character of the latter in any way, the tube filled with the sugar solution is substituted for the control plate. The telescope is adjusted, if necessary, so as to give a sharply-defined field, which must appear round and clear. (This condition must be fulfilled before the observation is performed, as it is essential to accuracy.) The milled head is turned until the neutral point is found, and the reading is taken exactly as previously described, the operation repeated five or six times, the average taken with the rejection of aberrant readings, the average figure corrected for the deviation shown by the control observation from the sugar value of the control plate at the temperature of observation as given in the table, and the result taken as the polarisation of the sugar. When a series of successive polarisations is made under the same conditions as regards temperature, position of the instrument with relation to the high intensity, of the light, &c., the control observation need not be made before each polarisation, one such observation being sufficient for the entire series. The control must be repeated at least once an hour, however, and oftener when the operator has reason to think that any of the factors indicated above have been altered, for any such alteration of conditions may change the zero point of the instrument.

In the polarisation of the quartz plates as also in the polarisation of very white sugars, difficulty may be experienced in obtaining a complete correspondence of both halves of the field. With a little practice this may be overcome and the neutral point found, but when it cannot, the ordinary telescope of the instrument may be replaced by another, which is furnished with the polariscope and which carries a yellow plate. This removes the difficulty and renders it possible, even for one not well accustomed to the instrument, to set it at the exact point of neutrality.

Summarised Sources of Error.

The following principal sources of error must be especially guarded against:—

1. Drying out of sample during weighing.
2. Excess of subacetate of lead solution in clarification.
3. Incomplete mixing of solution after making up to mark.
4. Imperfect clarification or filtration.
5. Concentration of solution by evaporation during filtration.

6. Undue compression of the cover glass.

7. Alteration of the temperature of room, position of instrument, or intensity of light while the observation or control observation are being performed.

8. Performances of polarisation with a cloudy, dim, or not completely round or sharply-defined field.

In closing this report the members of this Commission hereby signify their intention to promote uniformity and accuracy by adopting and using the standards and general plan of procedure recommended in this report in the polarimetric determinations over which, in their respective branches of government work, they have control.

PRELIMINARY NOTE ON THE TECHNICAL ANALYSIS OF GAMBIER.

BY H. R. PROCTER, F.I.C.

Lecturer on Leather Industries, Yorkshire College, Leeds.

At the instance of the Leeds Leather Trades Association, and of the National Morocco Manufacturers' Association of the United States, I sent a circular a few weeks since to those chemists whom I knew to be interested in the analysis of tanning materials both here and on the Continent, asking their opinion as to the possibility of agreeing on a standard method for the analysis of gambier, in order to avoid the serious discrepancies which arise in consequence of all the present processes being rather relative than absolute. In response, I have received much valuable information. My correspondents are unanimously in favour of the "indirect gravimetric method," in which equal quantities of the infusion of the tanning material are evaporated, in the one case after careful filtration through paper only, and in the other after complete removal of the tanning matter by treatment with purified hide powder; and the tanning matter is calculated from the difference of weight of the dried residues. There is, however, considerable diversity of opinion as to the details both of making the infusion, and of carrying out the absorption of the tanuin; and I think it will be advantageous if I summarise as briefly as possible the points still requiring discussion, and the respective advantages of the various modifications, in the hope that some chemists may be induced to make independent investigation where it is required. I purpose myself to examine several points in the leather industries laboratory of the Yorkshire College as soon as time allows; and, if other chemists co-operate, I think we may devise a method which will at any rate answer present commercial requirements, and do away with the uncertainty of analytical reports, which, more than anything else, has discredited chemistry in its application to tanning.

It is desirable that such a method should not be confined to gambier, but should be capable with slight modification of general application to all tanning materials. A point of great importance is that of sampling, which, unfortunately, has only been dealt with by one of my correspondents, Mr. Bertram Hunt. I think it will be convenient, however, to begin by saying a few words about it.

The sampling of cube gambier presents no difficulties, and calls for no special remark, except that as the material darkens in colour, and therefore presumably alters in other ways by exposure to the air, it is best to cut up the cubes as short a time before weighing as possible. With block gambier, on the other hand, the difficulties of sampling are great. The "blocks" consist of oblong masses of about 2 cwt. each, wrapped in matting, and quite pasty inside, though tolerably hard on the surface. The only practicable method seems to be to cut a sufficient number of bales across the middle, and to take slices with a fair proportion of inside and outside, to mix the mass as well as possible, and to put it at once in a tight tin or jar to avoid loss of water. It might be worth trying a tubular sampling tool, such as is used for paraffin scale, but from the adhesive nature of the material success does not seem very probable unless the plug were forced out with a piston. The following method has been found satisfactory by Mr. Bertram Hunt, but unfortunately it is not generally applicable. "Slices from a number of bales are taken and weighed (at least 1 cwt. from a large lot), and dissolved by agitation in a known quantity, say an equal weight of hot water; and a definite quantity of the mixture weighed off for analysis." Possibly the same method on a smaller scale might be employed to utilise and average large samples in the laboratory, but the thick liquid would require very careful mixture.

With regard to solution it is unnecessary, and possibly undesirable to boil the solution, though Mr. Hunt's experiments on the destruction of gambier tannin by boiling (this Journal, **4**, 266) only applied to such strong infusions as have just been described. All the valuable constituents of gambier are soluble in water near the boiling point. These consist of catechutannic acid, which is soluble in water at all temperatures and catechin, which, according to Zwenger, is soluble in three parts of boiling water and in 1,133 parts at 17° C. Catechin is not a tannin, though it is said by Etti to be converted into catechutannic acid by dehydration, which goes on slowly even at ordinary temperatures in vacuo over sulphuric acid, or at 100° C. on the water-bath.

Opinions differ as to its tanning value (Mr. Hunt considers that it plays a great part in gambier tanning), but it is quite clear that a body so easily converted into tannin cannot be disregarded in analysis, as it practically would be by the use of strong solutions and cold filtration. It is certainly taken up by raw hide in the hide-powder filter. In practical tanning it remains suspended in the liquor in the form of fine acicular crystals, which gradually disappear, probably by slow solution and absorption by the hide.

Many tanning materials, even gambier itself, to some extent, contain other matters, generally red or brown amorphous bodies, of the nature of tannins, and probably anhydrides of the more soluble tannic acids, which are freely soluble in hot water, but gradually deposited on cooling, so that similar questions arise in the analysis, and especially so in the case of hemlock and quebracho extracts; and it will be seen that in these cases the more dilute the solution, the higher will be the result in soluble tannins. It is not possible, however, in practice to use solutions so dilute as to insure the solution of all matters capable of being absorbed by hide. The whole might be estimated by hot filtration, but the result in the case of many extracts would be to give a very unfair advantage to the low-grade makers, who, by extracting at high temperatures, and under pressure, get an inordinate proportion of such dark-coloured matters, which are to a great extent lost in tanning, from their insolubility in liquors of ordinary strength, and which are very injurious to the colour of the leather. Probably 8—12 per cent. is quite an ordinary proportion of such difficultly soluble matters in a hemlock extract; and, once precipitated, a considerable proportion cannot be re-dissolved by boiling. The method of cooling such infusions is of importance, as well as the temperature and proportion of water: since the separation takes time, and higher results in soluble matter will therefore be obtained by rapid cooling under the tap, than by allowing to stand overnight in the laboratory.

In the Vienna laboratory, solutions leaving about 1·2 grms. of total extract are employed, the extract or gambier being dissolved in hot water, cooled, and filtered. Supposing Zwenger's figures to be approximately correct for the catechin of gambier, which is by no means certain, as they were obtained from that of cutch, which may not be identical, the Vienna method would estimate about 5 per cent. of catechin on the weight of the gambier employed.

Professor von Schroeder, at Tharandt, and Dr. Koch, at Leipzig, use solutions containing 0·2—0·5 grm. per 100 cc., dissolving hot, cooling rapidly with water, and filtering as soon as cool. The first 100 cc. of the filtrate is rejected, to avoid loss by possible absorption of tannin by the paper,* which Professor von Schroeder has shown to

* Dingl. J. 1888, 269, 38—42.

occur with some materials. This method would of course estimate most of the catechin; and a considerably larger amount of difficultly soluble tannins in extracts such as hemlock and quebracho, than the stronger solution.

Mr. Hunt uses 10 grms. per litre, or slightly more than the above, dissolves hot, allows to subside overnight, but does not filter, believing that tannin is absorbed by the paper. Catechin remains to a considerable extent suspended as a fine crystalline precipitate, and is thus partially estimated. The method seems to give pretty constant results, but the use of a partially turbid solution seems indefinite, and will not commend itself to most chemists.

Dr. Maschke, Director of the Laboratory of the German Tanners' Association in Berlin, uses 10 grms. gambier, which he dissolves in a beaker, stirring with a glass rod and decanting and washing the insoluble residue with successive quantities of water. The infusion is made up to 1 litre and filtered through sand under pressure in an apparatus similar to Koch's extractor. The hide-powder filter is used.

The estimation of the catechin and of difficultly soluble tannins would be easily accomplished by filtering at 100° C., cooling rapidly, and after well shaking, measuring and evaporating 50 or 100 cc. of the turbid liquor. Experiments are required to ascertain whether under these conditions tannin is absorbed by paper to a serious extent. If this is so possibly a sand-filter might be substituted. After complete cooling, the liquor might be re-filtered, and the percentage soluble in 100 or 200 volumes of cold water ascertained by evaporating another 50 cc.

Dr. R. Koch recommends a double determination of easily and difficultly soluble tannin by making a concentrated solution, and diluting an aliquot part before filtration. This is a very practicable method, but its results would depend on the concentrations employed, which would have to be a matter of convention. If 1·0—1·2 grm. total extract per 100 cc. were adopted as the higher limit and 0·2—0·3 grm. as the lower, the results would represent those of the Vienna and Tharandt schools respectively, and this seems to me a method of harmonising the two which is well worth consideration. It does not seem certain that dilution before and after cooling would yield the same results, or in other words, that the once separated phlobaphen-tannins would redissolve completely on dilution, and whether this is so, should be determined by experiment.

Possibly, as gambier is often used warm in the tannery, the filtration might be taken at 30° instead of 15° C., so as to include a large proportion or the whole of the catechin, but this could only be done under a very definite convention to which buyers as well as sellers had agreed. It is clear that no proportion of cold water could be practically used, which would insure the solution of the whole of the catechin, but it would be desirable to experiment on the influence of changes in this respect.

Another method which suggests itself as practicable, but which I have not yet been able to experiment on, is to dissolve in a determined quantity of water, filter off the amount required for analysis while hot through a tared filter, which would be best supported in a cone of wire gauze, silvered if necessary. The filtrate would be cooled and re-filtered to determine the "easily soluble" tannin, while the cone and filter would be placed in the top of a beaker with a little water boiling over a lamp, and thoroughly washed with boiling water so long as anything was dissolved. The filter dried and weighed, would give "fibre and insoluble matter," and the "catechin and tannin (or phlobaphenes) soluble at 100°" could easily be got by difference. The determination of fibre and actually insoluble matter would throw much light on some reputed adulterations. It is possible that the filter might become so choked as to render the washing impracticable, but I have found the use of steam very effective in preventing this with similar materials.

With regard to absorption of the tannin by hide-powder much depends on the strength of the infusion employed. With dilute infusions of say 10 grms. block gambier per litre, the hide-powder filter may be used; but it has little advantage over a short-digestion in a flask, and it is of small importance whether the hide powder is added in successive portions, or all at once, since the infusion is not strong enough to harden the surface. Hunt for instance adds 5 grms. hide-power to 100 cc. of infusion, digests with frequent shaking for six hours, and finds tannin completely removed. Mr. A. N. Palmer, using a liquor of about 0·4 grm. of total extract per 100 cc., mixes 3 grms. of hide powder with 30 cc. of liquor and percolates in a wide tap burette plugged with cotton-wool, rejecting the liquor. He then adds 70 cc. more liquor and percolates twice for about half an hour, returning the filtrate. The tannin is completely absorbed, and the use of 4 grms. hide-powder makes no difference. On the other hand with strong solutions of, say 20 grms. per litre, with "total extract" 1·0—1·2 grms. per 100 cc., it is necessary either to add the powder in successive quantities, or to use the hide-powder filter in which a great part of the tannin is absorbed by the first portions with which the liquor comes in contact.

The essential objects to be kept in view are:—1st, to completely absorb the tannin; 2nd, to avoid any error arising from the solubility of the hide; and 3rd, to minimise the merely mechanical absorption of indifferent matters. To attain as far as possible all these ends, the quantity of hide-powder must be enough, and not too much; and as all hide-powder yields traces of soluble matter to cold water, a constant quantity should be used, and a suitable correction applied. If these conditions are fulfilled, it is indifferent whether it be by the hide-powder filter, or by mere maceration. It is also a matter of comparative indifference within certain limits whether the infusion is strong or weak, since a strong solution requires a larger quantity of hide-powder, and the dissolved matter is in all probability proportional to this rather than to the amount of solvent. It seems clear that 1 grm. of hide-powder for each 0·1 grm. of total extract is the outside quantity required, and it would be well to try whether this could not be still further reduced. 1 grm. of hide would ultimately absorb nearly 1 grm. of tannin, so that the question is simply one of time. As, however, the last traces of tannin in a dilute infusion will penetrate very slowly through a surface of tanned hide, rapid action with small quantities of powder will probably be best attained by successive additions, or on the filter principle. Rapid action is important, not only to save time, but because in warm weather putrefactive changes soon occur, and increase solution of the hide.

The practical limits of strength are closely approached by the Vienna chemists on the one hand (1·2 per cent. total extract), and by Von Schroeder and Koch (0·4 per cent.) on the other.

A practical difficulty of the hide-powder filter arises from the fact that some samples of powder are so water-repellent as to be wet with great difficulty, and to filter mainly up the sides of the tube, leaving the centre of the powder unused. Another arises from the fact that the filtrate progressively changes in composition; the first 25 cc. containing most of the soluble matter from the powder, and least of gallic acid and other matters which are loosely absorbed, while in successive quantities these conditions are gradually reversed. Probably a combination of maceration and percolation on the principle of Mr. Palmer's method would be satisfactory, but as it is impossible *completely* to get rid of the liquor used to wash the powder, it would be better to retain the whole and make a suitable correction for solubility.

The correction for solubility is generally obtained by making a blank experiment with pure water. This, as several of my correspondents point out, is wrong in principle, since much of the soluble matter is precipitated by tannin, and hence the solubility in water is much greater than in liquor. Mr. Bertram Hunt makes the correction by a blank experiment with water, and after drying and weighing, redissolves and precipitates with slight excess of tannin, and collects on a tared filter. Half the weight of the tannate so obtained is deducted from the total residue. The absorption of tannin with hide-powder is so conducted as to leave no matter precipitable by either tannin or gelatin in the filtrate. This method is correct in principle, and deserves general adoption, and as the determination can be made once for all on a good stock of hide-powder, is very little trouble.

The amount of organic matter dissolved even by pure water from a good hide-powder employed as a filter

(7 grms. to 100 cc.) has been shown by Dr. Koch† not to exceed 0·004 grm. in 50 cc., though most commercial sorts leave much more. He points out the importance of using powder which has not in any stage of the process undergone putrefaction, not only on account of the solubility of the decomposition products, but because such powders absorb a larger proportion of colouring matter than those of pure hide fibre.

A point which requires attention is the temperature at which water should be determined, and the residues should be dried. This ranges among my correspondents from that of the ordinary water oven to 110° C. The time of drying is greatly abridged by the use of a temperature above boiling point, and it probably yields more constant results. With many tanning materials the difference in results is immaterial, but the catechin of gambier not only loses its water of crystallisation, but is according to Etti‡ converted slowly at 100° (or even at ordinary temperatures in vacuo) into catechutannic acid with loss of a molecule of OH_2. This reaction is rapid and complete at 127° C., and the next anhydride is only found at a considerably higher temperature. It is desirable to choose a temperature at which the change is rapid and practically complete, since block gambier takes days to arrive at a constant weight in the water oven. If catechin is to be estimated as tannin, there is no objection theoretical or practical to weighing it as such. It is desirable that experiments should be undertaken to determine the most satisfactory drying temperature, not only for gambier but other materials.

I shall be extremely obliged for further information on these and other points, so as to enable me to outline at an early date, a method which will represent as nearly as possible the average of chemical opinion. I am making a similar appeal to American and continental chemists, and am simply acting as secretary to the informal "Commission." I have to thank many chemists for information besides those named in the foregoing, but whose methods are practically identical with one or other of those quoted.

† Dingl. J. 1891. **280**, Hept. 6 and 7.
‡ Watts' Dict. III. Sup. Art. "Catechin."

Journal and Patent* Literature.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

The Destruction of Lead Pipes. Jour. f. Gasbeleuchtung, **34**, 175.

The following communication by K. Hartmann, published in the "Gesundheits-Ingenieur," purposes to draw the attention of technical men to the damages caused to lead-work by the larva of a woodworm. Recently, when tracing the leaky places in a lead pipe, a live woodworm was found in one of the leaks, with its head protruding in the wall of the piping. The outer opening of the cavity was of oblong form, measuring 7 mm. by 4 mm., and the inner surface of the same showed fine indentures. Similar cases are not unknown and have occasionally found their way into literature. Thus it is mentioned in Kerl and Stohmann's "Handbook of Technical Chemistry," that certain woodworms (*Sirex gigas*) perforate sheet lead, the holes produced showing a rough surface with fine indentures. At the "Muldener Hütte" holes up to 6·5 mm. diameter were caused in sheet lead, the same being affixed to timber-work. As the woodworm, which belongs to the family of the *Coleoptera*, works its way from the sap of the timber towards the bark, and from thence into the lead, it is proposed to so place the timber that the bark may be furthest removed from the lead.

Scheurer-Kestner (Compt. Rend. **53**, 518) has published a case in which cylindrical holes were found in the lead lining of a beam of a new vitriol chamber, and this only a few days after effecting the covering. In one of the holes the semi-developed body of an insect was found, partly in the lead, and head first. The diameter of the perforation corresponded exactly to the body of the insect, so that the latter could not turn round in order to escape.

Similar observations having been made by others, the author does not doubt that in the case mentioned first the corrosion was caused by the woodworm.—H. A.

PATENTS.

Improvements in and relating to Apparatus for Evaporating Solutions containing Salts and for other Liquids. J. Foster, Sunderland. Eng. Pat. 9518, June 19, 1890. 8*d*.

This invention relates to improvements in multiple-effect evaporating apparatus, more especially to modifications of some of the designs described in a previous patent, Eng. Pat. 7343 of 1889 (this Journal, 1890, 593). They refer to details of the construction of the vertical tubular evaporating vessels, embracing the provision of lower conical ends to the same, and outlets for the collection of the concentrated liquor or the deposited salt, and the fitting of automatic rotary valves to the outlets for withdrawing the contents at regulated intervals. Also the application of central rotary stirrers for agitating the liquid and for preventing deposit on certain surfaces. There are three claims and two illustrations.—B.

Improvements in or relating to Apparatus applicable for the Extraction of Fats or Oils, Sulphur and other Material, and for Manufacturing Extracts for Dyes and other Purposes. A. J. Boult, London. From "G. Boulet fils, Douard and Contamine," Rouen, France. Eng. Pat. 9825, June 24, 1890. 8*d*.

The apparatus consists of two boiling vessels, surmounted by two receivers or "displacers," from each of which the extract or solution is led into the opposite boiling vessel. The receivers, which are provided with water and steam pipes and with filling holes for the material to be extracted, have internal false bottoms, perforated and placed at an inclination, which act as filters for the descending liquor. The extracted liquor passes into the opposite boiler as described, and may there be heated by steam or otherwise. The rising vapour reaches the receiver overhead, where it condenses, and both heats and extracts the soluble parts from the surrounding substances. The solution passes through the filter into the other boiler, where it may be withdrawn or mixed with other liquids or extracts, with or without the admission of heat. The boilers are used alternately, and provision is made for the condensation of all excess vapour whether arising from boilers or receivers, and its return to the apparatus. The inventors claim that with this arrangement they succeed in preventing all loss of vapour or volatile liquids and in avoiding all danger from fire. For details the specification should be consulted, which embraces four claims, and is illustrated by two drawings.
—B.

* Any of these specifications may be obtained by post, by remitting the cost price, *plus* postage, to Mr. H. Reader Lack, Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C. The amount of postage may be calculated as follows:—

If the price does not exceed 8*d*.	½*d*.
Above 8*d*., and not exceeding 1*s*. 6*d*.....	1*d*.
„ 1*s*. 6*d*., „ „ 2*s*. 4*d*.....	1½*d*.
„ 2*s*. 4*d*., „ „ 3*s*. 4*d*.....	2*d*.

Plates for Oil and other Presses. W. C. Leechman, Colombo, Ceylon. Eng. Pat. 9526, July 19, 1890. 6*d*.

See under XII., *page* 708.

Improvements in Glass-lined Tubing. D. Rylands, Stairfoot, and R. Morant, Barnsley. Eng. Pat. 11,734, July 26, 1890. 6*d*.

The object of this invention is two-fold: (1) the manufacture of glass-lined tubing, so that in the one tube there can be two or more tubes inserted, thus enabling one or more complete circuits to be secured by means of one metal tube thus lined; and (2) in the mode of coupling up unprotected glass tubes. In the former the metal pipe is somewhat like a double-barrelled gun, with an outside flange at each end, and the glass tubes are inserted in each barrel with suitable packing to keep them in position, and to enable them to resist pressure. After insertion in the tube the ends can be ground down level with the faces of the flanges, and the whole can be coupled up by bolts and suitable washers.

In unprotected glass tubes, the tubes are formed with angular interrupted projections at each end. A metal flange is threaded on each tube, and the two flanges are rotated till the projections on the flanges bear on those of the tubes; a suitable ring being now inserted they can be drawn together and secured by bolts.—E. S.

Improvements in Refrigerating Apparatus. H. Imray, London. From "Compagnie Générale pour la Production du Froid (procedés E. Fixary)," Paris, France. Eng. Pat. 12,896, August 16, 1890. 8*d*.

In Eng. Pat. 2387 of 1885 the thawing of the rime from the circulating refrigerating pipes was described as being mainly effected by the circulation of the comparatively warm air when arriving in the first compartment of the refrigerating apparatus. In this invention, while the temperature of the air to be refrigerated can be reduced to a very low degree, depending on the temperature at which the liquefied gas (as ammonia, &c.) evaporates, the melting of the rime is effected by the refrigerating fluid itself after compression. The apparatus consists of two chambers, through which air is circulated by a fan. Each chamber contains a set of the refrigerating pipes, placed one above the other, and the coils of each chamber are connected by branches with shut off cocks, with the supply conduit for liquefied vapour; with the exhaust conduit leading to the compressor; and also with the compression conduit of the compressor, the melting of the rime off the coils being effected by admitting the warm vapour from the compressor, which being done, the conduit for liquefied vapour is shut off from the second set of coils, and the liquid in the first set is made to expand into the second set.—E. S.

Improved Apparatus for Evaporating and Distilling Liquids. R. Harburn, Sunderland. Eng. Pat. 13,322, August 25, 1890. 8*d*.

The object of this invention is to evaporate and distil liquids by aid of steam in one or more chambers, in which the pressure is practically reduced below that of the atmosphere. The chambers have outlets to a condenser and to a pump which carries off any matter not intended for evaporation. The method consists in admitting the steam and liquid into a special mixing apparatus, so arranged that the steam comes in contact with the liquid immediately before it enters what is called the evaporating chamber. In the chambers suitable plates are fitted for intercepting matter not intended for evaporation or distillation, such matters being carried away by the pump, the evaporated and distilled portions being conveyed to the condenser by suitable connections. In order to understand the construction and working of the apparatus, the drawing attached to the specification must be consulted. The invention may be applied to various purposes, among others to the manufacture of sugar, the separation of salts and alkalis in chemical manufacture, and the purifying of sea-water for use in marine engine boilers.—E. S.

Improvements in Filtering Materials and Filters. E. Edwards, London. From O. Arlt, Goerlitz, Germany. Eng. Pat. 8440, May 16, 1891. 8*d*.

The filtering materials consist of inorganic substances of various densities and quality, arranged in layers one above another in such a way that the lowest, loosest and coarsest layer is surmounted by a finer layer, and so on, to the uppermost, which is finest of all. The raw materials employed are—(1) slag wool or silicate cotton; (2) clean, white, long-tailed asbestos; and (3) ordinary asbestos in the form of the finest fibre. After undergoing certain treatment these are made into different mixtures, according to the layer each is intended to occupy in the filter. This is a cylindrical vessel made of sheet copper or other metal, and is supported on legs. When full the filtering materials are covered by a perforated plate, over which is the tight-fitting cover. The liquid to be filtered is admitted through a cock at the bottom, and discharged through another at the top. Several modifications of the filter are shown on the drawing accompanying the specification.—E. S.

Improvements in Evaporating and Distilling Apparatus. W. J. Mirrlees, Glasgow. From H. T. Yuryan, Toledo, Ohio, U.S.A. Eng. Pat. 8809, May 23, 1891. 11*d*.

In previous patents relating to multiple-effect evaporating apparatus (Eng. Pats. 14,162 of 1886 and 213 of 1888; this Journal, 1887, 39; and 1888, 313), the increasing volume of the vapour passing through the coil during the process of vaporisation was met by a gradual increase in the diameter of the tubes from the inlet to the outlet of the coil. But as the surface of a tube does not increase at the same rate with an increase of diameter as its contents, it was found that the effective heating surface diminished relatively to the contents of the coil. The present invention seeks to obviate this objection by dividing the tube constituting a coil into succeeding series of tubes, preferably all of equal diameter, each following series having a larger number of tubes than the preceding one. The series may be either super-imposed with suitable end pieces or connected end to end as indicated in two sheets of drawings. There are three claims.—B.

II.—FUEL, GAS, AND LIGHT.

The Gasification of Tar. Merkens. Jour. f. Gasbeleuchtung, **34**, 188. From the Society of Baltic Gas Engineers.

By injecting into a red-hot retort half filled with coke a spray of tar by means of a Körting's jet supplied with superheated steam, the author has succeeded in converting the whole of the tar into gas, without leaving any residue in the retort. The gas had a high candle-power, and in this way he has been able to avoid the use of expensive enriching material. On conclusion of the experiments, the author hopes to furnish further details.—F. H. L.

The Dinsmore Process of Gas Manufacture. G. Kraemer. Jour. f. Gasbeleuchtung, **34**, 225—228. (Compare this Journal, 1890, 444—447.)

According to the author, the experiments which were carried out in Liverpool, and reported in the Journal of Gas Lighting for February 17, 1891, must be taken as proving conclusively that this process possesses no advantages whatever over the usual method of procedure, but seeing that it still excites considerable interest—like the problem of perpetual motion—he submits the following considerations from the purely chemical point of view:—

As improved by Carr, the process consists in passing the whole of the products of the distillation of the coal, tar, and liquor, as well as gas, through an empty retort before entering into the hydraulic main. Of the constituents of the gas, the only substances affected by the treatment are methane and the olefines. The action on the benzene and naphthalene will be considered with the tar. Berthelot (Annalen, **142**, 251) has proved that by passing through a red-hot tube, methane and ethylene are converted into acetylene and hydrogen, the former being at once polymerised into benzene, &c.; the decomposition, however, is never complete, traces of ethane and its homologues being produced. Seeing that these hydrocarbons form only about 40 per cent. of the gas, and that it is impossible owing to the speed of its passage through the retort, and to its being a bad conductor of heat, for the action to be anything like complete, the increase in volume is small, and being due partly to benzene and its homologues, is in part only temporary. Watson Smith (this Journal, 1890, 444—447) has stated that the increase in volume may be as much as 10 per cent., and as this amount can hardly be obtained from the gas, it is necessary to consider the action of the constituents of the tar. Benzene and its homologues are split up in part under this treatment into diphenyl, anthracene, naphthalene, &c., and free hydrogen, but as in 100 kilos. of tar only 2·5 kilos. of naphtha are found, to the corresponding volume of gas (600 cbm.), an increase of only 4 cbm. or 0·66 per cent. may be expected. If the phenols are decomposed in a similar manner, the latter figure may reach 1·0 per cent. The naphthalene is practically unaltered, and from the heavy hydrocarbons only small amounts of hydrogen are given off. From 100 kilos. of the heavy oils, 10 cbm. of gas may be obtained, a figure agreeing partly with the results obtained by the author in the works at Grabow and Erkner; this gas, however, is much poorer in hydrocarbons than that derived from the naphtha. If these figures are added together and calculated on the yield of gas, it will be found that *an increase in volume of hardly 0·5 per cent. may be expected from the gasification of the tar.*

With regard to the alleged increased candle-power, the original gas contains, together with 47 per cent. of hydrogen, about 40 per cent. by volume of gaseous hydrocarbons, which latter have the property of keeping considerable amounts of benzene and naphthalene in suspension, thus materially increasing the illuminating power. The increase in volume, by the process under consideration, being, the author thinks, only at the expense of the methane and olefines, the 40 per cent. of hydrocarbons is greatly reduced, and hence far less benzene and naphthalene can remain suspended, the nett result being of necessity a loss of illuminating power.

Experiments carried out on the large scale are considered by the author to show that the statement that by heating two molecules of cresol and one of phenol, one molecule of anthracene, one of benzene, and three of water are formed, is only in part correct (compare this Journal, 1890, 447). From 100 kilos. of cresol he obtained 19·9 cbm. of gas of average illuminating power and 76·1 kilos. of tar, the tar containing 9 per cent. of benzene, 20·9 per cent. of crude phenol solidifying at 23°, 46·6 per cent. of unchanged cresol, and 23·3 per cent. of hydrocarbons of high boiling point, with little anthracene but a large amount of phenanthene. That is to say that hardly 10 per cent. of the cresol was decomposed according to the formula.

From the adoption of the Dinsmore process, therefore, an increase in the volume of the gas may be expected, but this only at the expense, it is thought, of the gaseous hydrocarbons, which are not only valuable in themselves as a source of light, but confer upon the gas its property of holding in suspension the various liquid and solid hydrocarbons to which a large proportion of its illuminating power is due. The author believes this process gives results in no way different from those obtained by employing a higher temperature of carbonisation, the advantages of the higher yield of gas being in his opinion neutralised by the trouble caused by tar stoppages in the ascension pipes and naphthalene stoppages in the mains.—F. H. L.

Detection of the Sulphur not combined with Hydrogen in Illuminating Gas. "L. Ilosvay de N. Ilosva." Bull. Soc. Chim. 1890, **4**, 714—715.

See under XXIII., *page* 726.

Fuel for the Hefner Lamp. Jour. f. Gasbeleuchtung, **34**, 265—266.

A discussion on the subject of amyl acetate, the fuel of the Hefner lamp, has recently taken place; it was originated by Voller, who, in carrying out some photometric observations with the lamp, used a sample of amyl acetate, obtained from a Hamburg druggist, which boiled at 80° instead of 138° and consisted of a mixture of amyl acetate and alcohol. As the photometric determinations gave erroneous results, Voller questioned the advantage of using the Hefner lamp as a standard light instead of candles (Electrotechnischen Zeits. 1891, 122), owing to the variability in composition of commercial amyl acetate.

Hefner-Alteneck replied as follows (Ibid. 177):—As the Hefner lamp has been only recently unanimously adopted as a standard by the "Deutschen Vereins von Gas- und Wasserfachmännern," and as, moreover, it is usually employed as such in electro-technology, Voller's remarks must not be allowed to pass unnoticed; there is no difficulty whatever in obtaining reliable samples of amyl acetate if the pure compound is ordered and the exhaustive experiments of Liebenthal (Ibid. 1883, 583 and 610) have shown that the lamp is an excellent unit and does not require that the amyl acetate should be chemically pure. It is essential, however, in making photometric observations with the Hefner lamp, to do so in fresh air, especially in testing the illuminating power of incandescent lights, as an increase in the proportion of carbon dioxide in the air affects very materially the illuminating power of all flames.

The following are some simple tests by which the presence of impurities in ordinary commercial amyl acetate can be detected. (1.) The specific gravity should be 0·872—0·876 at 15°; if it is less than 0·872, alcohol, amyl alcohol, amylene, &c., may be present. (2.) The sample should mix with its own volume of benzene or carbon bisulphide without any turbidity being produced; if not, it is probable that the sample has been adulterated with aqueous alcohol or aqueous amyl alcohol, to increase the specific gravity. (3.) On shaking 1 cc. of the sample with 10 cc. of alcohol of 90 per cent. (Tralles) and 10 cc. of water, a clear solution should result; if a turbidity is produced, amylene, toluene, &c. are probably present. (4.) A drop of the sample placed on white paper should leave no permanent grease-spot on evaporation; this test proves the absence of fats and high-boiling coal-tar oils. In addition to the four tests given above it is advantageous to determine the boiling point, which should be 136°—142° under a pressure of 760 mm.—F. S. K.

Analyses of "Carbon Minerals." C. E. Munsell. Jour. Amer. Chem. Soc. 1891, **13**, 143.

The following Results of Analyses of various Peats, &c. are given.

Material and Source.	Water.	Carbon.	Hydrogen.	Sulphur.	Nitrogen.	Oxygen.	Ash.
Peats:							
Ravenna, Ohio. Surface	7·95	57·84	7·10	0·20	0·84	21·12	4·95
Ravenna, Ohio. Bottom	12·60	41·84	6·95	0·26	2·24	16·48	13·66
Lignites:							
Kanarrah, Utah. Cretaceous	7·45	53·95	8·30	0·90	0·98	23·57	4·85
Cedar City, Utah. Cretaceous	2·39	59·55	6·68	1·22	0·98	25·89	3·29
Canon City, Colorado	5·65	56·95	4·65	1·19	0·28	27·06	3·62
Morrison, Colorado	8·20	64·05	4·80	0·51	0·70	17·24	4·50
Fort Berthold, Dakota	8·00	57·20	5·22	1·88	0·70	25·52	1·48
Carbon Station, Wyoming	7·35	63·65	4·60	0·76	1·40	19·41	2·80
Point of Rocks, Wyoming	5·35	70·50	4·50	0·98	1·12	12·35	5·20
Cosmy Coal:							
Crested Butte, Colorado	1·00	74·29	7·49	0·61	1·40	9·17	6·04
Anthracite:							
Crested Butte, Colorado	0·72	82·50	5·15	0·85	1·12	4·45	5·21
Absolite:							
Castle Valley, Utah	0·67	71·30	7·96	0·70	0·28	18·05	1·04
Shale:							
Green River, Wyoming	2·40	35·35	6·11	1·20	0·84	2·79	50·92

—T. L. B.

Coke Breeze as Fuel. G. Frère. Compt. Rend. de la Soc. tech. de l'Ind. du Gaz en France, 1890, 108; Proc. Inst. Civil Eng. Abstracts, **105**, iii., 59—60.

The fuel value of coke-breeze depends upon its composition, which varies according to the source from which it is derived. That produced from breaking coke consists of—

	Per Cent.
Moisture	5
Carbon	84
Ashes and clinkers	11

and that from coke direct from the retorts—

	Per Cent.
Moisture	13·5
Carbon	70·0
Ashes and clinkers	16·5

The average composition of the "Pas-du-Calais" coal, generally used in the gasworks of the North of France, is—

	Per Cent.
Moisture	1·5
Carbon and volatile matters	88·0
Ashes and clinkers	10·5

Taking the percentage of carbon in each of these cases, and assuming the coal worth 16*s.* per ton, this would give the value of the breeze from the coke breaker as equal to 15*s.* 3*d.* per ton, and that from the retorts to 12*s.* 9*d.* per ton, the lower value of the retort breeze being chiefly due to the larger percentage of moisture it contains.

At some gasworks the coke breeze is made into bricks to be used for generating steam or for heating the retort furnaces, but if the breeze is worth 6*s.* to 7*s.* per ton, and its conversion into "briquettes" costs about the same sum, coal at 15*s.* per ton would be preferable, as the manufacture of "briquettes" requires expensive machinery.

The direct use of breeze as fuel has for some years attracted considerable attention, and, with special appliances, it has been utilised successfully either alone or with a mixture of coal. Of such appliances reference may be made to the Perret furnaces, which are now extensively used. The cathedral of St. Quentin was heated during the winter of 1889 by eight of these furnaces, burning only coke-breeze. The cubical contents of the church are 3,178,530 cubic feet, and during five winter months, which included 65 days of frost, the average temperature in the church was maintained at 52·6° F., as compared with an average external temperature of 36·5° F. The average daily consumption of breeze was 3,053 lb., which, at 6*s.* 5*d.* per ton, would cost 8*s.* 9*d.* per day. The system is also employed for steam boilers.

The author has also experimented for two years with a mixture of coke-breeze in a generator retort-furnace with the following results:—

With a mixture of half breeze and half small coal, and with the air-supply under pressure, and a consumption of 30 cwt. of the mixture per 24 hours, the result was unsatisfactory, as the temperature was not maintained sufficiently high for the proper carbonisation of the coal. When the air-supply under pressure was done away with the furnace worked well, a slight vacuum being maintained in the generator and a slight pressure at the top of the furnace. The coke-breeze used was from the coke-breaker, on account of the smaller quantity of water it contained; the breeze was very fine, having passed through a screen perforated with holes of about ¼ in. diameter. It was not considered practicable to use coke-breeze alone, because it would not agglomerate, and the furnace bars would have been obstructed by it. The fuel was put into the generator every hour in quantities of 61 to 66 lb. Twenty minutes after filling the generator the mixture was raised with a bar and the lumps pushed to the back of the generator, the firing proceeding in a manner similar to that with coke. For one month a mixture of 40 per cent. by weight of small coal and 60 per cent. of breeze was used, and of this 32 lb. were required to carbonise 220 lb. of coal. During the next month, with 35·8 per cent. of small coal and 64·2 per cent. of breeze, the rate of consumption was 30 lb. of fuel per 220 lb. of coal carbonised.

The following comparisons will show the estimated cost of heating a bench of seven retorts, carbonising five tons of coal in 24 hours, with coke or with small coal:—

	s. *d.*	*s.* *d.*
(1.) 71½ bushels of coke at 4·36*d.*		27 0
(2.) 2,204 lb. small coal	16 0	
Extra labour	1 2½	
		17 2½
(3.) 540 lb. small coal at 16*s.*	3 11	
1,003 lb. breeze at 6*s.* 5*d.*	2 10½	
Extra labour	1 2½	
		8 0

If, as is the case in some works, the coke-breeze is of little or no value, the economy would be greater, but if, on the contrary, it can be sold for more than 6*s.* 5*d.* per ton, the economy would be proportionately reduced.

The Utilisation of Coke-Breeze. Compt. Rend. de la Soc. tech. de l'Ind. du Gaz en France, 1890, 358; Proc. Inst. Civil Eng. Abstracts, **105**, iii., 61—63.

At the meeting of the society at Paris in June 1885 the author read a paper upon a system of heating gas-furnaces with coke-breeze. So far it has not been found possible to use breeze alone for heating gas-furnaces, but where there is not an easy sale for the small coke good results may be obtained by leaving it with the breeze. With breeze alone the quantity of clinker was so great that it formed an impenetrable layer on the furnace bars, the air-supply found passages in various parts, the combustion became imperfect, and the heats fell off.

The following proportions of various fuels were found necessary for heating a bench of retorts for 24 hours:—(1), 49½ bushels of coke-breeze and 16½ bushels of coke; (2), 55 bushels of coke-breeze and 13¾ bushels of small coal; (3), 30¼ bushels of small coal and 5½ bushels of coke; (4), 82½ bushels of large coke, but in cases 1, 2, and 3 only 10,582 lb. of coal were carbonised, while in case 4 the quantity was 11,905 lb. of coal. Also in cases 1 and 2, 2¾ bushels or 198 lb. of small coal and 4½ bushels of coke-breeze were required for the production of a forced draught by steam. A breeze furnace wears out more quickly than an ordinary furnace, the additional cost for which is shown to be 13*d.* per furnace per day. The breeze furnace is fired every 15 to 20 minutes and clinkered every four hours, which occupies six to 10 minutes, a special rake being used to push the fuel to the back of the furnace, as, without this, the clinkering would be more difficult than with an ordinary furnace. The clinkers do not adhere to the bars, but stick more firmly to the sides of the furnace; the furnace-bars are not injured, being found in the same condition when a furnace is let down as they were when put in, the air and steam keeping them always cool. It was expected that there would be deposits of ashes in the flues and chimney, but during five years' working no unusual deposits have been found.

The volume of air forced into the furnace by the injector varied between 23,993 cubic feet and 26,811 cubic feet per hour. Theoretically 1 lb. of carbon requires 142¾ cubic feet of air for complete combustion, and taking case No. 2 before referred to, the breeze and small coal would weigh about 3,417 lb., or, deducting the residuals, the net weight of the carbon would be 2,885 lb., and the theoretical quantity of air for this would be 411,833 cubic feet. Taking account of the partial or total stoppages for clinkering, and also of the carburetted hydrogen in the small coal, it will be seen that there was not an excess of air, as, with a chimney draught, it is generally assumed that the air necessary for combustion is double the theoretical volume.

From analyses of the products of combustion it appears that, shortly after the furnace is charged, few of the combustible elements are lost, and that a constant condition is attained until the time for clinkering, and under this condition 4 per cent. of carbonic oxide and 4 per cent. of hydrogen escape in the chimney; the absolute absence of oxygen also indicates an insufficient air-supply.

In consequence of the enormous quantities of breeze which accumulate in a gasworks with the increasing demand for broken coke, many gas managers may be interested in the use of this system, and the selling prices of coke and breeze and the cost of coal at any works being known, a very simple calculation will enable them to decide whether there would be an advantage in doing so.

Trials were also made with firing two 30-H.P. Babcock and Wilcox steam boilers with coke-breeze and small coal, using a forced draught obtained by means of a Bourdon steam-blower. The results are given as follows:—

(1.) With Small Coal and Breeze.

Length of trial		10 hours.
Average steam pressure		6 atmospheres.
Water evaporated		14,109 lb.
Small coal used	1,898 lb.	
Breeze used	467 lb.	
		2,365 lb.
Normal horse-power		30 H.P.
Actual power developed		42·66 H.P.

(2.) With Small Coal and Breeze.

Length of trial		6 hours.
Average steam pressure		6 atmospheres.
Water evaporated		7,584 lb.
Small coal used	856 lb.	
Breeze used	587 lb.	
		1,443 lb.
Normal horse-power		30 H.P.
Actual power developed		36·39 H.P.

(3.) With Small Coal and Breeze.

Length of trial		6 hours.
Average steam pressure		6 atmospheres.
Water evaporated		5,621 lb.
Small coal used	370 l..	
Breeze used	794 lb.	
		1,164 lb.
Normal horse-power		30 H.P.
Actual power developed		28·33 H.P.

(4.) With Small Coal and Breeze.

Length of trial		6 hours.
Average steam-pressure		6 atmospheres.
Water evaporated		5,556 lb.
Small coal used	326 lb.	
Breeze used	849 lb.	
		1,175 lb.
Normal horse-power		30 H.P.
Actual power developed		28 H.P.

The proportions of small coal and breeze given in the last example may be taken as the limit for practical working.

PATENTS.

Improvements in Apparatus for and in the Manufacture of Water-Gas. S. Fox and E. Blass, Leeds. Eng. Pat. 6131, April 10, 1889. (Second Edition.) 6*d.*

In order to obtain the steam necessary for the production of water-gas without the aid of a steam boiler, water is admitted under pressure into a heated regenerator and there converted into steam.—F. S. K.

Improvements relating to Apparatus for Burning Liquid Fuel. W. E. Smith, Brighton. Eng. Pat. 9604, June 20, 1890. 1*s.* 6*d.*

The patent refers to a means for burning liquid fuel in which the "atomised" fuel is mingled with heated air in such a manner that combustion complete and well under control can take place. To this end an injector fixed in a cylindrical or other shaped chamber, which is surrounded by a similar larger chamber, is used to atomise the fuel, the air for its consumption being drawn in through the annular space between the two cylindrical chambers and thereby heated. The heating is promoted by the use of a steam coil situated in the annular chamber and supplied with steam from the boiler to be fired; the steam may be superheated before its entrance into the coil, and also on its passage from the coil to the injector, which is its ultimate destination. The heating and mixing effects are enhanced by the employment of baffle plates, wire gauze, &c. to break up and commingle the streams of gas and vapour about to be consumed. Various modifications of the apparatus,

such as the use of U-pipes projecting into the combustion chamber, through which the air is made to pass before consumption, and the hinging of the whole apparatus so that it can be swung back from the combustion chamber upon occasion, are described and illustrated, as are also particular applications to an ordinary single flue Cornish boiler and a locomotive boiler. In the last case a fire-brick lining and fire-brick perforated hood distribute the heat so as to avoid injury to the tube-plate or tubes.

—B. B.

Improvements in and relating to Apparatus for the Manufacture of Gas for Illuminating and other Purposes. J. Love, Stratford. Eng. Pat. 10,329, July 3, 1890. 11*d*.

The most important feature of this invention is that the apparatus is entirely self-contained, the water-gas, hydrocarbon gas, and the steam necessary for the production of the water-gas and for working various mechanical arrangements, being all generated in one retort: a considerable economy in space is thus effected and the apparatus is more easy to work, and requires less labour than other gas producers.

The vertical, somewhat bottled-shaped combustion chamber in which the fuel is placed is surrounded by an outer shell or annular space, partially filled with water, the whole apparatus being similar in form to an ordinary vertical boiler. The combustion chamber is charged from above by a mechanical arrangement, consisting of an endless screw or elevator enclosed in a cylindrical casing, and worked by a small steam engine securely fastened on to the side of the outer shell of the retort: the charge is introduced into the combustion chamber with the aid of a suitable feed-hopper, fitted with an air-tight cover. The hydrocarbon is placed in a chamber situated near the bottom of, and partially surrounding the retort, the chamber being fitted with trays and wicks, and also with a coil through which steam or hot water is passed to vaporise the liquid.

There are eleven claims and two sheets of drawings.

—F. S. K.

Improvements in the Composition and Manufacture of Fuel from Coal Dust and similar Material. W. H. Buckland, South Hayling, and G. Myers, Hampstead. Eng. Pat. 11,239, July 18, 1890. 6*d*.

Instead of using pitch to cement coal-dust together to form briquettes, the patentees employ "substances of a glutinous or farinaceous character, such as are obtained from wheat, barley, rye, or other cereals or vegetables, 5 per cent. to 95 per cent. of coal-dust being a suitable proportion. The mixture may be kneaded by hand and sets in a short time, so that moulding under pressure is unnecessary, though the use of moulds may be adopted to aid rapid manufacture. It is claimed that the product burns with less smoke than the ordinary briquettes, and is more economical in use. Ashes or refuse matter from coal fires with or without fresh coal may also be utilised.

—B. B.

New or Improved Apparatus for Drawing Coke from Coke Ovens. C. W. Bartholomew, Towcester, and J. Oxley, Wombwell. Eng. Pat. 12,580, August 12, 1890. 8*d*.

This apparatus for drawing coke from coke ovens cannot be properly described without the aid of drawings; the principal feature of the apparatus is the use of a suspended working lever, arranged to reciprocate and work a coke-drawing fork.—F. S. K.

Improvements in the Production of Coke and in the Apparatus Employed therefor. M. Fromont, Brussels, Belgium. Eng. Pat. 13,177, August 27, 1890. 8*d*.

This invention has for its object the improvement of coke furnaces in such a way that coke can be produced from coal containing little or no fatty substance or oil, and from coal or lignite briquettes or other fuel; this object is attained by burning practically the whole of the escaping volatile matters upon the walls of the coking chambers.

The coking chambers, which are arranged in juxtaposition alternately, and on different levels, are first heated to incandescence and then charged with coal through feeding channels. The gases evolved from the heated coal pass through hollow doors or ports into "heat-restoring chambers" placed below the coking chambers, and containing fire-proof blocks or partitions; here the combustible gases encounter air, previously heated in conduits or pipes, and such intense heat is produced that the duration of the carbonising process is considerably shortened; the excess of heat is also stored up so that when carbonisation is at an end the apparatus is ready for a fresh supply of material.—F. S. K.

Improvements in the Methods of Setting Clay Retorts for the Manufacture of Coal-Gas. T. Cooke, Bristol. Eng. Pat. 17,745, November 5, 1890. 6*d*.

Eight through retorts, 18 to 20 ft. long, are set in one arch and heated by direct firing by means of four shallow coke furnaces, two of which are placed beneath the retorts at each end of the arch; or, eight retorts 9 to 10 ft. long, having only one mouthpiece each, are fired directly by two such furnaces placed in a similar position. In either case the retorts are set in three tiers, three in each of the bottom tiers and two in the top one, and are supported on brick piers with apertures between them allowing a free circulation of the furnace gases.

The heating can be effectually accomplished, consuming not more than 30 per cent. of the coke produced in the retorts.—F. S. K.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

Terpene from Compressed Gas Oils. A. Étard and P. Lambert. Compt. Rend. **112**, 945—947.

Portable or compressed gas is prepared in France from the heavy paraffinoid oils obtained from the bituminous schists of Autun or less frequently from material similar to Scotch boghead. The oils are carburised at a cherry-red heat in long cast tubes, and the resulting gas is compressed in cylinders; in this operation light liquids condense holding in solution such gases as butylene, ethylene, &c. The authors have examined the gas oils obtained from both the above sources and find them practically identical. They distil between 20°—360°, leaving a tar, and yield about 60 per cent. of benzene, 10 per cent. of toluene, 6 per cent of light unsaturated hydrocarbons, and 10 per cent. of higher oils between 140°—190°, which give no definite boiling point, but undergo steady decomposition at about 167°. Repeated fractionation of the light oils thus produced yielded a product C_5H_8, boiling point 42°5, density 0·803, vapour density 2·45 (theory 2·35), named by the authors *pyropentylene*; it has the principal terpene properties. It has a peppery taste and characteristic odour, is not acted on by ammoniacal silver or cuprous salts, but ammonia potassic solutions of silver deposit silver mirrors in its presence. Concentrated aqueous silver nitrate produces a white crystalline precipitate; aqueous sulphurous acid forms

with it white crystals of the composition $C_{10}H_{12}.2\,H_2SO_4$, insoluble in almost all reagents except alkalis, and which exhibit a remarkable tendency to retain small quantities of iron. Halogen acids resinises it rapidly or cause it to explode, oxidising agents even when dilute destroy it completely, whilst bromine gives rise to liquid derivatives. In the cold it gradually polymerises, the density increasing regularly with the time of exposure, ultimately forming a solid, $C_{10}H_{12}$, melting at 8° with a density 1·003 and called *di-pyropentylene* which depolymarises on heating. Pyropentylene is neither identical with valylene nor pirylene.

—D. A. L.

Paraffin and Bitumen in Brown-Coal Tar. E. von Boyen. Zeits. f. angew. Chem. 1891, 261—265. (Continued from this Journal, 1891, 455.)

The author has tried a large number of experiments on the possibility of preparing crystalline paraffin from the tar without distillation; but neither by the action of pressure alone, nor by caustic soda, nor by sulphuric acid followed by pressure, were the results satisfactory. The best yield was given by the following proeess: The tar was treated with 6 to 8 per cent. of caustic soda (40° B.) at a temperature of 60°, and the top layer of the liquid, containing the hydrocarbons separated, cooled, and pressed. The cake was melted with 3 to 6 per cent. of purified creosote oil (boiling point 200°) and another 3 per cent. of soda added; after separation, the crude paraffin was dissolved in 40 per cent. of paraffin oil and treated with 4 per cent. of sulphuric acid at a temperature just above the solidifying point. This latter process was repeated twice, and the paraffin separated.

Of methods involving distillation a large number are given, which may be divided into two classes: 1st, those in which the tar is first washed and finally distilled; and 2nd, those in which the distillation precedes the washing. Of these, for the details of all of which reference must be made to the original article, the author recommends, in the case of tars containing less than 5 per cent. of bitumen, that the tar be treated with sulphuric acid, the oils separated, washed, and distilled under atmospheric pressure, and the resulting paraffin purified by pressure at a temperature of 2°. The great majority of tars containing more than 5 per cent. of bitumen, the use of alkali becomes harmful, owing to the great loss and the difficulty of working up the dissolved substances, and the best process is to distil the tar under atmospheric pressure and to refine the paraffin by a second distillation *in vacuo*. (See also this Journal, 1890, 487.)—F. H. L.

The Coal-Tar Industry during the Year 1890. Jour. f. Gasbeleuchtung, **34**, 185—188.

The past year has been, on the whole, a favourable one for the coal-tar industry, the prices of most of the different products having risen considerably. Phenol, however, has been the single exception, having probably passed its maximum demand. Benzene has risen in value nearly 25 per cent., and this increase is likely to be maintained, owing partly to its increased use, and partly to the fact that the amount of benzene in the tar is steadily diminishing, and threatens to become very small if the Dinsmore process is largely adopted. Naphthalin is stronger, having found more outlets in the colour works. Anthracene remains much as usual. The prices of ammonium sulphate depend more on the sodium nitrate trade than on the value of the coal, and no improvement is likely to be experienced. Pyridine bases for denaturing spirit have also increased in price about 25 per cent., being employed for this purpose in Germany, Austria, Switzerland, and, according to report, Sweden.

The most important factor in the phenol market has been the success on a manufacturing scale of the process for its synthetical production. This substance has now been known long enough to be recognised as of the best quality. The exact process employed in its manufacture is unknown, but whether it is made from benzene sulphonic acid, or aniline, benzene must always be the starting point, and therefore the process is only workable when the latter is considerably below phenol in price. The further advantages claimed for the synthetical product, viz., greater purity and non-colouration in the light, do not apply, for the second claim is contrary to fact, and it is possible with only slight loss to prepare from tar a phenol equally pure. Much work is apparently being done on the purification of this substance, this being due to the constant demands of the market for greater purity at a lower price, and to the Pharmacopœia Commission, who demand an article far purer than there is any occasion for.

The only purifying process which has been made public is that of Riehm (D.R.P. 53,228 and 53,307), which depends on the separation of the phenol as a barium salt. According to the inventor it is possible by this process to separate also the three isomeric cresols. On a manufacturing scale, however, this process becomes impracticable, owing to the insolubility of the barium, which necessitates the employment of such large quantities of water. Whether there is any opening for the separated cresols remains to be seen.

Among the new substances discovered in tar may be mentioned cumarone and indole (Ber. **23**, 78—83; this Journal, 1890, 275). These substances possess, however, no technical importance, but are of interest in indicating the method of formation of a large number of other bodies.

Progress has also been made in the employment of the heavy tar-oils for disinfection, their value in this direction having been known for a long time; among the substances brought out may be mentioned Pearson's creolin (this Journal, 1886, 274), and more lately Lysol (this Journal, 1890, 1136). Benefit, however, will only accrue to the coal-tar industry when such substances as these are sold at prices having some relation to their real value.

Among other branches which have increased in importance may be mentioned the use of creosote oil in lueigen apparatus, phenanthrene and carbazol, both of which find a ready sale in the colour trade.

The value of the process for the synthesis of indigo from phenylglycocine is still undecided, as is the future of the new explosives prepared from the nitrated hydrocarbons. Taken altogether, the outlook of the industry is very promising.

—F. H. L.

PATENT.

Improvements in and connected with Retorts for Distilling Shale or other Oil-yielding Minerals. F. J. Rowan, Glasgow, and H. Armour, East Breich. Eng. Pat. 11,581, July 24, 1890. 8*d*.

In order to facilitate the escape of the vapours or gases generated in retorts used for distilling shale, &c., and thus prevent as much as possible the decomposition of the vapours, a pipe, provided with perforations or slits, is introduced centrally into the top of the retort and extended downwards for a suitable distance; this pipe serves to draw off the vapours and is connected above with the ordinary outlet.

Instead of this simple arrangement a much longer perforated pipe passing from the ordinary outlet almost to the bottom of the retort may be employed when it is desired to treat the material in the retort with steam. This pipe is divided by suitable partitions into three distinct portions of about equal length; the upper one serves for drawing off the vapours as before, and the central one as a sort of channel, through which the gases may pass from one part of the retort to another, and thus be brought into contact with different portions of the fuel; the third and lowest portion is used for the distribution of steam through the material, the steam being brought into this portion of the pipe through a narrow pipe which passes down the whole length of the perforated pipe.—F. S. K.

IV.—COLOURING MATTERS AND DYES.

Action of Sunlight on Organic Compounds. H. Kling and O. Standke. Ber. **24**, 1340—1346.

The authors have previously shown (Annalen, **249**, 137) that phenanthraquinone unites in direct sunlight with aldehydes, forming ethereal salts of dihydroxyphenanthrene, and it was stated that quinone behaves in an analogous manner forming ethereal salts of quinhydrone. The authors now find that when a mixture of quinone and benzaldehyde is exposed to sunlight a mass of dark green crystals of quinhydrone separates out, and the solution on evaporation yields *quinhydronedibenzoate*—

$$C_6H_4O_2.2C_6H_4OH(OCOC_6H_5)$$

which crystallises in deep brown needles with a violet reflex; melts at 116—117°, and dissolves readily in alcohol and ether. It also dissolves in benzene, but is split up into its constituents on dissolution. It melts when placed in boiling water and is gradually decomposed, quinone passing over with the steam; on heating with sulphurous acid it likewise breaks up into quinone and *benzohydroquinone (dihydroxybenzophenone)* $C_6H_5CO.C_6H_3(OH)_2$ the latter forms bright yellow crystals melting at 125°, and readily soluble in ether, benzene, and alcohol. It also dissolves in alkalis, but is reprecipitated on boiling the solution. With benzoyl chloride it yields *benzohydroquinone dibenzoate*, $C_6H_4(OCOC_6H_5)(OCOC_6H_5)$, which crystallises in brilliant white needles, melts at 118°, and dissolves readily in ether and benzene, and with difficulty in alcohol.

Quinone and isovaleraldehyde are similarly converted on exposure to sunlight into quinhydrone and *isovalerquinhydrone*, $C_6H_4O_2.C_6H_4OH(OCOC_4H_9OH)$. The latter crystallises from dilute alcohol in large red plates with a green metallic reflex which gradually become dull yellow on exposure to the air. It melts at 103°, and dissolves readily in alcohol, ether, benzene, and glacial acetic acid. With water it behaves like benzoquinhydrone; sulphurous acid converts it into hydroquinone and *isovalerhydroquinone*—

$$C_6H_4(OCOC_4H_9OH)_2$$

which crystallises from dilute alcohol in yellow needles, melts at 115°, forms orange-coloured solutions with the alkalis, and generally resembles benzohydroquinone in appearance and reactions. It combines with quinone, valeroquinhydrone being formed. With benzoic chloride, it yields *valerohydroquinone dibenzoate*—

$$C_6H_4(OCOC_4H_9OH(OCOC_6H_5O)_2$$

which crystallises from alcohol in white needles, and melts at 105°. On hydrolysing this compound, valerohydroquinone is re-formed. Quinone is scarcely attacked in the dark by either benzaldehyde or valeraldehyde, only traces of quinhydrone being formed after many months' action.

S. B. A. A.

Isatine Blue. O. Schotten. Ber. **24**, 1366—1373.

Dipiperidylisatine, $C_{11}HNO(C_5H_{10}N)_2$, is prepared by heating an alcoholic solution of isatine (1 mol.) with piperidine (2 mols.) on the water-bath for about an hour. It crystallises from alcohol in flat colourless prisms, dissolves with difficulty in alcohol and ether, and scarcely at all in benzene and chloroform. It may be heated to 160° without decomposition. It is decomposed by mineral acids in the cold and by warm alkalis. It dissolves in glacial acetic acid with decomposition forming a green solution.

Isatine Blue is obtained when dipiperidylisatine is rapidly heated to a temperature between 125° and 160°, a current of air or other gas being passed over it to remove the piperidine evolved. It is best prepared by warming a mixture of dipiperidylisatine with an excess of acetic anhydride for some time to 60° with frequent agitation, and throwing the resulting blue mass into water. The product is a deep blue, almost black faintly glistening powder consisting of minute prismatic crystals which exhibit marked dichroism. In the formation of isatine blue three molecules of piperidine are liberated from every two molecules of dipiperidylisatine, but the remaining piperidine also probably undergoes some change. Isatine blue may be heated without change to 160°, but is completely decomposed at 230°. It dissolves in glacial acetic acid and with some difficulty in alcohol and in ether, forming deep indigo-blue solutions; it is insoluble in benzene and in chloroform. It is readily decomposed by mineral acids, but is more stable in alkaline solution; by prolonged boiling with alcoholic potash the blue colour is, however, gradually discharged, a bright cherry-red solution being formed. The acetic acid solution also turns red on prolonged standing or on heating, and yields a fine purple-red colouring matter very soluble in ether. Similar red solutions may be obtained by heating dipiperidylisatine with anhydrous formic acid or with acid chlorides. On distilling isatine blue with alcoholic potash the distillate contains no piperidine, and the residue does not yield isatine on acidification.—S. B. A. A.

Benzidine-ortho-disulphonic Acid. H. Limpricht. Annalen, **261**, 310—338.

Benzidine-o-disulphonic Acid—

$$\left\{(SO_3H)(NH_2)C_6H_3\right\}_2 3H_2O\ [SO_3H:NH_2=2:4]$$

is readily obtained by the reduction with caustic soda and zinc dust of *m*-nitrobenzene-sulphonic acid, and subsequent molecular transformation, by the action of hydrochloric acid, of the hydrazobenzene-disulphonic acid so formed; after allowing the acid solution to stand for several days, the separated benzidine-*o*-disulphonic acid is collected on a filter and washed, and is thus obtained pure (see also this Journal, 1890, 51).

Diazoamidodiphenyl-o-disulphonic Acid is produced by mixing a solution of benzidine-*o*-disulphonic acid (10 grms.) in dilute caustic soda (250 cc.) with one of sodium nitrite (2 grms.), and, after adding ice, slowly running in sufficient dilute sulphuric acid to liberate the nitrous acid. The solution becomes coloured red, provided the temperature remains at 0°, but if it is allowed to rise, the solution takes a yellow colour and then contains tetrazodiphenyldisulphonic acid. After standing several days in the cold, orange or red crystals of the diazo-compound, intermixed with somewhat variable amounts of unchanged benzidine-*o*-disulphonic acid and tetrazodiphenyl-*o*-disulphonic acid, deposit. From this mixture the benzidine-*o*-disulphonic acid may be separated by washing with cold water. Heated with absolute alcohol under a pressure of 400 mm., *p*-diazoamidodiphenyl-*o*-disulphonic acid yields a compound insoluble in alcohol, which was not closely examined.

Hydroxyamidodiphenyl-o-disulphonic Acid is obtained by heating the above diazo-compound with water. Its barium salt forms a soft, pale yellow mass, which, on standing over sulphuric acid, sometimes becomes crystalline; it contains 7 or 8 mols. of water of crystallisation, is easily soluble in water and alcohol (96 per cent.), and is precipitated by ether from its solution in the latter.

Hydrazinamidodiphenyl-o-disulphonic Acid is prepared by the action of an acidulated solution of stannous chloride on the diazo-compound, and is purified in the usual manner; its barium salt crystallises with $4H_2O$.

Amidodiphenyl-o-disulphonic Acid—

$$(SO_3H)(NH_2)C_6H_3-C_6H_4(SO_3H)$$
$$[SO_3H:NH_2=2\ 4\ \text{and}\ SO_3H=2]$$

is obtained on boiling the aqueous solution of the last described compound with copper sulphate; its barium salt contains $4H_2O$.

Tetrazodiphenyl-o-disulphonic Acid—

$$\left\{N\begin{matrix}\diagdown\\\diagup\end{matrix}\begin{matrix}N\\SO_3\end{matrix}\diagdown C_6H_3\right\}_2$$

prepared by the action of nitrous acid (from 10·2 grms. of $NaNO_2$) on benzidine-*o*-disulphonic acid (25 grms.) in the

way described for the diazo-compound, crystallises with probably 2 mols. of water, is stable only at low temperatures, and on boiling with water is converted into *dihydroxydiphenyl-o-disulphonic acid*; on reduction with acidified stannous chloride, *dihydraziudiphenyl-o-disulphonic acid* is produced. The latter crystallises, with 2 H_2O, in rhombic prisms, and is very unstable; its barium salt is remarkable for its stability on heating and for the tenacity with which it retains on drying 1 mol. of the 3 mols. of water it contains, the last mol. of water being removed only after prolonged drying at 180°, and the salt undergoing little decomposition at this temperature.

Diphenyl-o-disulphonic Acid is produced on boiling the last-described compound with copper sulphate solution, or by treating the same, in presence of alcohol, with copper powder; it forms an uncrystallisable syrup; its barium salt crystallises in prisms, containing 6·5 H_2O.

o-Diphenol is obtained on fusing diphenyl-*o*-disulphonic acid with a mixture of potash and soda, and extracting with ether the acidified solution of the fused mass. It was purified by treating its solution in benzene with light petroleum, which precipitates resinous matters. After removal of these solvents by distillation and allowing the residue to stand over sulphuric acid, it was obtained in large, colourless prisms, melting at 99°, and possessing a faint, phenol-like smell. This compound is identical with that obtained by Hodgkinson and Matthews (Ber. **16**, 1103) by fusing fluorene with potassium hydrate.

Tetranitrodiphenyl-o-disulphonic Acid—

$$\left\{(OH)(SO_3H)(NO_2)_2C_6H\right\}_2 \quad [OH:SO_3H = 4:2]$$

is formed by the action of nitric acid on dihydroxydiphenyl-*o* disulphonic acid; its potassium salt forms pale-yellow crystals. The author did not succeed in preparing the acid potassium salt of this compound.—E. B.

Chloranil. C. Graebe. Annalen, **263**, 16—31.

Hitherto chloranil has almost invariably been prepared from phenol, both in the laboratory and on the large scale. In place of phenol the author recommends the use of *p*-phenylenediamine or its hydrochloride, both of which are now commercial products. Chloranil has already been obtained from this compound by Krause (Ber. **12**, 52) by passing chlorine into its acetic acid solution, but the following method is recommended by the author for preparing it either on the large or small scale: 100 grms. of *p*-phenylenediamine hydrochloride are mixed with 250 cc. of water and 800 cc. of crude hydrochloric acid in a cooled vessel of such size that it is only filled to one-third of its capacity, and 250 grms. of potassium chlorate crystals gradually added in such a manner that the temperature is at the beginning not higher than 35°—40°, and later not higher than 20°—30°, which requires about a day.

After standing over night the whole is gradually warmed to 100° in a water-bath, heated till all the chlorate is decomposed, filtered, and well washed with hot water. 115 grms. of crude chloranil are thus obtained, and are purified by warming the substance, which need not be quite dry, with 350—400 cc. of crude hydrochloric acid for two hours on the water-bath; the trichloroquinone is thus converted into chloranil, trichloroquinol, and tetrachloroquinol, whilst the chloranil is scarcely affected. The trichloroquinol may be first extracted with water, which also takes up a little tetrachloroquinol, or the whole may be directly oxidised preferably with a little potassium bichromate. If recrystallised chloranil is required, the best solvent is toluene purified with sulphuric acid, or for small quantities acetic acid.

Chloranil after repeated crystallisation from toluene melts, if heated in a sealed tube at 290°, but varieties melting at 280° give good numbers on analysis and may be regarded as pure.

The crude chloranil may also be purified by means of nitric acid, which removes the trichloroquinone, but simultaneously acts to some extent on the chloranil, and is therefore not so suitable as hydrochloric acid. If it be required also to isolate the trichloroquinone, the mixed compounds may be moistened with alcohol, mixed with 10 times the quantity of water and a strong current of sulphurous anhydride passed through the liquid for 10 to 15 minutes at the ordinary temperature. The residue is extracted with alcohol, which removes the remaining trichloroquinol and the small quantity of hydrochloranil formed. To convert either chloranil or trichloroquinone by themselves into the corresponding quinols, it is best to employ amorphous phosphorus and hydriodic acid.

To convert chloranil into chloranilic acid, 10 grms. of the former, which may be taken in the crude or pure condition, are well moistened with alcohol, added to a solution of 9 grms. of caustic soda in 220 cc. of water warmed to 80°, allowed to remain for two hours, and 20 grms. of common salt then added. The crystals which have separated after some hours are washed with a 10 per cent. salt solution till almost colourless. The residual sodium salt is washed pure with a small quantity of water to remove sodium chloride, and then recrystallised from a large quantity of the hot liquid. The chloranilic acid obtained thus should be washed first with dilute hydrochloric acid and then with water. If crude chloranil be used 42—44 grms. of chloranilic acid will be obtained for every 100 grms. of *p*-phenylenediamine hydrochloride employed, whilst if the chloranil be purified with hydrochloric acid, 46—50 grms. are obtained.

Chloranilic acid crystallises with 2 mols. H_2O, which it loses slowly over sulphuric acid in a vacuum, and quickly at 115°. Water dissolves 0·19 parts of the anhydrous substance at 13·5° and 1·41 parts at 99°. The solubility of the potassium and sodium salts has also been determined; 100 parts of water dissolve 1·77 parts of the former at 20°, and 9·25 parts at 98·6°, and 1·06 parts of the latter at 21°, and 6·19 parts at 99°.

To prepare hexachlorobenzene from chloranil it is best to employ a mixture of phosphorus trichloride and pentachloride in equal molecular proportions, and heat them with chloranil at 190°—200°. The yield is almost quantitative.

With regard to the constitution of quinone, the author whilst regarding the diketone formula as, on the whole, the more probable, does not believe that our knowledge is yet sufficient to decide definitely between this and the peroxide formula.—H. G. C.

Bromanil. C. Graebe and L. Weltner. Annalen, **263**, 31—38.

Bromanil, like chloranil (see preceding abstract), may be readily obtained from *p*-phenylene diamine; 10 grms. of the latter are dissolved in 40 cc. of acetic acid, gradually poured into 40 cc. of bromine in a beaker cooled by water. After remaining over night, the mixture is warmed in a hot water bath, mixed with water, the dried precipitate purified by excessive warming with 40 cc. of ordinary and of fuming nitric acid. The bromanil thus obtained is almost pure and may be converted into bromanilic acid and *p*-hexabromobenzene by the methods used for the corresponding chlorine compounds.—H. G. C.

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m-Nitro-p-amidophenol and its Derivatives. H. Hähle. J. prakt. Chem. **43**, 62—75.

Diacetyl-*p*-amidophenol is conveniently prepared by treating *p*-amidophenol, rapidly dried in a current of hydrogen at 130°—140°, with twice its weight of acetic anhydride. A lively reaction takes place on the application of heat and the reaction is completed by heating half an hour in a reflux apparatus. After removal of the greater part of the solution by distillation, the residue is crystallised from water. The compound crystallises in large plates melting at 150°. By the action in the cold of fuming nitric acid (1½ parts) on this compound (1 part), *m-nitrodiacetyl-p-amidophenol* is obtained. The latter crystallises from dilute alcohol in splendid, pale-yellow prisms, melts at

146°—147°, and boils, with considerable decomposition, at 260°; it is sparingly soluble in water, moderately soluble in acetic acid, alcohol, and ether.

m-Nitro-p-amidophenol is produced by the action of alkalis, avoiding excess, or acids, on *m* nitro-acetyl-*p*-amidophenol. Crystallised from alcohol and finally from ether, it appears as dark-red prisms with a green reflex, melting at 148°, and decomposing at a higher temperature; crystallised from water, it contains 1 mol. of water of crystallisation: its aqueous solution has an orange-red colour, which is changed to pale yellow by acids, and to deep-purple by alkalis; its hydrochloride and sulphate are decomposed by water; its tetramethylammonium compound, prepared by the action of tetramethylammonium hydroxide in aqueous solution, yields, on heating, a small quantity of *nitro-p-anisidine*. This crystallises in dark-red prisms or plates melting at 125°, is soluble in water, alcohol, and ether, less so in benzene, and volatilises with steam; its acetyl compound melts at 145°.

m-Nitro-p-diazophenol Chloride is prepared by suspending nitro-*p*-amidophenol hydrochloride in alcohol, to which a little hydrochloric acid has been added, and treating it, whilst well cooled, with a current of nitrogen trioxide. The greater part of the diazo-compound separates out; the remainder may be precipitated by the addition of ether. It is thus obtained in the form of pale-yellow, microscopic prisms, which exhibit the characteristic properties of diazo-compounds, decomposing violently at 126°—129°. Azo-derivatives are readily obtainable from it by interaction with dimethylaniline and resorcinol, an alcoholic solution of the former giving a chocolate-coloured compound, which dissolves in hydrochloric acid with a rich, red colour, and an alkaline solution of the latter yielding a red-brown solution which gives a precipitate of the same colour on the addition of acid. On heating a solution of *m*-nitro-*p*-diazophenol chloride in absolute alcohol under a pressure of 790—800 mm., *m* nitrophenol is obtained; the production of this compound determines the constitution of the above-described nitro-*p*-amidophenol. Unsuccessful attempts were made to prepare nitro-quinol by heating *m*-nitro-*p*-diazophenol with acids and by heating the perbromide of the same compound with alcohol, *m*-nitrophenol being in each case obtained. It was also found impossible to prepare a nitro-quinone-chlorimide by the action of calcium hypochlorite on nitro-amidophenol, such a compound being probably highly unstable owing to the presence of the nitro-group in its molecule.

m-p-Diamidophenol is obtained by reducing *m*-nitro-*p*-amidophenol. It melts with decomposition at 167°—168°; its aqueous solution it becomes oxidised, on exposure to air or by treatment with ferric chloride, with formation of a brown dyestuff, probably a substituted phenazine, which dissolves in hydrochloric acid with a crimson colour; the triacetyl derivative of *m-p*-diamidophenol melts at 135°—136°.

m-p-Diamido-anisol Hydrochloride, obtained by reducing *m*-nitro-*p*-anisidine with tin and hydrochloric acid, is very prone to oxidise, yielding a red colouring matter; it crystallises in colourless lustrous leaflets, and dissolves in water with a brown colour.

m-Nitro-p-iodophenol, prepared by the action of hydriodic acid in the cold on *m*-nitro-*p*-diazophenol, crystallises in yellow needles, melting at 146°, it is feebly soluble in cold water, more easily so in hot, and does not volatilise with steam; on fusion with potash it yields hydroxyquinol; on boiling with alcoholic potash *m*-nitrophenol was obtained instead of the expected nitroquinol.

m-Nitro-p-iodophenetol is produced by the action of ethyl iodide on the silver compound of *m*-nitro-*p*-iodophenol. The reaction is so violent that it is necessary to moderate it by the addition of alcohol or ether to the mixture. The compound obtained crystallises in pale yellow, microscopic needles, melting at 63·5°, and boiling, with slight decomposition, at 320°; it is insoluble in cold, and very sparingly soluble in hot water, but easily soluble in alcohol and ether, and is volatile with steam.—E. B.

Nitro-Derivatives of Dimethylortho-anisidine. E. Grimaux and L. Lefèvre. Compt. Rend. **112**, 727—730.

In a previous communication one of the authors has drawn attention to the difference in behaviour between ortho- and meta-dimethylanisidine as regards the formation of colouring matters; they have now studied some of the nitro-derivatives of the ortho-compound.

The *mononitro*-derivative $N(CH_3)_2.C_6H_3(NO_2).OCH_3$ [$N(CH_3)_2 : NO_2 : OCH_3 = 1 : 4 : 6$] is obtained, together with a compound melting at 170°, which seems to be a dinitro-derivative, when dimethylortho-anisidine is gradually added to ice-cold, fuming nitric acid; it is, however, most easily prepared by dissolving the base (1 part) in dilute (1 : 10) sulphuric acid (2 parts), and gradually adding a solution of sodium nitrite (3·2 parts) in water (60 parts); it is purified by recrystallisation from alcohol, from which it separates in slender yellow needles, melting at 99°. On reduction with zinc and hydrochloric acid it gives a colourless crystalline base, which melts at 83°, and turns reddish on exposure to the air.

The *trinitro*-derivative—

$$NO_2.CH_2.N(CH_3).C_6H_2(NO_2)_2.OCH_3$$

is formed when dimethylortho-anisidine is warmed with concentrated nitric acid until oxides of nitrogen begin to be evolved. It crystallises from boiling alcohol in colourless prisms, melting at 135°, and when boiled with 10 per cent. potash it is converted into dinitroguaiacol (melting point 121°—122°); this behaviour shows that the trinitro-compound has the constitution—

$$[OCH_3 : (NO_2)_2 : NO_2.CH_2.NCH_3 = 1 : 3 : 5 : 2].$$

Trinitromethylortho-anisidine—

$$NO_2.N(CH_3).C_6H_2(NO_2)_2.OCH_3$$

is obtained when dimethylortho anisidine, or either of the nitro-compounds described above, is boiled with concentrated nitric acid (15—20 parts) until the evolution of oxides of nitrogen is at an end. It crystallises from alcohol in almost colourless plates, melts at 118°—119°, and is decomposed by boiling 10 per cent. potash, yielding dinitroguaiacol (melting point 121°—122°).—F. S. K.

Some New Compounds of Aniline with certain Metallic Sulphites. G. Denigès. Compt. Rend. **112**, 802—805.

The author has discovered a whole series of new bodies formed by the union of aniline and its homologues with various metallic sulphites, and also with the salts of other polybasic acids. In the present paper only the compounds of aniline with certain metallic sulphites are considered. They may be represented by the general formula—

$$(SO_3)_2M''H_2.2(NH_2.C_6H_5),$$

and are readily obtained by mixing an aqueous solution of aniline with solutions of the respective metallic bisulphites. Or aniline dissolved in water may be added to a solution containing sodium bisulphite and a soluble salt of the metal whose aniline compound is required. Another way is to saturate a solution of the metal with sulphurous acid and then add aniline. The bodies thus obtained all form clear, lamellated, hexagonal crystals, almost insoluble in water and other neutral solvents. Aldehyde and acetone appear to dissolve certain of them with decomposition.

Cuprous Aniline Bisulphite, $(SO_3)_2Cu_2H_2.(NH_2C_6H_5)_2$, forms silky, yellowish white, hexagonal crystals, which are not affected by air or light when quite dry. The salt is soluble in ammonia and by hydrochloric acid.

Cadmium Aniline Bisulphite, $(SO_3)_2Cd.H_2(NH_2C_6H_5)_2$, and *zinc aniline bisulphite*, $(SO_3)_2ZnH_2(NH_2C_6H_5)_2$ resemble each other closely. Both form white hexagonal plates.

Manganese Aniline Bisulphite, $(SO_3)_2MnH_2(NH_2C_6H_5)_2$, crystallises in hexagonal plates of a very faint pinkish colour.

Cobalt aniline bisulphite, $(SO_3)_2CoH_2(NH_2C_6H_5)_2$, is of a beautiful rose colour.

Ferrous Aniline Bisulphite, $(SO_3)_2FeH_2(NH_2C_6H_5)_2$, resembles ferrous oxalate in appearance.

Nickel Aniline Bisulphite, $(SO_3)_2NiH_2(NH_2C_6H_5)_2$, separates in greenish-yellow crystalline crusts.

Mercuric Aniline Bisulphite—

$$(SO_4)_2HgH_2.NH_2.C_6H_5 + H_2O$$

differs from the preceding salts in containing only one molecule of aniline. It forms white crystalline plates.—H. T. P.

The Simultaneous Action of Air and Light on a Number of Organic Compounds. A. Bidet. Bull. Soc. Chim. 1891, **5**, 13—20.

Details of a number of experiments are given, which go to show that many aromatic compounds which become coloured, or which darken in colour when exposed to the light, remain unalterable when prepared in a state of special purity. Amongst the bodies examined are:—Nitrobenzene, nitrotoluene, phenol, aniline and its salts, resorcinol, benzyl chloride, benzaldehyde, cinnamic acid, nitro-cinnamic acid, naphthol, naphthylamine and its salts and quinoline and its salts. The author found that when benzene or toluene, carefully freed from thiophene and its homologues by treatment with sulphuric acid, was used in the preparation of any of the above bodies, these latter could be exposed to light for a long period without undergoing any change at all, whereas the ordinary commercial products not treated thus darkened rapidly. Another method of purification adopted with phenol, resorcinol, and naphthylamine was to sublime the product very carefully when the substance or substances giving rise to the colouration are left behind These specially purified bodies were characterised by a more agreeable and less marked smell than is usually associated with them. The addition of nitrothiophen to the purified nitrobenzene caused the latter to darken as usual on exposure. Nitrothiophen itself does not darken in sunlight, in absence of air, but very readily in its presence. By very careful and repeated sublimation of nitrothiophen, the author was able to separate it into a crystalline sublimate, which was not affected at all by exposure to air and light, and a liquid residue which is darkened at once when exposed. No details concerning this latter body are given.—C. A. K.

Alkyl-Hydroxy-derivatives of Dimethylaniline. E. Grimaux. Bull. Soc. Chim. 1891, **5**, 646—649.

Already abstracted from Compt. Rend. **112**, 290—292; this Journal, 1891, 459.

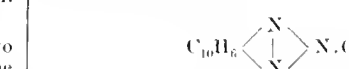
Notes on the Azo-derivatives of β-Naphthylamine. R. Meldola and F. Hughes. J. Chem. Soc. (Trans.) 1891, 372—383.

This is an extension of the work published by Meldola in conjunction with East (this Journal, 1888, 617) and Morgan (J. Chem. Soc. Trans. 1889, 114 and 603).

Orthonitrobenzene-azo-β-Naphthylamine has been prepared by diazotising orthonitroaniline and adding the product to a cold dilute solution of β-naphthylamine hydrochloride. It forms lustrous bronzy scales, melting at 198°, is soluble in alcohol and benzene, more readily in boiling glacial acetic acid, forming orange-red solutions. In its general appearance it bears a striking resemblance to the isomeride from paranitraniline (J. Chem. Soc. Trans. 1883, 430), whilst the colour of the meta-isomeride (J. Chem. Soc. Trans. 1884, 116) forms a marked contrast to the ortho- and para-compounds. When sodium nitrite is added to a solution of orthonitrobenzene-azo-β-naphthylamine in glacial acetic acid at 70°, the solution left to cool, and then precipitated with water orthonitrobenzene-azo-β-naphthol is obtained, crystallising in orange needles, whilst the meta- and para-nitro-compounds under the same conditions have been shown to yield azonaphthyl-acetates (this Journal, 1888, 617). Orthonitrobenzene-azo-β-naphthol crystallises in orange-red needles, melting at 209°—210°, and like other azo-derivatives of β-naphthol is devoid of phenolic character. Orthonitrobenzene-azo-β-naphthyl acetate is, however, formed when sodium nitrite is added to a cold saturated solution of the β-naphthylamine azo-compound in glacial acetic acid.

Acetyl-derivatives of the three isomeric nitrobenzene-azo β-naphthylamines have been prepared; that from the para-compound crystallises in brick-red needles, melting at 227°—228°; the acetyl-derivative of the meta-compound forms bright orange needles, melting at 192°, and the corresponding ortho-derivative crystallises in orange-brown needles, melting at 154°.

The *Pseudazimides*—



are prepared from the nitrobenzene-azo-β-naphthylamines by oxidation with chromic acid in a glacial acetic acid solution. The para compound forms flat, transparent, whitish needles melting at 236°, and the meta-derivative opaque, whitish needles, melting at 223°—224°; the ortho-derivative has not been obtained pure.

Action of Nitric Acid on Azo-β-Naphthylamine Derivatives.—Substances are obtained which are more or less explosive and apparently uncrystallisable; their nature is being further investigated.

Action of Aldehydes on the Azo-Derivatives of β-Naphthylamine.—This reaction gives rise to the formation of triazines (see also Goldschmidt and Rosell, this Journal, 1890, 494).

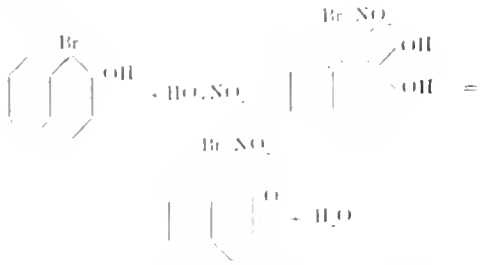
The action of halogens on the azo-derivatives of β-naphthylamine is also being investigated.—A. K. M.

The Action of Nitric Acid on Naphthol Derivatives as Indicative of the manner in which Nitration is effected in the case of Benzenoid Compounds generally. The formation of Nitro-keto-compounds. H. E. Armstrong and E. C. Rossiter. Proc. Chem. Soc. 1891 [98], 89—91.

When warmed with nitric acid, the chloro- and bromo-derivatives of β-naphthol are converted into derivatives of β-naphthaquinone, but, as the authors have pointed out in their previous notice, the formation of these products is preceded by that of an unstable intermediate compound. When these intermediate compounds are carefully heated, they are converted into bromo-derivatives of β-naphthaquinone, and in preparing these latter it is desirable to separate the intermediate compound from the excess of nitric acid, and to decompose it by carefully heating it with acetic acid, except in the case of tetrabromo-β-naphthol; tribromo-β-naphthaquinone is so readily formed from this compound, and is so difficultly soluble and well characterised, that small quantities of tetrabromo-β-naphthol may be detected in presence of the di- and tri-bromo-derivatives by simply heating the mixture with acetic acid and nitric acid. Thus, if nitric acid be added to dibromo-β-naphthol, suspended in acetic acid, a clear solution is obtained which, after a short time, deposits a crystalline substance; if quickly separated by filtration, this product is almost colourless, but it decomposes when kept, becoming yellow. It was conceivable, judging from the manner in which it was produced, that the compound was a nitrate, formed by the simple displacement of the hydroxylic hydrogen by NO_2, and the results of analysis were in accord with this view; but such a nitrate should be reconvertible into the parent substance by treatment with alkali, whereas actually it affords, as chief product, *bromonitronaphthol*. Bromo-β-naphthol, in like manner, eventually yields α_1-nitro-β-naphthol, and the tri- and tetra-bromo-derivatives afford di- and tri-bromonitro-β-naphthol; the bromine atom displaced by NO_2 by this method of treatment, there can be little doubt, is invariably that in the α_1-position.

The authors are of opinion that the intermediate compounds in question are nitro bromo-keto-derivatives corresponding to the di-chloro-keto-compounds of Zincke, and that their formation affords evidence that the elements

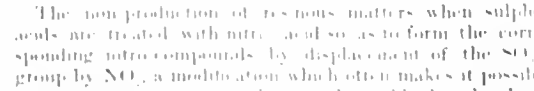
of nitro acid first become added to the bromonaphthol, thus :—



The theory that the formation of such addition compounds precedes that of nitro-compounds generally appears to afford a satisfactory explanation of a large number of well-known facts which hitherto have remained unexplained. The non production of nitro-compounds from paraffins and their derivatives, except in a certain very limited number of special cases, appears as the natural consequence of the inability of paraffins to form addition compounds. The theory affords a simple explanation of the formation of nitro-derivatives of *phenols* on nitrating hydrocarbons, to which Nolting has drawn special attention in the case of toluene and orthoxylene (Ber. 1885, 2670; 1888, 3158), for if the addition compound lose HNO_2 instead of H_2O a phenol would result; thus—

An agent that would favour the separation of the elements of water from the addition compound would increase the production of the nitro-compound and diminish that of the phenol; and, as a matter of fact, it is known that when a mixture of nitric and sulphuric acids is used there is less of the phenol derivative produced than when nitric acid alone is employed. A compound such as the addition compound of benzene with nitric acid above represented would obviously be unstable and prone to undergo oxidation; hence it is not difficult to understand that so large an amount of nitrous fume should be produced even on nitrating benzene. The reduction in the amount of such fume, and the improvement of the yield of nitro-derivative effected by adding sulphuric acid, is doubtless attributable to the action already referred to of the acid in promoting the separation of the elements of water; sulphuric acid must be supposed, in fact, in such cases to act not merely as a dehydrating agent in maintaining the nitric acid concentrated, but to exert a specific influence on the course of change. Lastly, the resinous matters often formed in large amount on nitrating many phenols are, doubtless, products of the interaction of several molecules of the addition compounds, or of the keto-compounds formed from them in the first instance.

The non production of resinous matters when sulpho-acids are treated with nitric acid so as to form the corresponding nitro-compounds by displacement of the SO$_3$H group by NO_2, a modification which often makes it possible to prepare nitro-compounds not obtainable by the direct action of nitric acid, is also elucidated by the authors' theory; the addition compound formed in such a case would very readily break up into sulphuric acid and the nitro-derivative, thus



A New Method of Preparing Nitro-Derivatives and the Use of Nitrogen Dioxide as a Nitrating Agent. H. E. Armstrong and E. C. Rossiter. Proc. Chem. Soc. 1891 [98], 91—92.

Reference has been made in the foregoing note to the production from the compounds formed by the addition of the elements of nitric acid to the bromo-derivative of beta-naphthol of nitro-derivatives of the naphthol *on treatment with alkali*, a bromine atom becoming displaced by NO_2. As in this interaction a bromine atom is removed and an atom of hydrogen is added to the CO group, such a method of treatment obviously is scarcely that best calculated to effect the formation of the nitro-derivative, and, as a matter of fact, the nitro-derivative is not the only product. On treating the addition compound, however, with sulphurous acid, a practically theoretical yield of the nitro-naphthol is obtained; this method appears to be of general application.

The authors have been naturally led to study the action of nitrogen dioxide, NO_2, on unsaturated compounds of various kinds, in the expectation of obtaining addition compounds which by loss of HNO_2 would pass over into nitro-derivatives of the substances treated. They find that such addition compounds are actually obtainable, and that on treatment with alkali and reducing agents they yield nitro-derivatives. Thus beta-naphthol affords as much as 75 per cent. of its weight of nitro-beta-naphthol; alpha-naphthol behaves similarly. In some cases the addition compound is so unstable that it spontaneously decomposes: thus phenol at once yields a mixture of ortho- and para-nitrophenol. The authors propose to study the behaviour of unsaturated compounds generally towards nitric acid and nitrogen dioxide from the point of view indicated in this and the previous note.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

The Theory of Dyeing: Action of Ammonia on Cotton. L. Vignon. C'ompt. Rend. **112**, 487—489.

The author has shown that, compared with animal fibres, cotton exerts very little chemical action, as measured by the heat evolved when it is brought into solutions of acids, alkalis, &c. (this Journal, 1890, 771 and 855). The behaviour of cotton towards colouring-matters is consistent with its general chemical inertness. To show that such is the case, the cellulose molecule was modified by treatment in a determinate manner, and the dyeing properties of the resultant compound investigated. This change was effected by heating cotton (1 part) in sealed tubes with ammoniacal calcium chloride (4 parts) or aqueous ammonia (4 parts at 22°) to temperatures between 100° and 200°, for periods varying from a few hours to several days. The chemical properties of the cotton were considerably altered by this treatment, without its physical properties being affected. Samples submitted to analysis, after washing successively with water, dilute acid, and again with water, and then drying at 110°, were found to contain from 1·05 to 2·86 per cent of nitrogen, the amount varying according to the conditions of treatment with ammonia. When brought into normal sulphuric acid solution, contained in a calorimeter, 0·90 calories were disengaged per 100 grms. of this modified cotton, as against 0·38 calories in the case of bleached, and 0·36 calories in that of unbleached cotton. This increased chemical activity of the "ammoniated" cotton coincides with its behaviour in dyeing: samples of it and of ordinary cotton were immersed together in acidulated solutions of various acid dyes, and, on comparing the results, it was found that the "ammoniated" cotton dyed considerably the better, the ordinary cotton being only faintly stained.—E. R.

Mordants and the Periodic System. Prud'homme. Bull. Soc. Ind. Mulhouse, 1891, 217—219.

The author gives some further details regarding the methods of experiment employed by him in studying the relations of the metallic oxide mordants to the periodic system (this Journal, 1891, 362). In ascertaining by means of dye-tests the colouring-effects of the various elements, in addition to the usual methods of fixation by ageing and steaming, use was made of a solution of caustic soda for fixing the mordanting oxides on cotton. For such double mordants as aluminates, silicates, phosphates, arsenates, and antimonates, double decomposition was found to be the most suitable method of deposition on the fibre. Advantage was also taken of the property possessed by a considerable number of metals of forming insoluble tannates, the cotton tissue being first prepared with tannic acid.

Steaming cloth impregnated with dissociable salts of volatile acids gives excellent results; the mordanting salts must, obviously, contain the same acid, for example, acetic acid. The presence of ammonium and sodium acetates, necessary with certain salts, may modify the results obtained. Oleïne, also, sometimes considerably affects the shades; redder shades are obtained, for instance, with Alizarin-blue and Mg, Zn, Cd, Ca, Sr, and Ba, on cloth prepared with oleïne than on unprepared cloth. In this connexion, the author some time ago (Bull. Soc. Ind. Mulhouse, 1879, 393) drew attention to a remarkable change of shade caused by the presence of oleïne on the cloth, in the case of a colour obtained from a mixture of Galleïn, acetate of chrome, and calcium chloride, the shade produced being blue, instead of violet as on unprepared cloth.

In the preparation of lakes, the colour-effects were observed by adding solutions ($\frac{1}{2}$ to $\frac{1}{20}$ normal) of the salts of the metals of a given group to separate portions of a solution of a salt of the metal under investigation, and then adding the calculated amount of an alkaline solution of Alizarin or other phenolic colouring matter. In certain cases the shade of an alkaline solution of a colouring matter is affected by the alkali or alkaline salt employed for solution; thus, a sodium carbonate solution of Alizarin is more purple than a potassium carbonate solution of the same; at the moment of mixing, Alizarin-blue S gives a purple-blue solution with sodium carbonate, and a yellow-green one with potassium carbonate. An ammoniacal solution of Alizarin yields with the sulphates of Li, Na, and K, solutions varying in colour from violet to red; other salts of these metals produce the same gradation of colour. The reaction is characteristic of the bases, though slightly different shades are produced by the various salts of a particular base; the chloride, bromide, and iodide of potassium, for example, yield somewhat different shades.

The author finds, on continuing his experiments, that some of the statements made in his previous note are incorrect; thus, in the second and fifth groups of elements the shades yielded respectively by Mg, Zn, and Cd, and by P, As, Sb, and Bi, progress regularly and not irregularly as stated; Zn has a yellowing influence; the members of the fourth group do not, strictly speaking, represent the maximum colouring-effect, but a transition state between sub-groups of three elements which resemble one another in general properties; the members of this group give with Alizarin in general orange shades, Pb yielding the reddest shade of that colour.

In the fourth period V appears to be the central element as regards its colour-effects; it gives with Alizarin an orange, which contrasts well with the dull red yielded by Cr.

Fe, Co, and Ni give with Alizarin a series of purples, of which that from Fe is the bluest, and that from Ni the reddest; this trio of elements may be considered as a link between the fourth and fifth periods.—E. B.

The Formation of Insoluble Azo-Colours on the Fibre by Printing. Sealed note deposited March 9, 1889. A. Feer. Bull. Soc. Ind. Mulhouse, 1891, 220—221.

The cloth is padded with a solution of 30 grms. of β-naphthol and 30 grms. of caustic soda at 38° B. per litre, with the optional further addition of sodium carbonate, hydrate, phosphate, acetate, &c., and is dried. It is then printed with a mixture containing per litre one-fifth of the molecular weight in grms. of a diazo-compound, in the form of the chloride, sulphate, or, preferably, thiocyanate of the same, the last-named compound being prepared by double decomposition between the diazo-chloride and potassium thiocyanate. The thiocyanates of the diazo-bases are sparingly soluble and fairly stable. The stannic chloride and zinc chloride double salts with the diazo-chlorides are also more stable than the simple diazo-chlorides.

The colours obtained from α-naphthol, resorcinol, and phenol are not fast to soap. These compounds, however, may with advantage be mixed in small quantity with β-naphthol for the purpose of modifying the shades produced, such modified shades being fast to soap.—E. B.

The Formation of Insoluble Azo Colours on the Fibre by Printing. (Note on the preceding article.) A. Feer. Bull. Soc. Ind. Mulhouse, 1891, 222—228.

The hydroxyazo-colours, obtained by the combination of diazo-salts with phenol, resorcinol, and α-naphthol, are soluble in caustic alkalis, and are, consequently, removed by soaping from fibres, such as cotton, which have no affinity for them, but are faster when produced on wool or silk. The compounds of diazo-salts with β-naphthol no longer contain hydroxyl-groups, but belong to the class of hydrazone-compounds; they are distinguished by their indifferent behaviour towards reagents, insolubility, and fine shades of colour; moreover, they are well suited for application on the various textile fibres, and especially so on cotton.

There are three methods available for the production by printing of the azo-colours on cotton, namely:—

1. Printing a mixture of a phenol and an amido-salt, on cloth prepared with sodium nitrite.
2. Printing a mixture of amido-salt, phenol, and nitrite, on cloth prepared with tartaric acid.
3. Printing a diazo-salt on cloth which has been prepared with an alkaline solution of a phenol.

The last of these methods alone gives satisfactory results. The first and second methods would be advantageous in the production of resorcinol azo-colours on silk, if the colours obtained from that phenol were faster.

The slight excess of acid over that theoretically required, which has to be used in diazotising the amido-compound must be neutralised by the addition of sodium acetate to the mixture before printing on calico, as otherwise the naphthol on the cloth is partly liberated, and very unsatisfactory results obtained. There is no advantage, however, in adding so much sodium acetate as will entirely convert the diazo-salt into acetate, as has been recently recommended.

In thickening the diazo-solution, starch and natural gums must be used; artificial gums reduce the diazo-compound. The temperature of the colour-mixture must not be allowed to exceed 5°.

The cloth, after being prepared, is dried by hot air, and preserved from the direct rays of the sun; it should be printed the same day as it is prepared. All kinds of patterns should be printed with considerable pressure. The colour is instantly produced on the diazo-mixture coming into contact with the naphthol, and remains unaltered throughout the subsequent operations. The printed pieces are passed into dilute sulphuric acid (5 per cent.), washed, dried, and cleared. The colours produced are very full and bright; they are almost as fast to light as a medium shade of indigo, are unaffected by acids, and withstand soaping at 75°.

Different diazo-mixtures may be printed to produce patterns in several colours, or alizarin colours, which develop well on cloth prepared with β-naphthol, may be associated with the diazo-colours for the same purpose.

Sodium β-naphtholate acts as a resist for aniline black.

Reserve patterns under the diazo-colours may be produced in several ways; the prepared calico may, for example, be printed with a thickened solution of an acid to liberate the naphthol; or the naphthol may be converted into a body incapable of combining with a diazo-salt, by

printing on it thickened solutions of nitrous acids, sulphites, or stannous chloride. The last compound is preferred in practice: a mixture containing up to 1,200 grms. of stannous chloride per litre is printed, the cloth dried, padded with the diazo-salt, and then passed through dilute acid, rinsed, soaped, dried, and cleared.

With *wool* the best results are obtained when the cloth is chlored and prepared with free β-naphthol. The latter is effected by padding it with a solution of β naphthol (35 grms.) in dilute caustic soda (35 grms. at 38° B. per litre) and, without drying, passing through a bath of ammonium chloride (50 grms. per litre), then rinsing and drying in a stentering machine. The printing is the same as for cotton.

Silk in its behaviour is intermediate between wool and cotton. Good colours are obtained on it both when prepared with free β-naphthol and with sodium β-naphtholate, provided that the diazo-mixture contains little or no excess of acid. (See also this Journal, 1890, 1125 and 1126; and preceding abstract.)—E. B.

Method of Determining Indigotine for Commercial Purposes. F. A. Owen. J. Amer. Chem. Soc. 1891, **13**, 32—33.

See under XXIII., *page* 729.

PATENTS.

An Improved Process for Dyeing Wool, and Apparatus for Use in the same. P. Cavaillès, Paris, France. Eng. Pat. 7202, May 8, 1890. 8*d*.

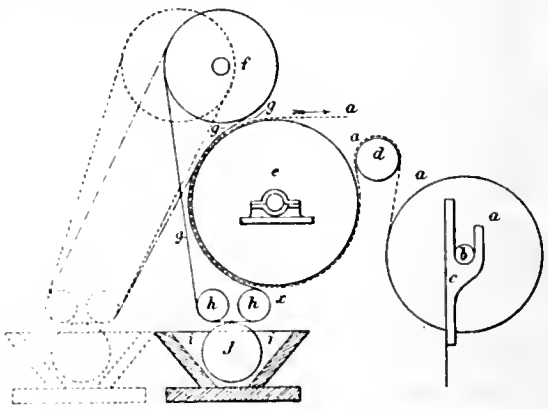
The inventor makes four claims: first, for a concentrated indigo vat, which is prepared by adding milk of lime (20 litres) to indigo (10 kilos.) previously moistened with hot water (10 litres at 60°), and then treating the mixture with the sodium "hydrosulphite" obtained from the interaction of sodium bisulphite (25 kilos. at 30° B.) and zinc powder (2 to 3 kilos.); sufficient of this concentrated vat to be added to the dye-vat to obtain the desired shade of blue in one "dip." The second claim is for the "optional adjunction to the dye-vats of a squeezing apparatus," of which a drawing is given with the original specification. The third claim relates to the "employment of this vat for dyeing wool, cotton, and other vegetable fibres, either hot or cold," and the fourth deals with methods of "brightening" the colour on the dyed fibre by the use of "acids or acid salts which do not attack either the wool or the colour," "of sulphides or chlorides, oxygenated water, barium dioxide, and in general of any oxidising agents in suitable proportions."—E. B.

Improvements in Machinery for Dyeing, Scouring, and Drying Hanks. E. and D. Sykes, Huddersfield. Eng. Pat. 8131, May 24, 1890. 8*d*.

Two discs are fixed parallel to each other on a horizontal shaft, and mounted to rotate in a dye-vessel. The discs carry inner and outer horizontal cross-bars, arranged in pairs. A slow revolving motion is imparted to either the outer or inner sets of cross-bars by suitable gearing attached to the same and to the shaft which carries the discs. The hanks to be dyed, &c., are placed on the cross-bars and in this way caused to continuously move their position on the bars whilst being carried round by the discs. Arrangements are made for the slackening of the hanks whilst in the dye, or other liquor, as it is found that the yarn receives the solutions better when not in a state of tension. Further, to obviate the laying of the loose fibres in one direction by the passage of the yarn through the liquors, the motion of the revolving discs is, at intervals, reversed by self-acting mechanism. The mechanical details are fully explained in the original specification by the aid of two sheets of drawings.—E. B.

Improvements in Colouring, Sizing, and otherwise Treating Paper, and in Apparatus therefor; also applicable for Filling and Treating Woven Fabrics. J. M. Campbell, Disley. Eng. Pat. 8183, May 27, 1890. 8*d*.

The paper *a* (see Fig.) to be coloured, &c., is wound upon a roller *b*, supported in bearings on standards *c*, from which it passes over a guide roller *d* to the main drum or roller *e*. The roller *e* is driven positively and itself drives, preferably by means of expanding pulleys or change wheels, the axle of the upper sieve roller *f*. The sieve cloth *g* passes from the upper roller *f*, which may be fixed, but is preferably adjustable, to two rollers *h*, supported by the colour-box *i*, which also carries the colour-furnishing roller *j* and is adjustable to the main drum *e*. The sieve cloth and the drum *e* are driven preferably in the same direction.



By moving the colour-box and the lower sieve rollers nearer to, or further from, the drum *e*, a greater or smaller surface of contact between the paper to be coloured, &c., and the sieve cloth is produced. The colour, &c., is fed on to the sieve cloth in the usual manner, and the surplus colour, &c., preferably removed from the same by a "doctor" or brush applied at the point *x*.

In colouring hard or smooth paper, the frame with the colour-box, &c., or the upper sieve roller *f*, is brought nearer to the drum *e*, in order to give a large surface of contact, and increase the friction between the sieve cloth and the paper: for soft or rough paper, the colour-box, &c., is moved away from the drum, to reduce the surface of contact and increase the speed of the sieve cloth in order to diminish the friction on the paper.

The apparatus and method are also applicable for "backing," filling, and otherwise treating woven fabrics.

—E. B.

Improvements in Apparatus for Washing, Dyeing, and Treating Textile Materials and Goods. E. Sutcliffe and G. E. Sutcliffe, Halifax. Eng. Pat. 8270, May 28, 1890. 8*d*.

This invention is to some extent an improvement on Eng. Pats. 10,933 and 14,971 of 1886 and 4509 of 1887. According to the former inventions the materials (wool tops, raw cotton, &c.) to be dyed, &c. were coiled or massed around a hollow, perforated pipe, which could be revolved while the dye or other liquor was forced through it and the surrounding materials. The objects of the present invention, it is stated, are to increase the productive capacity of the apparatus and to bring its action more under the control of the operator, especially when the apparatus is used for dyeing. A number of perforated pipes or conduits are arranged to radiate from a central hollow shaft or barrel into which the liquor is forced or discharged under pressure. The hollow shaft is mounted so that it can be slowly revolved whilst the liquor is being discharged through the goods. A detailed description of the mechanism employed is given in the original specification with the aid of drawings.—E. B.

Improvements in the Production of Azo-Colours upon Fibres. B. Willcox, London. From the "Farbenfabriken vormals F. Bayer und Co.," Elberfeld, Germany. Eng. Pat. 8530, June 2, 1890. 6*d*.

Cotton is dyed shades ranging from blue or violet to black by first dyeing it with the colouring matter obtained by the combination of 1 mol. of the tetrazo derivative of benzidine, tolidine, dianisidine, or diamidostilbene with 2 mols. of amidonaphthol sulphonic acid G, or with 1 mol. of this compound and one of a phenol or aromatic amine, and then diazotising on the fibre this amido or diamido dyestuff, and combining the resultant body with 1 or 2 mols. of a phenol or amido compound; thus, cotton which has been dyed with the colouring matter produced by the combination of 2 mols. of amidonaphthol sulphonic acid G with 1 mol. of tetrazodiphenyl, after being treated in a cold dilute solution of nitrous acid, gives the following shades when worked in baths containing the substances mentioned:—

Developing Substance.	Shade Produced.
Phenol	Blue-black.
Resorcinol	Green-black.
Salicylic acid	Blue-black.
α-Naphthol	Violet-black.
β-Naphthol	Blue-black.
m-Phenylenediamine	Green-black
α-Naphthylamine	Black.
β-Naphthylamine	Reddish-black.

The various naphthol- and naphthylamine-sulphonic acids and the dihydroxynaphthalenes and their sulphonic acids yield black or very intense shades. The combination of the phenols and amido-phenols is effected in an alkaline solution, that of the amines in an acetic acid solution. Some of the colouring matters so produced on the fibre which contain amido groups, can be again diazotised and combined with phenols, amines, &c.—E. B.

Improvements in the Treatment of Fabrics Printed or Dyed with several Colours. W. L. Wise, London. From "Favre and Braun," Mulhouse, Germany. Eng. Pat. 8809, June 7, 1890. 6*d*.

Insoluble tannates, such as those of antimony, zinc, lead, and tin, are added to soap-baths in the treatment of printed calicoes for the purpose of precipitating from solution the basic dyes which become to some extent detached from the cloth in this operation. The brightness and purity of alizarin and similar colours, &c. are in this way preserved, and it is possible to work for a long time without renewing the bath; thus, a bath prepared with 5 kilos. of soap and 1 to 2½ kilos. of moist tannate of antimony, per cubic metre of water, can be used "for weeks." (See also this Journal, 1891, 361.)
—E. B.

Improvements in Machinery for Dyeing Hanks of Silk and other Yarn. A. H. Wardle, Leek. Eng. Pat. 11,100, July 16, 1890. 11*d*.

The object of this invention is to provide mechanism for simultaneously dyeing a number of small parcels of silk or other yarn as many different colours or shades of colour, so as to economise labour in the execution of small orders for dyeing.

Six or more small dye-baths are fitted up in a line alongside one another. The hanks to be dyed are suspended from reels, which are fixed above the surface of the dye-liquors, and caused to rotate on their axes, and, at the same time, around given points, the regular dyeing of every part of the yarn being thus ensured. No adequate description of the mechanical details of this invention can be given without reference to the drawings which accompany the original specification.—E. B.

Improvements in Machinery and Arrangements to be used in connexion with Apparatus for Bleaching, Dyeing, or Washing Textile Fabrics, Warps, and Yarns. J. T. Reid, C. Edmeston, and A. Edmeston, Salford. Eng. Pat. 11,306, July 19, 1890. 11*d*.

The object of this invention is to provide mechanism for rendering automatic the operation of "piling" textile piece-goods, warps, or yarns, which have been passed through bleaching and related apparatus, the invention being more especially applicable to bleaching keirs which operate simultaneously on two or more lengths of fabrics passed continuously through the same, such as the keir patented by Bentz, Edmeston, and Grether (this Journal, 1890, 388). Apart from the four sheets of drawings which accompany the original specification, no proper description of the mechanical arrangements by which this object is effected can be given.—E. B.

Improved Process of Dyeing or Printing in Aniline Black or Analogous Colours. H. Thies, Laaken, and F. Cleff, Ramenthal, Germany. Eng. Pat. 2533, February 12, 1891. 6*d*.

Use is claimed, in the production on the fibre of aniline black or analogous colours, of hydrofluoric acid along with, or instead of, the acids commonly employed in combination with aniline, &c., for this purpose. The advantages attending the use of hydrofluoric acid are: the "avidity" of this acid, which, compared with that of hydrochloric acid, is in the ratio of 100:5; its non-liability to decomposition; its property manifested on being liberated and volatilised in the course of the development of the black, of absorbing "much of the heat which interferes with the effect of the increasing energy of the heat of oxidation on the fibre;" the black produced is not affected by "sulphurous acid or by acids generally," and since "it has not the basic properties of ordinary aniline black," it "combines more easily with tar colours;" and, most important of all, the black is produced without diminishing the lustre of silk or the softness of wool, and vegetable fibres "scarcely suffer." As an example of the application of hydrofluoric acid in the black dyeing of mixed fabrics of cotton and silk, the following recipe is given: 55 grms. of hydrofluoric acid (60 per cent.) diluted with 200 cc. of water, are mixed with a solution of ammonium and copper chlorides, prepared by acting on 2 grms. of copper carbonate and 4 grms. of ammonium bicarbonate with 25 grms. of hydrochloric acid (30 per cent.), then 140 grms. of aniline are added, and, finally, 60 grms. of sodium chlorate dissolved in a little water, and the whole is diluted with water to 1 litre.—E. B.

VII.—ACIDS, ALKALIS, AND SALTS.

Sodium Manganates. G. Rousseau. Compt. Rend. **112**, 525—527.

A series of compounds of soda and manganese dioxide are obtained by heating sodium manganate to temperatures varying from 300°—1,300° C. When crystallised from water they have the following compositions. At 300° C. $8\,MnO_2.Na_2O.5H_2O$; at 800° C. $12\,MnO_2.Na_2O.4\,H_2O$; at 1,000° C. $16\,MnO_2.Na_2O.8\,H_2O$, and at 1,200°—1,300° the same as at 300° C., and then at a white heat the same as at 800°; the salt going through the same cycle of changes as at the lower temperatures.—A. L. S.

On some Ammonia Compounds of Mercuric Cyanide. R. Varet. Compt. Rend. **112**, 535—536.

If a saturated solution of cuprammonium bromide be added to a solution of mercuric cyanide in ammonia, on standing crystals are deposited, having the composition

$HgCy_2.CdBr_2.2\,NH_3$. If the salt $HgCy_2.CdBr_2.3\,H_2O$ be added to a warm solution of ammonia until the solution is saturated, crystals are deposited on standing, having the composition $HgCy_2.CdBr_2.2\,NH_3.2\,H_2O$.

An ammoniacal solution of cadmium iodide containing an excess of the latter is added to an ammoniacal solution of mercuric cyanide as long as the latter dissolves it. The filtered solution deposits crystals having the composition—

$$HgCy_2.CdCy_2.HgI_2.2\,NH_3 \qquad \text{—A. L. S.}$$

Effect of Haloid Potassium Salts on the Solubility of Potassium Sulphate. C. Blarez. Compt. Rend. **112**, 939—942. (See page 717.)

The solubility of potassium sulphate in water practically increases with the temperature, and the quantity dissolved in 100 parts of water, between the limits 0 and 30, may be represented by the formula—

$$Q\,t = 8{\cdot}5 + 0{\cdot}12\,t.$$

The slightest addition of a haloid potassium salt renders some of the sulphate insoluble, the quantity being proportional to the amount of potassium contained in the haloid salt added, as illustrated by the following numbers obtained with potassium bromide:—

	Percentage of $KBr = K$.	SO_4K_2 dissolved.	$SO_4K_2 + K$
		Per Cent.	
1	0·327	9·43	9·76
2	0·654	9·10	9·75
3	0·980	8·84	9·82
4	1·308	8·44	9·45
6	1·959	7·52	9·48
8	2·616	6·56	9·45
12	3·924	5·62	9·54
		Mean.....	9·69

indicating that—

SO_4K dissolved + constant = K of the salt added.

In subsequent experiments on the solubility of potassium sulphate in a 6·4 per cent. solution of potassium bromide ($t = 2$ of K) it was found that between 0 and 30 the solubility varied in the manner represented by the following formula:

$$Q\,t = 5{\cdot}5 + 0{\cdot}1417\,t$$

the constant at any temperature would be between these limits—

$$\text{Constant at } t = 7{\cdot}5 + 0{\cdot}1417\,t$$

which, applied to the second equation, gives—

SO_4K dissolved at t + $7{\cdot}5 + 0{\cdot}1417\,t$ = K of the salt added.

Numerous experiments have been made with potassium chloride, bromide, and iodide, and the actual numbers obtained agree within experimental error with numbers calculated on the above basis, and prove that the precipitating action of potassium haloid salts on saturated solutions of potassium sulphate is proportional to the equivalent of the salt added.—D. A. L.

Compounds of Mercuric Chloride. G. André. Compt. Rend. **112**, 995—998.

See under XX., *page* 724.

New Process for the Oxidation of Chromium Ores and the Manufacture of Chromates. J. Massignon and E. Vatel. Bull. Soc. Chim. 1891, **5**, 371—376.

The present method of manufacturing bichromates consists in making an intimate mixture of finely powdered chromium ore with a salt of potassium or sodium and a large excess of lime, and heating it with constant rabbling in a reverberatory furnace to a very high temperature for six to eight hours in presence of a large excess of air. The mass is then cooled, lixiviated with water, and the solution treated with sulphuric acid and crystallised. The disadvantages attached to this process are that it necessitates (*a*), a large consumption of fuel; (*b*), expensive manual labour for rabbling; (*c*), loss of alkalis by volatilisation and combination with the gangue, and especially with the silica of the ore, thus rendering poor or siliceous ores unfit for treatment; (*d*), loss of ore which escapes oxidation.

The authors have worked out a new method based on an observation made by Pelouze that chromic oxide combines with lime forming a calcium chromite which absorbs atmospheric oxygen at the ordinary temperature, and is converted into the corresponding chromate.

The process is conducted as follows:—A mixture of the ore and limestone is finely powdered, well mixed, made into a paste with a concentrated solution of calcium chloride, and thoroughly incorporated with a paste consisting of lime slaked in a similar solution of calcium chloride. The lime or limestone is used in a proportion rather more than sufficient to combine with the whole of the chromium when oxidised to the state of chromic acid, and one equivalent of calcium chloride is used for every three equivalents of the total lime present. The mixture made in the manner described sets promptly, and is cut into cakes or bricks which are first partially dried in the open air, and then thoroughly dried and fired in a limekiln until the limestone is completely converted into caustic lime. The calcined bricks are piled in sheds and exposed to the action of the atmosphere for a month or more according to the temperature and humidity of the atmosphere, the supply of air, &c. If too much calcium chloride is added, the bricks will run together during the calcination instead of remaining open and porous, and the product will be hygroscopic. The presence of a small quantity of aqueous vapour in the air is essential, the oxidation being completely arrested in perfectly dry air; in presence of an excess of water, on the other hand, a retrograde action sets in, part of the chromic acid already formed being reduced to the state of chromic oxide.

When the chromium is completely oxidised the bricks entirely lose their green tint and acquire a yellow colouration. At this stage they contain calcium chromate, calcium chloride, excess of lime, and calcium carbonate, together with the ferric oxide and gangue contained in the ore, part of which also enters into combination with the lime.

The bricks are then systematically lixiviated with successive quantities of hot water, by which means the chloride of calcium (which is 100 times more soluble than the chromate) is obtained in a concentrated solution containing only small quantities of the chromate. The residue from this lixiviation is treated with sulphate or carbonate of soda or potash, filtered, and the solution crystallised at once or previously treated with sulphuric acid for the preparation of bichromates. Chromic acid may also be prepared from the residue by direct treatment with sulphuric acid. The chromic acid in the chloride of calcium liquors may be recovered either by again using the liquors in the process of manufacture or by precipitating them with a lead salt and separating the lead chromate (chrome yellow) which is thus obtained in a most economical manner (see also Eng. Pat. 2224 of 1891, this Journal, 1891, 547).

—S. B. A. A.

PATENT.

Improvements in the Electrolytic Production of Caustic Soda, Caustic Potash, and other Products from their Salts. C. J. Richardson, Clerkenwell, and T. J. Holland, Snodland. Eng. Pat. 2296, February 12, 1890. (Second Edition.) 8*d*.

In the usual production of the above materials by electrolysis the hydrogen which is given off stirs up the liquid and products of electrolysis and at the same time it covers the cathode and polarises the cell. The inventors therefore cover the cathode with oxide of copper, which is reduced by the hydrogen and can afterwards be easily re-oxidised and used over again. When caustic soda or potash are required, the electrodes are horizontal, the cathode being at the bottom of the cell, while the anode is above it. The heavy caustic soda remains at the bottom, while the chlorine produced at the anode can be led away and used if desired. If hypochlorites be required, the plates are reversed, when the chlorine in ascending meets and combines with the caustic soda now produced above it. For small work, vertical electrodes may be used with porous diaphragms; the *carbon* anode may also be replaced by one of zinc, and the arrangement will then act as a voltaic cell, and in effecting the electrolysis will give an electric current which can be utilised.—E. T.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

On the Cause and Cure of the Brown Spots occurring during the Manufacture of Mirrors. A. Jolles and E. Wild. Zeits. f. angew. Chem. 1891, 266—268.

These brown spots are found to consist of silver sulphide formed by the action of free sulphur on the surface of the glass on the silver at the moment of deposition. This free sulphur is due to the decomposition, by the action of moist air and carbonic acid, of the sodium sulphide, which is reduced from the original sulphate by the furnace gases during manufacture. All glass, therefore, intended for the preparation of mirrors should be silvered as soon as possible after it is made; but if, through storage in a damp place or otherwise, free sulphur is feared, it should be boiled for one minute in a 10 per cent. solution of sodium carbonate, the glass being previously heated to avoid risk of fracture. The spots may also be dissolved, after removal of the varnish and silver, by a 5—10 per cent. solution of either sodium hydrate or carbonate. This treatment is found to answer perfectly without in the least degree injuring the polished surface.—F. H. L.

New Process for Soldering Glass and Porcelain.

The United States Consul at Reichenburg, in a recent report, calls attention to a new process invented by Cailletet for soldering glass and porcelain to metals, which is exciting much interest there.

The part of the glass tube to be soldered receives first a thin layer of platinum by applying to the slightly warmed glass by means of a brush a quantity of neutral chloride of platinum and etherised oil of camomile. The oil evaporates slowly. As soon as the white, strong-smelling vapour has entirely disappeared, the temperature is raised to red heat, and the platinum is thus reduced and coats the glass with a thin layer of metal. The plated glass is then put in a bath of sulphate of copper and the coating connected with the negative pole of a sufficiently strong battery, when a ring of copper is deposited so thick and strong upon the platinum that it can be worked in any way, and the glass tube can be treated as if it were metal as far as soldering is concerned.

It may be united to iron, copper, bronze, platinum, or any metal which will take solder.

PATENTS.

An Improved Method of Utilising Mineral Colours for Advertising Tablets and Decorative Work upon Glass, Enamelled Iron, and other Flat or Hollow Surfaces. J. Budd, London. Eng. Pat. 11,407, July 22, 1890. 4*d*.

The design is formed upon the glass or other surface in an adhesive material, such as vaselin and gum, and the mineral pigment is then dusted on and rubbed in. The whole is then steamed and afterwards fired.—V. C.

Improvements in Glass-lined Tubing. D. Rylands, Stairfoot, and R. Morant, Barnsley. Eng. Pat. 11,714, July 26, 1890. 6*d*.

See under I., *page* 684.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

The Testing of Bricks. M. Gary. Thonind. Zeit. 15, 501—503 and 521—523.

The methods proposed from time to time and adopted by various testing stations for ascertaining the value of natural and artificial building materials for their intended use, differ appreciably in several respects, notably in the clause that relates to the test designed to determine the capability of the material to resist the disintegrating effect of cold.

The method adopted by the conference held in Munich in 1885 and in Dresden in 1886 includes the subjection of the test-piece to no fewer than 25 alternate freezings and thawings, and is of so severe a character that when it was tried by Bauschinger on 41 samples of artificial stone, it was found that only 3 samples resisted the ordeal completely and 8 partially (this Journal, 1890, 1037). The method of testing used by Bohme is as follows: 30 test-pieces are weighed and 10 tested in compression in the air-dried state. The remaining 20 are dried for 25 hours upon an iron hot plate, and again weighed, after which they are immersed in water for 125 hours (that time being found sufficient for their saturation) weighed again, and 10 tested in compression, while the other 10 are frozen for 24 hours either in air or under water. This time is found long enough to freeze them completely to the centre. They are then tested in compression and the whole of the results tabulated. In considering the table which is appended it will be understood that the hardness of the burning affects the density, hardness, and porosity of the bricks, and that though hardness is, generally speaking, advantageous, yet extreme hardness is objectionable as hindering the adhesion of the mortar. In cases where a very hard dense brick is required, the surface must be grooved, perforated, or channelled, so as to enable the mortar to adhere.

A study of the table leads to the following conclusions:—

(1.) The strength of the specimens is independent of their specific gravity.

(2.) A saturated brick is weaker than the same brick unsaturated, but the diminution in strength shows no relation to the amount of water required to saturate it, or to the hardness of the burning it has undergone. With regard to this fact, it may be said that as bricks usually contain no constituent soluble in water and no caustic lime, the slaking of which might give rise to internal strains, the decrease in strength observed can only be due to the water diminishing the friction between adjacent particles of brick at the moment of compression, thus allowing their freer movement and ultimate severance more easily than in the dry state.

Kind of Brick.	Colour.	Sp. Gr.	Hardness Mohs Scale.	Absorption of Water. 12 Hours.	Absorption of Water. 125 Hours.	Strength in Compression. Kilos. per Sq. Cm. Air dried.	Saturated with Water.	Loss in Strength.	After Freezing. In Air.	Loss in Strength.	Under Water.	Loss in Strength.
				Per Cent.	Per Cent.			Per Cent.		Per Cent.		Per Cent.
Clinker burnt 6 cm. thick.	Yellow-brown	2·076	8	1·2	5·1	116	432	3·1	427	1·2	442	0·9
	Red	2·115	8–9	5·7	6·3	486	481	1·0	469	3·5	479	1·5
	Dark red	2·121	8–9	3·3	3·7	632	619	2·1	580	8·2	623	1·3
	Brown	2·372	8–9	1·1	1·5	796	785	1·4	..	..	..	..
	Greyish-white	2·116	7–8	1·5	2·2	146	141	1·1	..	..	..	..
Hard burnt 6·5 cm. thick.	Yellow	1·588	6	17·7	18·1	397	386	2·8	348	12·3	371	6·6
	Light red	1·622	5–6	16·0	16·9	396	383	3·3	385	2·8	380	1·5
	Red	1·903	6	11·7	12·2	386	373	3·4	361	6·5	365	5·4
	Light red	2·051	6	7·8	8·3	364	353	3·0	335	8·0	347	4·7
	Red	1·803	6	12·3	13·1	339	335	1·2	..	..	..	..
	Dull red	1·674	4–5	14·8	15·7	225	220	1·8	203	9·4	207	7·6
Fairly hard burnt 6·5 cm. thick.	Dull red	1·812	4	12·8	13·6	226	215	5·0	212	6·2	218	3·5
	Red	1·706	4	14·8	15·3	237	231	2·5	221	6·8	224	5·5
	Light red	1·486	5	22·6	23·5	247	226	8·5	..	..	..	..
	Yellowish-white	1·696	4	21·4	22·2	327	288	11·9	..	..	..	..
Lightly burnt 6·5 cm. thick.	Yellowish white	1·374	5	25·4	25·8	183	177	3·3	..	..	..	..
	Red	1·732	4	7·4	18·1	168	164	2·4	..	..	..	..
	Light red	1·611	4	23·9	24·9	219	217	0·9	..	..	..	..
	Light red	..	..	17·7	18·3	217	210	3·2	..	..	..	..
	Dull red	1·630	..	..	26·8	143	143	0·0	..	..	..	..

To make this hypothesis tenable a certain elasticity of the material must be postulated.

(3) Freezing the specimens in air or under water diminishes their strength; the diminution is less in the latter case because the expansion of the frozen water external to the brick tends to set up strains, neutralising to some extent the internal strains produced by the solidification of the water in the pores of the test-piece.—B. B.

Manufacture of Slag Bricks in Montana. T. Egleston. School of Mines Quarterly, U.S.A. **12**, 189—193.

See under X., *page* 702.

PATENTS.

Improvements in and relating to the Calcining of Carbonates for Cements and other Purposes. W. Darling Shotts. Eng. Pat. 10,127, July 5, 1890. 4*d*.

Blast furnace or similar slag is run into a "bogie or vessel having a close crucible or retort mounted within it," in which is placed the carbonate to be calcined. The product can be used for making cement. An alternative plan consists in adding the carbonate to be calcined to the molten slag contained in an open or close vessel, the product being applicable as a cement or manure; for the former purpose 30—60 per cent and in the latter 10—30 per cent. of limestone would be added. By using portable receptacles these operations can be conducted at a convenient distance from the furnaces.—B. B.

Improvements in Machinery or Apparatus for Crushing, Mixing, Grinding, and Delivering Materials for the Manufacture of Cement. N. W. Curtes and A. E. Carey, London. Eng. Pat. 10,918, July 14, 1890. 6*d*.

An edge runner immersed in a tank is used for crushing the raw materials for the cement, and is provided with paddles depending from the ends of its horizontal axis which mix the crushed materials with the water contained in the tank. "The edge runner mill has a detachable grating on the top of the outer edge of the fan and removable roller paths." The slurry passes from the edge runner to a grinding mill of any suitable form, placed in the same tank, and thence is pumped to the drying floors. "Sieves or screens may with advantage be fixed between the edge runner mill and the grinding mill.—B. B.

The Application of Certain Waste Materials for the Production of a New or Improved "Mineral White" and Improvements in the Process of Manufacture. J. J. Lee, Manchester. Eng. Pat. 12,085, August 1, 1890. 4*d*.

See under XIII., *page* 713.

Improved Manufacture of Artificial Stone. A. J. Boult, London. From L. Crote, Dresden, Germany. Eng. Pat. 5719, April 2, 1891. 4*d*.

Fifty grms. of dried wood pulp are steeped in "50 grms. of an ammoniacal solution of oxide of copper (100 parts in 500 parts of water)" and freed from the superfluous liquor; 500 grms. of "burnt magnesite" are mixed with 1,000 grms. of magnesium chloride solution (38 per cent.), and 350 grms. of zinc chloride solution (32 per cent.) and

the product dried and heated in closed vessels at a temperature insufficient to drive off any but an insignificant amount of hydrochloric acid. The mass after grinding is mixed with the prepared wood pulp, 5—20 per cent. of alumina being preferably added, forced into moulds and exposed to the air. "During the first 12 hours the water rapidly 'settles,' and the mass becomes strongly heated During the succeeding 12 hours it partly retains its plasticity, while at the same time it is capable of being turned or polished." It then becomes too hard to work. The gradual hardening allowing of mechanical treatment, is the main feature of the process.—B. B.

Improved Apparatus employed in the Manufacture of Artificial Sandstone. O. Imray, London. From F. Zernikow, Oderberg, Germany. Eng. Pat. 8017, May 9, 1891. 6*d*.

Artificial stone is made by mixing powdered quicklime with sand, slag powder, or similar material, ramming the mixture into moulds and slaking the lime by exposure to high pressure steam. In order to enable the moulds to resist the pressure exerted upon them by the expansion of the lime while slaking, they are supported one against another, wood or metal filling pieces being inserted between them and held in position by annular metal bands surrounding them, and by metal plates at each end securely bolted together. The whole arrangement is enclosed in a cylindrical vessel and high pressure steam admitted and maintained for several days.—B. B.

X.—METALLURGY.

The Destruction of Lead Pipes. Jour. f. Gasbeleuchtung, **34**, 175.

See under I., *page* 683.

On the Genesis of Ore Deposits. W. H. von Streeruwitz. School of Mines Quarterly, U.S.A. **12**, 181—186.

The author reasons as to the cause of the existence of metals other than iron in a ferruginous siliceous deposit at great depths, and the absence of those metals in the same ore-bed at the outcrop. The hypothesis of heat and the separation by the degree of volatilisation is not applicable as the result is sometimes the reverse of what it should be. The same might be said of the precipitate and circulating current theories which have been in vogue for so long. The author's own experiments are then mentioned. When a crystal of ferrous sulphate was placed in a cold solution of an alkaline silicate thin nearly colourless threads began to grow and to rise to the surface where they became oxidised, spread about and deposited a brown ferruginous silicate resembling that of the iron outcrops which indicate ore veins. Salts of other metals do not act in this manner unless perhaps with extreme slowness, a year's growth being barely perceptible. When however these salts were used together with the iron salt the threads of iron silicate commenced to grow at once and to carry with them the other metals, which were sometimes discovered to be in the metallic state, especially the gold and platinum, and occasionally the silver and copper. Somewhat similar results were obtained when heat was applied or galvanic currents used.

The formation of agates is next considered. The experimental development of siliceous layers, instead of commencing with an outer zone and progressing towards the centre, invariably started with an acicular crystalline nucleus of silica, which thickened slowly into regular agate bands of various tints by deposits on the surface.

From these few experiments which are considered as incomplete the following points appear to be established:—

(1.) It is principally the iron which, in silico-ferruginous fissure veins, brought the other metals from greater to (by mining) accessible depths.

(2.) Most siliceous ore-leads, carrying also large quantities of iron and having silico-ferruginous outcrops, seem to be deposited from hot aqueous solutions of the metals and silicates.

(3.) Metals and metal combinations contained in the rock surrounding the fissures and crevices were probably leached out by the hot liquids contained in the fissures and precipitated on and combined with the siliceous iron growing up in the fissures.

(4.) The fissures could be charged with ore veins in a comparatively short time, since, no doubt, high temperature and galvanic currents existed in the fissures at the time of the formation of the ore-gangues.

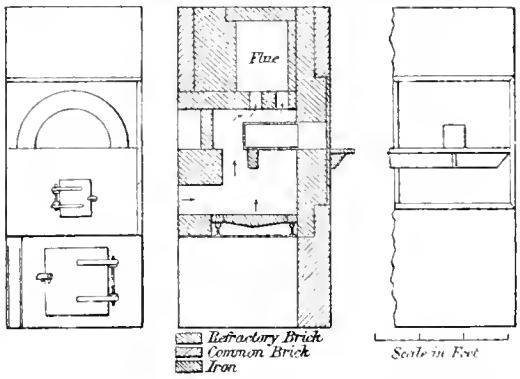
(5.) In contact-gangues the precipitation and deposition of ores was materially facilitated by galvanic currents, caused by the contact of different rocks, and it is owing to the prevalence of galvanic currents that in most cases richer deposits at the intersection of two or more leads were formed.

(6.) The so-called "iron outblows" are frequently not the product of igneous eruption, but a deposition product from aqueous solutions, and alteration in the rocks contiguous to such outblows are not necessarily the result of eruptive agencies, but of a leaching process.

(7.) The formation of banded agates does not always take place (as generally believed) in the cavities of a rock, but can also occur free in solutions, and the thickness of the bands progresses from the centre outwards, although a reverse process by osmosis may be possible under certain conditions.—A. W.

An Assay Furnace. H. Wood. School of Mines Quarterly, U.S.A. **12**, 186—188.

The author advocates the use of muffle furnaces which are fed from the back, and describes one which he has used in Colorado with satisfactory results. Its approximate cost is about 100 dollars, and its advantages consist in the economy of fuel, the greater cleanliness, the rapid heating, and the large size of the muffles. The latter are made in two sizes,

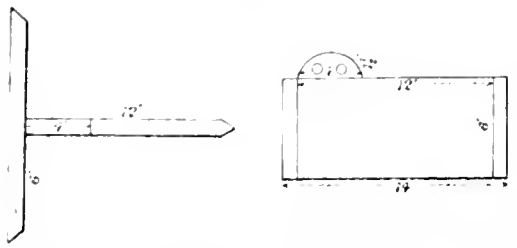


the small, 9 by 15 inches, and the large, 13 by 15 inches. The accompanying drawings illustrate one of three furnaces accommodated by the same flue, which latter consequently appears rather large. For a single furnace the size of the flue would be 6 by 8 inches. The only disadvantage is the danger in feeding of breaking the cross-bar supporting the muffle; this is remedied by constructing knees or projections from the wall which serve as a rest.—A. W.

Manufacture of Slag Bricks in Montana. T. Egleston. School of Mines Quarterly, U.S.A. 12, 189—193.

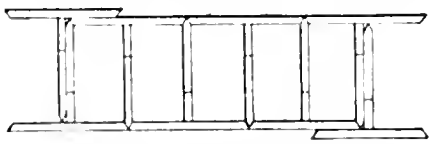
A SERIES of cast-iron plates 1 in. thick is made in the shape of a T with bevelled edges and with a small piece with clutch-holes as shown in Fig. 1, plan and elevation. These

Fig. 1.



plates are set up on a series of bed plates so as to form five moulds, the end pieces being held in position by an extra plate placed as indicated in Fig. 2. The molten slag is then

Fig. 2.



run into these moulds from the ordinary slag pot. Directly it is set the mould frames are lifted up by means of hooks which fit into the clutch-holes and the bricks are piled together and allowed to cool slowly. The most convenient size for the bricks is 12 inches long by 6 wide by 6 deep, and they weigh about 55 lb. each. They are used extensively for building purposes, as they are as strong as stone except when submitted to shock, and also for the construction of kilns. The secret of the remunerative working lies in keeping the mould frames coated with clay-water and in removing them from the bricks directly the latter are sufficiently set to remain firm. When the bricks are allowed to cool in the moulds the cast-iron pieces soon become useless, but by the above plan the wear is inappreciable.—A. W.

The Treatment of Copper Slates at Mansfeldt. T. Egleston. School of Mines Quarterly, U.S.A. 12, 85—117 and 193—218.

THIS paper is a long and general account of the well known methods of treatment of the Mansfeldt copper-schist as employed at the works in that locality. Drawings of some of the furnaces are given and a number of analyses of the various intermediate and final products. These analyses and the statistics of the paper have been obtained from the two pamphlets published in 1881 and 1889 by the company owning the works, and the remaining information is the result of two visits to the district made for the purpose of the article. The details of the process have been extensively dealt with by the author, and the paper is one of which an abstract cannot suitably be made.—A. W.

The Calculation of Blast Furnace Slags as Practised in certain Works in Europe. A. J. Rossi. J. Amer. Chem. Soc. 12, 143—148.

THIS paper, in which the term "bibasic" is employed for a slag with one base and in the sense of a monosilicate, contains two examples for calculating a blast furnace charge from the same data by the usual long methods—the first being worked by reducing the bases and acid present to their respective amounts of oxygen, and the second by converting all the bases into lime. In the former case the author prefers the formula SiO_2 for silica and uses the old atomic weights.—A. W.

The Colourations of Metals. Report by H. Burghardt on a Memoir submitted by Loewenherz to the Ind. Soc. of Mulhouse. Bull. Soc. Ind. Mulhouse, 1891, 67—69.

LOEWENHERZ has studied, from a decorative point of view, the formation of surface-colourations on metals exposed to high temperatures. Experiments were made on iron, copper, and brass, articles composed of the two latter being very commonly surface-coloured in this manner. The temperatures at which particular colourations are produced, were determined by enclosing samples of the metals named, in a double-jacketed air-bath, provided with an arrangement for regulating the heat, and with a glass window for enabling the progress of the oxidation to be observed. In the case of copper the colourations range from pale orange to dark grey, in that of brass, from yellow-orange to green; the temperatures corresponding to these colourations are not stated in the original memoir. In the case of steel the time required for the production of a particular shade of colour, is, within certain limits, inversely as the temperature employed; thus, to produce a blue:—

At 180	there are required	9	days.
At 230	„	„	50 hours.
At 290	„	„	7—15 minutes.
At 380	„	„	20 seconds.

The colourations may change to some extent during the cooling of the metal operated upon; moreover, they vary with the composition of metallic alloys, and in the case of steel, also the hardness. The author agrees with the opinion that the colour of hardened steel is by no means a sure index as to its quality.—E. B.

Physical Properties of some of the Alloys of Manganese, Copper, and Aluminium. Eng. and Mining J. 1891, July 11, 47.

THE German silver industry of the United States is one amounting in value to upward of six or eight millions of dollars annually. With a view to obtain if possible a cheaper and better article than German silver, Alfred H. Cowles and the author began some years ago to experiment with the alloys of copper and manganese. They found that whilst a pure metallic manganese could with difficulty be reduced by the ordinary methods, it could be cheaply reduced in the electric furnace. Through a long course of experiments they have perfected a substitute for German silver which is offered in the market under the name of "silver bronze."

Of course, it was no new thing to bleach copper with manganese. Dr. Percy, the discoverer of aluminium bronze, was also the discoverer or inventor of manganese bronze.

Following his written description several other makers have from time to time within the past thirty years attempted to produce a pure manganese bronze, but unsuccessfully. Some have even attempted its introduction into the German silver trade. But thus far it has been both too expensive to manufacture and of too corrodible a nature, as then made, to admit of a prolonged use.

In order to overcome the two prime difficulties, that of casting and that of corrosion, the authors have introduced a small percentage of aluminium into the alloy, and with excellent effect.

The successive steps that have been pursued are recorded on a list of upwards of 200 distinct mixtures of the several metals, copper, zinc, tin, lead, aluminium, iron, and manganese, and the metaloid silicon, with which experiments have been made to ascertain the tensile strength, ductility, colour, &c. The most important determinations derived from this list of experiments appear to be about as follows: That pure metallic manganese exerts a bleaching effect upon copper more radical in its action even than nickel. In other words, we found that 18½ per cent. of manganese present in copper produces as white a colour in the resulting alloy as 25 per cent of nickel would, this being the amount required to remove the last trace of red; that upwards of 20 or 25 per cent. of manganese may be added to copper without reducing its ductility, although it doubles its tensile strength and changes its colour; that manganese, copper, and zinc when melted together and poured into moulds behave very

similarly to the most "yeasty" German silver, producing an ingot which is a mass of blow-holes, and which swells up above the mould before cooling; that the alloy of manganese and copper by itself is very easily oxidised; that the addition of $1\frac{1}{4}$ per cent. of aluminium to manganese copper alloy converts it from one of the most refractory of metals in the casting process into a metal of the most superior casting qualities, and one whose non-corrodibility must in many instances be far greater than either German or nickel silver.

The "silver bronze" alloy which has been especially designed for rod, sheets, and wire purposes is of the following composition: manganese, 18 per cent.; aluminium, 1·20 per cent.; silicon, 5 per cent.; zinc, 13 per cent.; copper, 67·5 per cent. It has a tensile strength of about 57,000 lb. on small bars and 20 per cent. elongation. It has been rolled into thin plate and drawn into wire of 0·008 in diameter. Its electrical conductivity appears to be higher than that of German silver, and the hope is entertained that we have in it a material whose resistance will be such that it will afford the electrician better and cheaper wire for the rheostat than any other alloy.

A New Process for the Treatment of Cobalt Ore. L. Pelleton. Le Génie Civil, **18**, 1891, 373; Proc. Inst. Civil Eng. Abstracts, **105**, iii. 74–76.

At the works of the Maletra Chemical Company, at Petit Quérilly, near Rouen, a new process for the treatment of the cobaltic manganese ore from New Caledonia has been successfully introduced by Mr. Herrenschmidt. The composition of the ore, subject to variation in certain of the less valuable constituents, averages:—

Peroxide of manganese	18·00
Protoxide of cobalt	3·00
Protoxide of nickel	1·25
Peroxide of iron	30·00
Alumina	5·00
Lime and magnesia	2·00
Silica	8·00
Loss in calcination	32·75
	100·00

The operations are entirely performed by the wet way, and the reagents used are to a large extent waste products arising in the treatment of the ore. The order of operation is as follows:—

1. *Solution of Ore.*—The ore, which is comparatively soft, is ground to a fine powder under edge-rollers, and is thrown into large pans containing a strong solution of ferrous sulphate, which is boiled by blowing steam through it. This dissolves manganese, cobalt, and nickel as sulphates, while the whole of the iron, including that in the ore, goes down as basic ferric sulphate together with the silica and alumina. The action continues for some hours, fresh ore being added as required, until the liquor when tested with permanganate is found to be free from dissolved iron. The contents of the pan are then blown over to a settling tank, where the clear liquor is separated from the ferruginous precipitate. The latter is then passed through a filter process, dried, and calcined, giving a powder which is sold as colcothar.

The ferrous sulphate employed in the above operation is prepared on the spot from scrap iron and nitre cake, or the residue, consisting of sodium sulphate and sulphuric acid, obtained in the manufacture of nitric acid. This gives, in addition to the green vitriol, sodium sulphate, which salts are separated by crystallising; the latter may also be utilised at another stage of the process.

2. *Precipitation of Nickel and Cobalt.*—The liquors containing cobalt, nickel, and manganese sulphates are transferred to stills made of slabs of the lava from Volvic, in Auvergne, and sodium sulphide is added. This precipitates cobalt and nickel as sulphides, with only a small proportion of manganese, the bulk of the latter metal remaining in solution by reason of the acidity of the liquor. The mixed sulphides when separated are treated with a solution of ferric chloride which dissolves the manganese, giving a mixture of sulphide of nickel and cobalt nearly free from foreign matters. The manganese in the still liquors is converted into chloride by chloride of calcium, and precipitated by lime to be used in the Weldon process.

The sulphide of sodium used in this operation is obtained by decomposing the sulphate of sodium remaining from the ferrous sulphate with alkali waste in a closed vessel under pressure: the final residue of this operation being sulphate of calcium.

3. *Calcination of Cobalt and Nickel Sulphides.*—The precipitate of mixed sulphides, after the removal of the manganese, is subjected to a very careful roasting in a reverberatory furnace, which, if the operation is successful, results in its complete transformation into sulphates of cobalt and nickel soluble in water.

4. *Separation of Cobalt and Nickel.*—The product of the roasting operation No. 3, when dissolved in boiling water, is treated with chloride of calcium to convert the sulphates into chlorides, after which the liquor is divided. In one portion, A, the metals are precipitated as hydrated protoxides with lime, and, after washing to remove the calcium salts, the precipitate is diffused through water, and subjected to the joint action of a current of chlorine and of air under pressure, with the result of forming peroxides of nickel and cobalt. A second portion, B, of the original protochloride liquor is then added, and the whole is energetically mixed by blowing it up with steam. This has the result of reducing the peroxide of nickel in the A precipitate, which redissolves as protochloride with the peroxidation and precipitation of an equivalent proportion of cobalt from B, so that only nickel remains in solution, while the cobalt is entirely separated. The proportion of B is so chosen that the whole of the precipitated nickel is not dissolved, in order to ensure that the liquors contain no cobalt. Further additions of the solution are made in graduated quantities until the cobalt precipitate is completely free from nickel, when it is filtered, dried, and calcined for sale. The various liquors containing nickel are finally collected and treated with lime, the protoxide of nickel precipitated is separated by a filter-press, and after drying and calcination is ready for reduction.

The chlorine required in the operation is obtained from a portion of the ore which is used in the stills with hydrochloric acid, in the same way as an ordinary manganese ore. Cobalt, nickel, and iron pass into solution at the same time; the first two metals are recovered, while the ferric chloride is used in the treatment of the mixed sulphides.

The works as at present arranged are equal to the treatment of about 150 tons of ore per month, which corresponds to a yield of 4,500 kilos. of cobalt oxide and 1,850 kilos. of nickel. The former is worth about 25 frs., and the latter 3·50 frs. per kilog. The annual consumption of cobalt is estimated to be above 200 tons, or a value of about 300,000*l*.

The New Caledonian cobalt ore being very bulky it has been proposed, in order to save freight, to convert it into regulus at the mines. Experiments in this direction have been made at the same works, running down the ore with silica and iron pyrites in a water-jacket blast-furnace, with the result of producing a regulus with 8 per cent. of cobalt, in addition to iron and sulphur, and slags containing all the manganese, and only 0·02 per cent. of cobalt. This concentrated material it is proposed to treat in the same way, commencing, however, with operation 3, or the calcination of the mixed sulphides.

Uranium in the Black Hills. Scient. American.

Uranium has been found in the Bald Mountain District in the Black Hills in such large quantities as to warrant the prospect of early production of uranium salts, as well as the metal uranium in the United States.

At present uranium mining is carried on only in two places in the world, namely, at Annaberg, Saxony, and Redruth, Cornwall, and the scarcity of the mineral has been the cause of its not being used for a very important purpose —the manufacture of steel.

In Europe uranium has only been found in pockets in form of pitch-blende, which is uranous and uranic oxide (40 per cent. of uranous and 54 per cent. of uranic oxide) combined with silica, lead, iron, and manganese; the other uranium ores appearing in such small quantities as not to be commercially valuable. Mr. Reinhold, who made an examination of the different uranium ores at Bald Mountain, S. D., found the following minerals in a depth of only a few feet, the rock being of the archæan formation:—

1. *Uranit* (uranmuglimmer) embedded in the rock and the seams, in greenish yellow scales, the vein running vertically and being 40 ft wide on the surface. An analysis shows it to be $(UO_2)_2PO_4Cu$. As a source for uranium this mineral cannot be used, the costs of concentrating being too high.

2. *Pitch-blende.* This mineral appears in seams, together with the above-mentioned scales. From all appearances the rock contains large quantities in greater depths, the conditions being analogous with those at Cornwall. Its composition is UO_3 with iron, lead, magnesia, and manganese, also silica.

3. *Uranium ochre* (U_2O_3) 3 SO_3 and uranochalcit $U_2O_3(Fe, Ca)$ 0 SO_3, H_2O, in large bodies of kidney-shaped form; and

4. *Trogerit*, 3 UO_3, As_2O_5.

All these ores, with the exception of the first one mentioned, may be converted into uranium salts, which are commercially valuable. The chloride, nitrate, and sulphate of uranium are used in the manufacture of stained glass, producing a greenish yellow tint, peculiar to them. They are also used in colouring porcelain (black porcelain), and to some extent in photography. Germany and France are the principal consumers, and lately the output in Europe has decreased, and the price of uranium advanced materially, its cost being now 10 dols. a pound. The amount of uranium consumed in the manufacture of glass and porcelain is, however, very limited.

Experiments and tests which have been made by the great steel and gun manufacturers in England and Germany have shown that the addition of a small percentage of uranium to steel increases its elasticity, and at the same time its hardness, to an extent that makes its use in the manufacture of guns, armour plates, &c., most desirable, but the scarcity of the material, and especially the great difficulty in reducing the ore to metal makes the price of uranium steel too high. If the recent discoveries in the Black Hills prove as important as present indications are that they will, it is likely that the metal can be produced cheaply enough to be used for this purpose.

PATENTS.

An Improved Method of Separating Sulphur from Sulphurous Pig Iron. G. Hilgenstock and J. Massenez, Hoerde, Germany. Eng. Pat. 11,328, July 19, 1890. 6*d*.

Irons containing much sulphur, and more especially the varieties of iron produced by the "Thomas" process, may be desulphurised by adding to the bath of molten metal at a high temperature a quantity of a manganiferous pig which becomes completely liquid at that temperature, and allowing the mixture to stand for some time. A slag of sulphide of manganese is formed, and its separation may be hastened by stirring or agitating the bath. The process is best carried out in a species of converter without tuyeres in the bottom; it is heated before the introduction of the molten metals, and a number of operations is performed successively in it before removing the slag.

The presence of an excess of manganese is advantageous; for instance, a successful desulphurisation is effected with the following mixtures. (*a.*) 60 tons of iron containing 0·15 per cent. of sulphur and 0·9 per cent. of manganese and 10 tons of iron with 4·5 per cent. of manganese and 0·02 per cent. of sulphur; (*b.*) 20 tons of iron with 0·3 per cent. of sulphur and 0·8 per cent. of manganese and 50 tons of iron with 2 per cent. of manganese and 0·04 per cent. of sulphur; (*c.*) 20 tons of iron with 1·2 per cent. of sulphur and 0·5 per cent. of manganese and 50 tons of iron with 3 per cent. of manganese and 0·02 per cent. of sulphur. In all these cases the product contains about 1·5 per cent. of manganese and 0·03—0·05 per cent. of sulphur. The sulphide of manganese slag is mixed with limestone, &c., and smelted either alone or in conjunction with other iron ores for the production of a manganiferous iron, which is again available for use in this process.—S. B. A. A.

Improvements in Fluxes or Solutions for Coating Metals with Lead. A. M. Clark, London. From W. G. Horgan, New York, U.S.A. Eng. Pat. 12,624, August 12, 1890. 4*d*.

To coat sheet iron with lead it is freed from scale by means of hot dilute sulphuric acid, washed with water, and transferred to a vat containing a solution of lime or other alkaline compound, which serves to prevent oxidation and acts as a flux. The sheet iron is then placed in a dilute solution of zinc chloride containing on the average 20 lb. of oxalic acid and 10 lb. of sodium sulphite per ton of iron treated; these quantities depend, however, upon the quality of the metal. After this immersion the sheets are passed through melted lead and allowed to drain. A very closely adherent coating is obtained by this process.—S. B. A. A.

Improvements in or connected with the Coating of Metals or Metal Articles with other Metals or Alloys. W. P. Thompson, Liverpool. From F. J. Clamer, Philadelphia, U.S.A. Eng. Pat. 7777, May 5, 1891. 4*d*.

The inventor finds that articles of iron or other metals cleaned previous to plating with dilute sulphuric acid are left superficially covered "with a deposit of sulphuretted hydrogen," which is not removed by rinsing with water and prevents a proper union of the coating metal subsequently applied with the article taken. Sheets of metal, &c., treated by the process of Clamer (U.S. Pat. 363,593 of 1887) in which they are made the negative pole of an electric current in a cyanide bath, likewise have a deposit of cyanide of iron formed upon them which prevents the proper adhesion of the coating metal. By the present invention these deleterious deposits are removed by simply immersing the plates in a bath of muriatic acid, and subsequently in a saturated solution of equal quantities of zinc and tin in the same acid.

The inventor prefers to use the coating bath described in U.S. Pat. 283,077 of 1883, which is prepared by adding to one cwt. of molten lead about three ounces of sal-ammoniac, half an ounce of arsenic, three ounces of phosphate of lead or phosphorus, and half an ounce of borax or a similar flux. A small proportion of the mixed chlorides of zinc and tin may also be added.—S. B. A. A.

Improvements in the Treatment of Waste Tinned Steel or Iron. B. J. B. Mills, London. From W. L. Brockway, New York, U.S.A. Eng. Pat. 8111, May 12, 1891. 6*d*.

According to this invention waste tin plate, fruit cans, &c., are heated to 1,000° F. in a furnace in which a reducing atmosphere is maintained. It is claimed that in about from three to seven minutes the tin and solder are completely separated from the iron and fall to the bottom of the furnace, whilst the iron is left in such a condition that after cleaning, cold rolling, and annealing, it is suitable for applications in which a tough high-class iron plate or foil is required.

—S. B. A. A.

XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

The Practical Aspects of Electric Welding. F. A. C. Perrine, D.Sc. The Elec. Eng., New York, **11**, 1891, 600; Proc. Inst. Civil Eng. Abstracts, **105**, iii. 81—82.

The first welder actually sold was to the Roeblings, and in two years it made 370,000 splices in telegraph wire. This machine has been replaced by one large and seven small welders capable of working up to $\frac{1}{2}$ in. copper (40,000 watts) and during the year they have been set up, show an average of 1,000 welds per day. It is used by Messrs. Seaward and Son for uniting Norway iron and Swedish steel for carriage work; by the Pope Manufacturing Company for bicycle tires, the welds being finished in dies at the same heat. The Trenton Iron Company are now using it for joining their locked-wire rope, making, in fact, a solid bar of it for about 2 in. at the weld. It is also used for "spinning-rings" and steel axles up to $1\frac{1}{2}$ in. diameter, these standing the test of bending to 90° and back again. The heaviest work is probably being done at the Johnson Rail Company's works, and the hardest steel worked is that of band saws, and by this method even broken teeth are being replaced. Pipe-welding and bending is also being practised by several manufacturers by these means, the burrs being beaten down by rapid hammering, pneumatically driven or otherwise. In the Charlestown Navy Yard anchor chains up to 2 in. are being made, the links being in halves and the two sides welded at the same time and forged at the same heat, and electrically welded shells are manufactured to dimensions requiring a minimum amount of machining.

The electric welding process is rather a melting together of the two surfaces in contact than an actual welding; hence cast metals are not changed in their essential constitution at the point of junction, but rolled or drawn metal is practically reduced to its cast state, and therefore requires further treatment on the weld to bring it to a satisfactory condition. This is especially noticeable with heavy sections, and the gradual change of condition can be clearly perceived on both sides of the weld. Special additions are therefore provided for reheating joints in such metals and subjecting them to further hammering hot and in special cases also cold; but even this treatment still leaves much to be desired where great strength and pliability are required. This caution applies especially to copper and to the higher carbon steels; thus, by forcing the heat, however rapidly, a "burnt" steel can be produced electrically, and points rather to a rearrangement of molecules being the cause than any action of carbonisation, especially as the metal can be restored by careful forging.

The Direct Conversion of Heat into Electricity. R. J Gülcher. Sitzungsber. der Akad. der Wissensch. Berlin, **18**, 1891, 98; Proc. Inst. Civil Eng. **105**, iii. 82—84.

That electric currents can be developed by the direct application of heat to the junction of two different metals, which is the fundamental principle of the thermopile, was discovered by Seebeck in the year 1823. As regards the theory of the subject, Clausius suggested in 1880 that "by the molecular motion, which is termed heat, electricity is driven from one material to the other;" and Koblrausch's theory of 1875 is somewhat similar in assuming that the electric current is in some way connected with the flow of heat, and *vice versâ*. The discoveries of later years, culminating in the researches of Hertz, prove, however, that the electric current is merely the result of a certain vibratory motion of the luminiferous ether, and therefore, in accordance with the principles of the conservation of energy, a certain definite quantity of heat can be converted into a certain definite quantity of electricity without either loss or gain of energy, and it is this meaning that is given to the subject of this paper, conversion by a dynamo machine being termed "indirect."

Proceeding then to calculate the absolute efficiency of the ordinary means of producing the electric current by a steam-driven dynamo, the electrical energy developed is shown to be only 6·4 per cent. of the energy existing in the coal burnt in the boiler: but even this low efficiency is 18 times greater than the direct conversion of heat into electricity as furnished by a Noe and Clamond thermo-battery, where the efficiency works out at only 0·35 per cent. of the mechanical equivalent of the gas burnt. If the high efficiency of the dynamo and steam-engine in themselves, as manufactured at the present day, be considered, it is clear that not much greater results can be expected in that direction, and the author has for some years been experimenting in other directions, therefore, for the direct conversion of heat into electricity.

The principal idea acted on at first was the heating of a certain metallic salt in a platinum crucible, which should form the positive pole of the element, and a carbon rod immersed in the molten substance, the negative pole; this substance would part with its oxygen to the carbon, and then be re-oxidised by contact with the air; and with this form of apparatus, a mixture of caustic soda and carbonate gave an electro-motive force varying between 0·475 and 0·4 volt, the "sodium blast" generated at the carbon point burning at the surface with its characteristic yellow flame, accompanied with slight explosions. For the similar potash salts the electro-motive force was between 0·4 and 0·31 volt, the flame being violet and the burning more violent, and forming a small display of fireworks. The adoption of lead oxide resulted in a momentary high electro-motive force, and then a sudden collapse of the platinum crucible, owing to the metallic lead reduced falling to the bottom and eating through the platinum. The author was surprised also to find that at the junction of the platinum connexion wire the crucible was also severely pitted, as the current had never been short-circuited, and he has no valid explanation to offer therefor.

After these experiments, the results of which did not promise any simple solution of the problem, the author set himself to improve, if possible, the thermo-battery, and for which purpose attention was directed to the following particulars:—

1. The adoption of durable materials.
2. That the electro-motive force and specific conductivity should be as high as possible.
3. Improvements in the form of the element.
4. Improvements in the application of the heat, *i.e.*, a higher efficiency in the production of the heat itself.

Subsulphide of copper, in spite of its high electro-motive force, gave on account of its high specific resistance, a weaker current than materials which gave only half its electro-motive force, and it was also found that, by a species of dry electrolysis, granules of metallic copper were formed throughout the body of the material, and its use was therefore discarded. A form of battery is described, and which was exhibited at the meeting, consisting of tubes of nickel and a special antimonial alloy, which was found to be very durable; this consisted of fifty elements in series united in one casing, and gave an electro-motive force of 1·5 volts, and an internal resistance, when hot, of 0·4 ohm, with a consumption of $7\frac{1}{4}$ cubic feet of gas per hour, and the absolute efficiency is 1·08 per cent., or three times that of the existing thermo-batteries. Such a battery is almost exactly equivalent to two Bunsen elements, and though it is far below the dynamo in efficiency, still it may be suitable for various small installations and for experimental work, owing to complete absence of polarisation, as the electro-motive force does not fall on short circuit. The durability is enhanced by a regulator applied to the gas-supply to prevent any accidental overheating.

The author concludes by stating that he hopes to exhibit at the Frankfort Exhibition two cells which are the outcome of still later researches, and in which the efficiency has been raised to over 5 per cent., and thus almost capable of competing with the dynamo. The description of the construction is withheld; but it is stated that one form is capable of continuously furnishing current for eight 16 candle-power lamps at a consumption of 4·5 lb. of coke per hour. This success the author hopes still further to advance, and thereby exceed the efficiency of the dynamo system as a converter of heat into electrical energy.

PATENTS.

Improvements in the Electrolytic Production of Caustic Soda, Caustic Potash, and other Products from their Salts. C. J. Richardson, Clerkenwell, and T. J. Holland, Stodford. Eng. Pat. 2296, February 12, 1890. (Second Edition.) 8*d*.

See under VII., *page* 699

Improved Electrolytes for Primary Batteries. W. Wright, New York, U.S.A. Eng. Pat. 8394, May 30, 1890. 6*d*.

An aluminium salt is used in combination with bichromate of soda and sulphuric acid, or with other salts or acids. Such an electrolyte is said to be powerful and cheap.—E. T.

Improvements in Insulating Compositions for Electrical Purposes. A. N. Ford, London. Eng. Pat. 11,130, July 17, 1890. 6*d*.

Wood fibre, flax, cotton, or other fibrous material is coated repeatedly with linseed oil which has been oxidised by heating for some time with litharge or other oxidising agent to about 350° F., the whole being air-dried between each coating. After the weight has been thus increased 50 to 200 per cent. the mixture is ground up to a homogeneous mass, mixed with, say, 25 per cent. of gutta-percha or india rubber, again worked up, and finally rolled into sheets or blocks of convenient shape. There is thus great economy of gutta-percha or india-rubber.—E. T.

Improvements in Electro-Magnetic Separators for Extracting Metal from Slag and the like. P. W. Askham and W. Wilson, Sheffield. Eng. Pat. 11,690, July 26, 1890. 8*d*.

A number of electro-magnets are placed, in lines parallel to the axis, on the outside of a non-magnetic drum, so that their poles project through into the latter. The drum is inclined to the horizontal, and a mixture fed in at the higher end works its way in consequence to the lower end when the drum is rotated, and there falls into a shoot. In its passage, however, it comes in contact with the poles of the magnets, and the magnetisable portion sticks to these poles and is carried nearly to the top of the drum. As each series of magnets arrives at this position the electric current is turned off for a short time by a suitable commutator, and the material that was sticking to the poles drops into a trough supported a little above the axis of the drum, and is carried by a revolving worm to the outer end of the trough, and thus to a second shoot.—E. T.

Improvements in the Manufacture of Lead Wire suitable for Electrodes and other Purposes, and in Electrodes made of such Wire. J. and L. Legay, Levallois-Perret, France. Eng. Pat. 11,919, July 30, 1890. 8*d*.

A series of equidistant grooves are made in two similar rollers, such that the width of each groove is equal to the thickness of the wall between it and the adjacent ones. The two rollers are then mounted so as to revolve with parallel axes, and with the walls of each roller fitting into the grooves of the other. The rollers thus act as a series of circular shears, and lead sheet is cut by them into strips or wires. The shape of such wire can be altered by modifying the shape of the ends of the walls and bottoms of the grooves.

Electrodes are made by twisting such wires or by making cables of them and supporting in any suitable manner. Thus two cables, one right- and the other left-handed, are wound side by side over two horizontal bars forming the top and bottom of the future plate, in a sort of double thread, the juxtaposition of the opposing twists of the two cables being said to prevent buckling.—E. T.

Improved Compound for Electric Insulating Purposes. W. Sinclair, Hull, and B. S. J. Mackay, Belvedere. Eng. Pat. 12,013, July 31, 1890. 4*d*.

The insulating compound consists of sulphur 7 lb., clean pipeclay 1½ lb., slate dust 1½ lb., paraffin wax 2 oz., and a metallic oxide, say that of copper or iron, 5 lb. The oxide alters the colour, has a slight cohesive action, and increases the weight for commercial purposes.—E. T.

Improvements in the Methods of and Apparatus for Use in Recovering Tin from Waste Tinned Iron or Steel. W. Beatson, Rotherham. Eng. Pat. 12,200, August 5, 1890. 8*d*.

These improvements are in the details of the process described in Eng. Pat. 11,067 of 1885 (this Journal, 1886, 493). Waste tinplate is stripped by exposing it to the action of an electric current whilst immersed in a hot solution of caustic soda or potash. The solution (which contains about 3 lb. of alkali per gallon) is held in an iron tank provided with a series of iron plates connected with the cathode of the circuit, and with a series of iron pillars, on which are slung sheet-iron boxes, having two sides constructed of wire gauze and connected with the anode. The scrap tinplate is charged into these boxes, which are then immersed in the soda solution and the current passed. The tin is deposited upon the iron plates forming the cathode, and is subsequently scraped off, pressed into flat cakes, and purified by placing it in a strong solution of sulphate or chloride of tin and electrolytically redepositing it upon a revolving iron cylinder, on which it is condensed by tin rollers pressing on it.—S. H. A. A.

Improvements in or Relating to Electrical Batteries. E. Baffet, Brussels, Belgium. Eng. Pat. 12,763, August 14, 1890. 4*d*.

The object of this invention is to produce in the cell, oxide of zinc which has a higher marketable value than zinc itself. For this purpose the zinc is immersed in plain water in the porous pot, and a carbon electrode of large surface is placed in the outer vessel in the following solution: sodium nitrate 750 grms., sulphuric acid ("60° by the acid poise") ½ litre, distilled water 2½ litres. During action, oxide of zinc is deposited as a white mud in the porous pot.—E. T.

Improvements in Secondary or Storage Batteries. S. C. C. Currie, Philadelphia, U.S.A. Eng. Pat. 3331, February 24, 1891. 8*d*.

A conical rod of brass has a shoulder or expansion at its base to serve as a support for a woven tube of asbestos, which fits over such shoulder and reaches a little beyond the end of the coned portion which it encloses. Fused chloride of lead or other suitable salt is poured into the space between the tube and the cone. When cold, the latter is withdrawn, and its place supplied by melted lead. The chloride is then brought to the active state by electrolysis or other suitable method. As many of these rod-like electrodes as are required are then mounted vertically on lead connecting pieces at the bottom of the cell. The asbestos tube prevents damage from disintegration or scaling.—E. T.

An Improved Method of Electro-Plating Wire. T. L. Hemming, Birmingham. Eng. Pat. 5508, March 31, 1891. 6*d*.

Two drums or swifts are *immersed* in the electro-plating tank and the wire wound from one on to the other. The banks of wire make connection to rings in the drums, while the current is led into these rings by suitably supported brushes. The remainder of the specification relates to details of the bearings of the drums, methods of driving, &c. —E. T.

Improvements in Apparatus for Electrolytic Decomposition. C. Kellner, Vienna, Austria. Eng. Pat. 5547, March 31, 1891. 8*d*.

The apparatus is made like a filter-press, *i.e.*, with a number of frames of suitable material separated by porous diaphragms. Successive frames are alternately anode and cathode cells, the anode cells having an overflow to a channel on one side and the cathode cells to one on the other. All are supplied by a common channel at the bottom to which the diaphragms do not reach. The electrodes are carbon rods, so mounted and connected electrically as to be easily removed individually without stopping the working of the apparatus. When sodium chloride is being electrolysed, sodium hydroxide flows off into one side channel, and chlorine and chlorinated liquor into the other.—E. F.

Improvements in or Connected with Means or Apparatus Employed in Electrolysis. E. A. Le Sueur, Ottawa, Canada, U.S.A. Eng. Pat. 5983, April 7, 1891. 8*d*.

A large tank is half filled with the solution to be electrolysed. One, two, or more inverted cylindrical pans are placed in this with one edge of each raised so as to tilt it from the horizontal. The upper part of the pan contains a large positive electrode of gas carbon mounted so as to be easily raised or lowered in it. The mouth is covered with a diaphragm of parchment or other suitable material, immediately below which is the negative electrode of wire gauze. The caustic soda is thus formed in the large tank, the hydrogen readily escapes from the under surface of the diaphragm owing to its inclined position, and chlorine is collected from the top of the pan. Devices for sealing, making the electrical connections so that each pan can be attended to independently of each of the others, attaching the diaphragms, leading away the gases, &c., are described in a long specification with many drawings.—E. T.

Ozonizing Apparatus. J. Guenet, Paris, France. Eng. Pat. 6374, April 14, 1891. 6*d*.

See under XX., *page* 725.

Improvements in and relating to Voltaic Cells. G. Wester, Munich, Bavaria. Eng. Pat. 7168, April 25, 1891. 6*d*.

A battery cell, resembling an ordinary Leclanché, has the carbon of the latter replaced by copper in sulphate of copper, the zinc rod being in sal-ammoniac. The porous pot is specially prepared by dipping to one-third its height into paraffin wax and then filling with aqueous solution of ammonia. This is then poured out and replaced by copper sulphate, which is in its turn poured away and the pot allowed to dry. In this way a double sulphate of copper and ammonia fills the pores, and being insoluble in either of the battery solutions, prevents them from mixing. In one particular case the E.M.F. was 0·812 volt and resistance 4 ohms.—E. T.

Improvements in Storage Batteries. G. A. Washburn, Cleveland, U.S.A. Eng. Pat. 7715, May 5, 1891. 6*d*.

A loose lining of perforated lead is placed in a containing vessel, the space between the vessel and lining being filled with active material. Inside the lining is placed a porous pot containing more active material, connexion being made to the latter by perforated tubular lead conductors. In the centre of the pot is a large rectangular lead tube; when the active material expands, this tube alters in shape to accommodate the expansion and thus preserves the porous pot. The electrolyte is placed in the tubular conductors and in the space between the porous pot and the lead lining.—E. T.

XII.—FATS, OILS, AND SOAP MANUFACTURE.

Contributions to the Study of the Theory of Bleaching by Exposure to Air. A. and P. Buisine. Compt. Rend. **112**, 738—741.

When bees'-wax is exposed in thin layers to the air and to direct sunlight it is quickly rendered colourless, but in the dark, in presence of a free supply of air, oxygen, or ozone, no decolourisation whatever is effected, even after a long time. In presence of sunlight oxygen, and especially ozone, destroy the colour very rapidly, but the presence of oxygen is not absolutely necessary; when the wax is exposed to sunlight *in vacuo*, or in an atmosphere of carbonic anhydride, it is bleached, but much more slowly than in the presence of air.

The composition of the unbleached wax differs considerably from that of wax which has been bleached by exposure to air and sunlight; the latter contains a slightly larger percentage of free acids, but a large proportion of the unsaturated acids of the oleic series and of the unsaturated hydrocarbons in the crude wax have disappeared; this fact shows that in the bleaching process not only does the colouring matter suffer total combustion, but the unsaturated acids and the unsaturated hydrocarbons are converted into saturated compounds by the fixation of oxygen. This is also the case with other fatty substances such as suet, and the reason why the addition of 1—5 per cent. of suet to bees'-wax causes decolourisation to proceed more quickly is because the suet, in its oxidation or combustion, aids the destruction of the colouring matters; the addition of a small quantity of other oxidisable substances, such as essence of terebenthene, also hastens the action, so that it would seem that the destruction of the colouring matter is due to the formation of ozone by the oxidation of the added substance.—F. S. K.

Adulteration and Analysis of Bees'-Wax. A. and P. Buisine. Bull. Soc. Chim. 1891. **5**, 654—660.

See under XXIII., *page* 729.

African Palm Oil. Kew Gardens Bull. July 1891.

This Bulletin, in an article on the palm oil industry of the Western Coast of Africa, has the following:—

Of all the products of the Gold Coast the *Elæis guineensis* is undoubtedly the most important to the native. The fruit supplies him with a favourite food and two important articles of commerce; with the leaf stalks he builds his house and barn and thatches them with its leaves, and from the stem he extracts a pleasant and (sometimes) intoxicating drink. The tree prefers a moist soil, flourishing in the warm, damp valleys, where it grows in extensive forests. It has never been made the object of systematic cultivation, but, as far as can be ascertained, it begins to bear in its fourth or fifth year, increasing till its fifteenth, and continues to bear at least 60 years. It produces from four to seven bunches of nuts every year. As the "fatness" of the nuts (*i.e.*, the amount of oil contained in the fibre) differs greatly according to soil, the quantity of oil varies from three gallons per year in a moist soil to one gallon in dry. These nuts have a fibrous covering which contains the famous palm oil. Three varieties of the tree are distinguished, having orange, red, and black nuts respectively, the first giving the finest oil but small kernels, and others less oil but larger nuts. When the bunches of nuts are ripe they are cut and thrown into a hole in the ground till a sufficient quantity is collected to be made into oil. During this time the nuts appear to undergo a small amount of fermentation, and the produce is "hard" oil, the fresh nuts giving "soft" oil, which fetches a better price in the European markets. The quality of the "hard" oil is also deteriorated by the dirt which becomes mixed with the nuts while stored, to separate which no care is taken. When a sufficient quantity has been collected the nuts are boiled till the fibre is softened;

they are then heaped up in stone troughs specially prepared for the purpose, and beaten with sticks till the fibre is loose. The heap of nuts is then covered with plantain leaves and left for 12 hours, during which time great heat is developed and a quantity of oil runs off. The nuts are then washed in hot water and the fibre separated and squeezed by hand. The oil is then boiled to separate it from the water taken up in the washing.

This process is defective at every stage. To produce the finest quality and the largest quantity of oil the nuts should be treated when just ripe and fresh gathered from the tree. They should not be allowed to ferment, as this darkens the colour of the oil and causes it to harden. The separation of the fibre by beating and hand squeezing is slow and gives very imperfect results, and should be replaced by machinery in the first stage and hydraulic presses in the second. At present quite 25 per cent. of the oil is lost, first by imperfect separation of the fibre, a large quantity of which is left adherent to the nuts, and second by want of power in the squeezing, which fails to extract the whole of the oil. Finally, the last boiling further darkens the oil, as palm oil changes colour according to temperature. Pure fresh palm oil has an agreeable smell (it has been described as resembling that of plum cake), and is of a bright orange colour; but the oil of commerce, owing to faults of manufacture, has a stink absolutely indescribable, and every shade of colour between golden yellow and black. In the Western province the quality is further deteriorated by adulteration. At Salt Pond a peculiar fine red earth is used for mixing by the middlemen. In the Chama district the oil is mixed with over-ripe plantains and sour kanki. Accra may be considered the dividing line of the two sorts, the oil made in that district and to the eastward being soft, that made to the westward being hard. The soft oils are in general purer than the hard; these being less able to incorporate foreign substances, the adulteration is almost confined to the mixture of water. To show the effect of adulteration nothing more is necessary than to compare the position of Lagos oil (which is the purest known) with that of Gold Coast oil on the European market. When Lagos oil sells for 22*l.* 10*s.* per ton, Accra oil (which includes Addah and Quittah sorts) fetches 19*l.* 10*s.*, and Salt Pond (including Winnebah, Appam, and Chama sorts) 18*l.* only, or 20 per cent. less than Lagos sorts. No doubt some of the superiority of Lagos oil is inherent in the article, but having in view the amount of adulteration in the oil from the Gold Coast, it is not unreasonable to expect that the production of a purer oil and the adoption of the Lagos "cold" process of manufacture (as distinguished from the Gold Coast "hot" process) would approximate prices. It is impossible to pass from this subject without referring to the fluctuations in the price of palm oil which have occurred during the last few years. It is the difficulty of transport that keeps the price on the Gold Coast at such a height as renders the present state of the markets in Europe unprofitable to the exporter, although the grower can produce it at a cost which would enable him to sell it with profit at 3*d.* to 4*d.* per gallon. Allowing 300 gals. to the ton, the cost to the exporter would be 3*l.* 15*s.* to 5*l.* per ton, which, after paying for caskage, shipping, &c., and allowing 1*l.* per ton for transport from the plantation to the beach, would enable him to place it on the European market at 13*l.* per ton. In view of the increasing use of other fats, displacing palm oil in many directions, the inhabitants of the colony have to face the probability of the price of palm oil touching 15*l.* to 14*l.* per ton, and have the right to call upon their Government to perform its obvious duty by putting the roads in such a condition as to enable them to transport their produce at a reasonable cost, and to prevent their staple produce being driven from the market to the ruin of their trade. After the manufacture of the oil the nuts are still valuable, as they contain the well-known palm kernels. For every ton of palm oil there should be 2½ tons of clean palm kernels, and yet we find that the exports of this article are much below those of the oil. The direct loss to the colony is enormous, and arises from the same causes as diminish the export of oil. Machines have been invented by Connell and others for the purpose of rapidly breaking the nuts, but they can never come into general use until it is possible to move large weights in carts along roads adapted to the purpose, as will be evident when it is considered that under present conditions four men are required to carry, on their heads, sufficient nuts (2 cwt.) to produce 56 lb. of kernels, the value of which varies from 1*s.* 9*d.* to 2*s.* 3*d.* Owing to this cause 100,000*l.* worth of this one article are annually wasted. The palm kernels are exported to Europe, where the oil is extracted, but this might be done on the coast if it were possible to put oil mills on the plantations or to convey nuts cheaply to central mills, and would probably be found more remunerative than the exportation of the kernels. The average yield of the kernels being 30 per cent. of their weight in oil, the utilisation of the whole estimated crop would produce 8,700 tons of oil per annum, which at the price of cocoa-nut oil (which it closely resembles) would be worth to the colony over 175,000*l.* To this must be added the value of the cake after the expression of the oil. The brown or black oil made by the process now in use in the country is not worth exporting, as it can be only slightly bleached, and is therefore useless for soap-making.

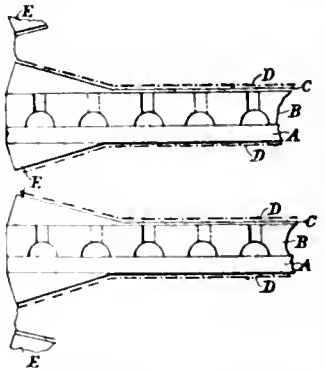
PATENTS.

Improvements in the Manufacture of Soap. R. Cuffe, London. Eng. Pat. 10,953, July 14, 1890. 4*d.*

A HARD neutral potash soap is obtained by the addition of 2 per cent. of chloride of potash and 5 per cent. of carnauba wax to stearate of potash. This soap possesses, according to the patentee, curative and prophylactic properties for gout, caustic potash and chloride of potash having no injurious effect on the blood, but are beneficial in neutralising urie acid. When ordinary alkaline soda soap is used the caustic soda set free is absorbed by the blood, on which it has injurious action.—K. E. M.

Plates for Oil and other Presses. W. C. Leechman, Colombo, Ceylon. Eng. Pat. 9526, July 19, 1890. 6*d.*

WITH a view to introduce good drainage on the surface of press plates by eliminating the clogging of the presses and the damage to the cloths, the patentee describes the arrangement in the press as shown in the accompanying figure, which represents a vertical section of a part of a press fitted with plates according to invention.



PLATES FOR OIL PRESSES.

AA, the plain press plates now generally in use; BB, extra plates grooved on one side; holes lead from the grooves to the ungrooved surface; CC, finely perforated thin plates; these are not required for moderate pressures of about half a ton to the square inch, but necessary for high pressures, when the fine perforations of the thin plates "throttle" the orifices of the holes in the grooved plate; DD, filter cloths; EE, rings with inclined surfaces, to prevent the material from spreading outwards.—K. E. M.

Improvements in the Manufacture of Soap. J. Baptista, Philadelphia, U.S.A. Eng. Pat. 11,360, July 21, 1890. 4*d*.

By the action of caustic soda solution on white rosin the inventor obtains a jelly, one pound of which is mixed with about one gallon of cotton-seed oil, and the mixture boiled. A suitable mineral oil is added in the proportion of half a gallon to one barrel and half a pound of chloride of lime dissolved in a little water to every 20 barrels of the soap stock mixture described above. This mixture after well boiling through is now ready to be introduced into the soap copper, where 25—35 per cent. of it is used in the composition of the boiling soap.—K. E. M.

An Improved Manufacture of Saponifiable Fatty Matter from Wool-Fat. I. Roos, Frankfort-on-Maine, Germany. Eng. Pat. 12,373, August 7, 1890. 4*d*.

Commercial dark brown coloured wool-fat is partially saponified by alkaline solutions and the resulting emulsion mixed with water. The cholesterines, &c., separate from the saponified materials, which latter either immediately or after being repeatedly subjected to the process may be decomposed by dilute acids yielding a light coloured fatty product suitable for the manufacture of soap. The unsaponified cholesterines thus separated can be employed for the manufacture of wax and other purposes.—K. E. M.

Improvements in or Appertaining to the Production of Odourless Wool Grease. C. A. Feuerlein and J. C. Lahusen, Delmenhorst, Germany. Eng. Pat. 13,634, August 30, 1890. 6*d*.

The inventor substitutes sulphurous acid for the mineral acids generally used in the recovery of wool grease from the waste water from wool washing and combing factories. The wool grease obtained from the grease sludge precipitated by mineral acids from the soapy water has an unpleasant odour due to sulphuretted hydrogen from the sulphides contained in the wool yolk. This odour is avoided by the use of sulphurous acid which converts the sulphides into sulphites, hyposulphites, and sulphur.—K. E. M.

Improvements in the Manufacture of Soap Tablets. F. W. Ostrom, Bridgeport, U.S.A. Eng. Pat. 14,339, September 11, 1890. 8*d*.

The invention consists in a device for compressing soap by the stamping machine around a suitable anchor provided with an eye which extends outside the soap and by which the tablet may be fastened to a chain. For details consult drawing accompanying specification.—K. E. M.

Improvements in Soaps for Diseases of the Skin. C. R. Illingworth, Clayton-le-Moors. Eng. Pat. 17,275. October 29, 1890. 4*d*.

Boracic acid is incorporated into a super fatted soap containing no free alkali with a view to combine cleansing and disinfecting action upon the skin.—K. E. M.

XIII.—PAINTS, PIGMENTS, VARNISHES, RESINS, INDIA-RUBBER, Etc.

The Composition and Manufacture of Chromium Pigments. C. O. Weber. Dingl. Polyt. J. **279**, 139—144, 210—213, 232—235, and 284—287.

1. Pigments containing Chromic Acid.

For the preparation of lead chromates, both soluble and insoluble lead salts are employed, but while the latter are much cheaper to use, it is universally admitted that the best chrome yellows are only to be prepared from the acetate, no other salt giving such a large variety of shades as well as other desirable physical properties. The lead acetate is preferably made from litharge in a lead-lined hemispherical iron pan fitted with a steam pipe passing to the bottom; in this is placed about half the necessary amount of acetic acid of 30 per cent. strength (6° B.), the pan being of such a size that it is about one-third filled. The liquid is then heated to the boiling point, and the litharge, which has been previously reduced by grinding under edge-runners with water to a fine cream, is run in through a sieve with constant stirring. Steam is again turned on for a few minutes, and when the liquid begins to boil, solution rapidly takes place. To convert this basic salt into the neutral acetate, the remainder of the acid is added gradually until a few drops of the liquid no longer give a precipitate with a 5 per cent. solution of mercuric chloride.

Basic lead acetate, $Pb(C_2H_3O_2)_2 . 2\,Pb(HO)_2$, has been recognised for a long time as the best source of chrome oranges, and later experiments have shown that in spite of certain difficulties in the manufacture, it is also admirably adapted for the manufacture of other chromes varying in shade from the softest lemon to the deepest scarlet; in fact, that neither in cost nor in beauty of shade can it be beaten by any other lead salt. It is prepared in the previously-described pan, which for this purpose should hold about 300 litres, by taking 76 kilos. of 30 per cent. acetic acid and heating to about 90°, the admission of steam being so regulated that the temperature remains above 70°. 120 kilos. of litharge are then added in the state of a cream as in the preparation of the neutral salt, a stiff brush being constantly worked about in the sieve to hasten the process. When all the litharge has passed through, the sieve is washed out with hot water, the brush being used all the time. The success of the operation depends largely on the speed of addition of the litharge and on the fineness of the sieve, which should not be less than No. 120, and great care must be taken that none of the cream is poured directly into the acid, as in this case, hard lumps are formed which fall to the bottom and escape the action. Thorough stirring must also be kept up the whole time, until the mass is seen to thicken and to change in colour to a pure white; should it then prove too thick for further manipulation, more hot water is added, but the addition of much water, whether hot or cold, is to be avoided as it slows the action. When the reaction is complete the pan is covered with a wooden lid and allowed to stand 12 hours. It should then form a very hard white mass in which no lumps and unchanged litharge are visible.

For conversion into chromate the basic acetate need not be dissolved in water, suspension being sufficient, and this may be attained by working it through a fine sieve by the aid of a brush as previously described, but seeing that the amount of metallic lead which is present in all commercial litharge is apt to spoil the shade of the chrome, it is better to run it through an ordinary paint mill, when the free lead will be found to remain in the grooves of the stones, and can easily be removed at the end of the operation. It is advisable to set up the mill in such a position that the cream after grinding can run direct into the precipitating tank.

The litharge employed for the manufacture of either normal or basic acetate must be as pure as possible, the presence of small amounts of copper being extremely prejudicial. To test for copper, 10 grms. of the litharge should be treated in a beaker with 20 cc. of ammonia, to which a few

drops of nitric acid have been added; after thorough stirring the whole is allowed to rest for six hours and filtered. The filtrate is acidified with acetic acid and a few drops of a 10 per cent. solution of potassium ferrocyanide added, if anything more than a slight brown colour is noticeable, the sample must be rejected. Of great importance also is the physical condition of the litharge, and in all cases a laboratory experiment on the case of conversion into the basic acetate should be tried before the substance is used on the large scale.

A.—The Chemistry of Lead Chromates.

Normal lead chromate, formed by the decomposition of lead acetate by potassium bichromate, although possessing when freshly precipitated a very brilliant sulphur-yellow colour, is rarely employed in commerce except for the production of green lead glass. The reason of this lies in the fact that during the prolonged washing necessary to free it from acid, its colour is liable to alter to an orange yellow, which will not bear dilution without giving very unpleasant and dirty shades. The exact cause of this change has yet to be explained, but it seems probable that it is due to a crystallisation of the chromate. It is not even possible to prevent it with certainty, but it is advisable to work with at least 5 per cent. excess of lead, to use the solutions as dilute and cool as possible, and to keep stirring during and for some time after the precipitation. Yellows of similar chemical composition show very different shades, according to the amount of the excess of lead present during the precipitation, being the more brilliant in colour the greater the excess. If the precipitation takes place in the presence of sufficient sodium carbonate to neutralise the whole or greater part of the nascent acid, the resulting chrome shows much less tendency to change. The American "chrome yellow for the production of chrome green," a pigment which owing to the peculiarity of its shade is unsaleable as a yellow, but is better adapted for mixing with Prussian blues than any other chrome, owes its non-liability to change to the large excess of lead present during precipitation as well as to the neutrality of the solutions. In this case the absence of free acid is attained by adding one part of crystallised tartaric acid to ten of the bichromate in concentrated solution, the result being a mixture of the normal salt with chromium chromate.

On the large scale the manufacture of lemon chromes of the formula $PbCrO_4$ by the action of a large excess of lead during precipitation with the bichromates becomes impossible owing to the great expense. They are usually prepared by the simultaneous action of chromates and sulphates on the lead salts, the larger the proportion of sulphate the paler the shade of the resulting pigment. These lemon chromes are said by the manufacturers to be "chemically pure," the lead sulphate being regarded as an integral part of the substance and not as an adulterant. The probability is that they consist of a double compound of lead—a sulphochromate—in spite of the facts that on precipitation the chromate falls first, and that on treatment with sodium thiosulphate, lead sulphate is extracted. This first peculiarity is due simply to the heat of formation of the chromate being much greater than that of the sulphate; for simultaneous precipitation could only be expected if the two amounts of heat were nearly identical. The lead sulphate is also only partially soluble in thiosulphate, and the shade of the resulting chrome is different from any directly prepared. The colours of the different lemon chromes cannot be imitated by mixing together lead chromate and sulphate, however intimately. These complex chrome yellows are much less liable to change of colour during washing than the simple chromate, but it is still advisable to precipitate them in the presence of a small excess of lead acetate.

Although possessing the same chemical constitution ($PbCrO_4 + PbSO_4$) lemon chromes prepared by different processes possess very different shades of colour and also vary considerably in their other physical properties, such as hardness and covering power. In Table I. are given five different mixings for the production of such chromes, and it will be found that the colour becomes regularly darker from 1 to 5, while 1 yields hard and brittle lumps which gradually get more flocculent and spongy till 5 is reached. The first are also more suitable for lithography and the preparation of coloured papers, while the latter are best used in oil as paints.

Table I.

——	1.	2.	3.	4.	5.
$Pb(C_2H_3O_2)_2 3Aq$	400	400	400	400	400
$K_2Cr_2O_7$	73·75	73·75	73·75	73·75	73·75
HNO_3	49	..	..	..	..
$Al_2(SO_4)_3 18Aq$.	..	166·5	..	166·5	..
Na_2SO_4	..	..	71·0	..	71·0
Na_2CO_3	..	..	..	26·5	26·5

The cause of these differences evidently lies in the diminishing acidity of the foregoing formulæ, this being one of the most important factors in the manufacture of chromes. The nature of the free acid is also of great importance, and if the lead acetate is replaced by the nitrate the resulting shades as well as the other properties of the chromes become very different. Free nitric acid also causes considerable swelling of the chrome, the mass becoming quite spongy in appearance; and as this swelling is in proportion to the amount of acid present, if the acetate in Table I. be replaced by the nitrate, 1 will yield a very bulky product, 5 being close and heavy. Many consumers value this spongy appearance very highly; it is therefore often induced by the addition to one of the wash-waters of sufficient acid to make it contain about 1·5 per cent. of HNO_3.

The regularity of the changes of shade caused by slight variations in the composition of the precipitants when soluble lead salts are employed disappears completely when insoluble or only slightly soluble compounds are substituted for them, and other substances have to be added and other methods of treatment employed which are incapable of classification. In the manufacture of chrome oranges the variations are much smaller, the yellowness or redness of the shade being strictly dependent on the weak or strong alkalinity of the liquids.

By treatment of chrome yellow with caustic or carbonated alkali they are converted into oranges, which can be made of as red a shade as desired by the employment of a sufficiently concentrated solution, the absolute amount of alkali added not having any relation to the resulting colour. A large number of experiments conducted by the author show that not more than 73·65 per cent. of the lead chromate can be converted into the basic compound in this way without danger of decomposing it entirely, and the process has the further disadvantage of causing the loss of the dissolved chromic acid, as the solutions cannot be economically worked up. For the avoidance of this loss several methods are available, each of which possesses its advantages, yielding an orange specially suitable for one particular process. The simplest is to precipitate a solution of basic acetate of lead with sodium chromate, the proportion between the numbers of molecules of litharge and normal acetate being varied according to the shade required. If this proportion is 1:2, the resulting orange has the formula $Pb_2(OH)_2CrO_4$, being the most basic it is possible to prepare, and therefore the deepest in colour; on increasing the litharge to its maximum (2:2) other compounds are formed, *e.g.*, $1\frac{1}{2}$ $PbCrO_4$, $\frac{1}{2}$ $Pb(OH)_2$, together with free caustic soda, which has the valuable property of causing the shade to be very deep and fiery, the decomposition, however, must be conducted at a high temperature (80° C.) to avoid the admixture of free lead hydrate which would spoil the colour. It is also possible to reduce the proportion of the litharge below that of 1:2, in which case various oranges may be produced having shades intermediate between the chrome yellow and chrome red; they, however, become more expensive to prepare, inasmuch as more acetic acid passes into the by-products.

From the lemon chromes having the general formula $PbCrO_4$, $PbSO_4$ various shades of chrome orange can be prepared by the action of caustic soda without loss of chromic acid, the less sulphate in the original substance, the yellower being the shade of the resulting orange. The lead sulphate is probably decomposed in the following manner:—

I.

$$2\,PbSO_4 + Na_2CrO_4 = PbCrO_4, PbSO_4 + Na_2SO_4$$

II.

$$PbCrO_4, PbSO_4 + 2\,NaHO = Pb_2(OH)_2CrO_4 + Na_2SO_4$$

Chrome orange so prepared, though slightly more expensive than that made as before described, possesses an exceptionally fine colour and a high degree of density.

The soluble lead salts may be replaced as a source of chrome yellows by the cheaper insoluble compounds, such as white lead, basic chloride, and also specially prepared sulphate, the ordinary sulphate of commerce being usually too impure for the purpose. The action of the normal or acid chromates on white lead is to produce yellows of such a bad colour as to be useless, but good results are obtained by converting a small quantity of it into either acetate or nitrate by the addition of the respective acid; on the addition of the precipitating mixture the soluble portion is attacked and part of the original acid set free, this action proceeding until the whole of the white lead is converted into chromate. A portion of the liberated acid is neutralised by the alkali of the bichromate, and in the production of pale yellows care must be taken to add in the first place enough acid to combine with the whole of the metal of the chromate employed, lest the shade should be injured by the action of the free alkali. The sulphuric acid used in the precipitation (cf. Table I.) must not be taken into account in this calculation. If the basic chloride of lead is used instead of white lead, the same process is employed. Sulphate of lead prepared from the basic acetate is admirably adapted for the production of certain shades of yellow, but it should not be dried, but employed in the form of a paste, and great care must be taken to keep it in excess during the reaction. Should the shade of the chrome not be dark enough, a small addition of soda should be made to one of the wash-waters.

B.—The Technology of Chrome Yellow Manufacture.

The following formulæ for the production of various yellows are given as embodying the considerations mentioned above:

1st. For Soluble Lead Salts:—

	Kilos.
Lead acetate	100
Potassium bichromate	18
Sulphuric acid (66° B.)	12

This mixture yields a yellow of the formula $PbCrO_4$, $PbSO_4$. To obtain good shades the amount of water employed should not be less than 1,000 litres, or double as much with the nitrate. In the latter case it is better to neutralise the lead nitrate and to replace the acid by the sulphate of an alkali or magnesium, or preferably aluminium; for the neutralisation of the bichromate the best substance is magnesite. The formula thus becomes: lead acetate and bichromate as before; magnesite, 6 kilos.; and aluminium sulphate, 27 kilos.

2nd. The Basic Acetate Method.—Litharge, 76 kilos., acetic acid (30 per cent.), 42; bichromate, 21·5; sulphuric acid, 21·5; water, 2,000 to 3,000 litres. To obtain a denser chrome 10 kilos. of soda should be added to the acetate and 5 of the sulphuric acid replaced by 10 of aluminium sulphate. For the production of an orange chrome the following formula is given: Litharge, 76 kilos; acetic acid (30 per cent.), 42; bichromate, 24; Solvay's soda, 15; and caustic soda (100 per cent.), 5. Care must be taken that the temperature does not rise sufficiently high to spoil the shade.

3rd. The White Lead Method.—In this case the white lead must be in the finest state of subdivision possible and suspended in the water; white lead, 100 kilos; nitric acid (36° B.), 12; bichromate, 13; and aluminium sulphate, 10; or nitric acid (40° B.), 44; bichromate, 24; sulphate, 20, the latter giving the more fiery shade. For the production of an orange, white lead, 100 kilos.; nitric acid (36° B.), 18; bichromate, 28; and caustic soda, 8, the latter being best added to the bichromate before precipitation, and the temperature kept between 65° and 75° C.

4th. The Basic Chloride Method.—The same proportions and temperature are suitable here as in the case of the white lead.

5th. The Sulphate Method.—Lead sulphate, 100 kilos.; bichromate, 24—45; Solvay's soda, 8·75—16; ammonia (24 per cent.), 1—2; and acetic acid (30 per cent.), 5—10. The sulphate in the form of a cream being gradually added to the other ingredients after solution.

C.—Zinc Chromates.

Although it is possible to prepare lead chromates having shades varying imperceptibly from the palest lemon to a deep granite-red, in the case of the zinc compounds scarcely any variation from the normal is possible, this being, however, different from anything obtainable with lead. Zinc yellows fall considerably below the ordinary chromes in their colouring power, but they are faster in light and are less poisonous. More than 80 per cent. of the amount annually made in Germany is used for the production of zinc green by mixing with Prussian blues, of which substance Holland, Switzerland, and Hungary are the greatest consumers. The zinc yellows met with in commerce vary in their constitution considerably, being usually acid chromates of zinc and potassium; basic zinc chromates being rare. Ordinary salts of zinc invariably contain small amounts of iron, which must be removed before they are used in the manufacture of colours. The simplest method is to heat them with the quantity of permanganate theoretically necessary to convert all the iron present into the ferric state, adding zinc hydrate, which need not be free from iron; after thorough stirring the whole is allowed to settle and filtered, when the liquid will be found not to contain a trace of iron. On the addition of chromate to such solutions a yellow precipitate ($ZnCrO_4$) falls, but owing to its great solubility in the liquid this process is valueless. By using an excess of bichromate the zinc chromate combines with some of the alkaline salt, forming the compound $(ZnCrO_4)_3K_2Cr_2O_7$ which may be washed without loss, but on drying yields an extremely hard sandy powder, possessing, in spite of its fine colour, no value as a pigment. By neutralising the two solutions before precipitating, a much higher yield of chromate is obtained, but still so much chromic acid is lost as to make the process too expensive to pay; formerly an addition of calcium chloride was made to the neutral solutions so as to precipitate some of the acid as calcium chromate which remained mixed with the zinc salt. The best results, both in regard to yield and colour, are obtained by adding to the zinc salt sufficient alkali to decompose one quarter of it, so that the chrome may have the formula $(ZnCrO_4)_3ZnO$; to the bichromate enough alkali should also be added to convert it into the normal salt. It is to be remarked that the nature of the metal combined with the chromic acid has the greatest influence on the shade of the zinc yellow, so much so that in manufacturing "acid" zinc yellow, the use of sodium bichromate is inadmissible. A basic zinc yellow prepared from the sodium salt has a redder and more cloudy shade than one made from the potassium compound, but the difference is hardly noticeable when sodium-potassium chromate is employed.

Modern zinc yellows are invariably prepared from acid solutions, and consist of a double salt of zinc chromate and potassium bichromate, mixed with a varying amount of unchanged zinc oxide, which must not be regarded as an adulteration of the pigment, as its presence gives the substance "body." As previously stated, sodium bichromate is inadmissible, as it does not form similar double salts. The raw material is usually zinc oxide, which is met with

in a state of great purity; by the addition of sulphuric acid this is converted into basic zinc sulphate, potassium bichromate solution is added and the whole stirred vigorously for an hour. At the end of this time the zinc chromate which was previously in a state of partial solution, begins to separate out in the form of a brilliant yellow scum on the surface of the liquid consisting of $(ZnCrO_4, K_2Cr_2O_7$, while the solution rapidly becomes almost colourless. Suitable proportions are: zinc oxide, 100 parts; sulphuric acid (66° B.), 60; and potassium bichromate, 100. Although it is hardly possible that any hydration takes place, it is found advisable to soak the zinc oxide in water for 24 hours before the other reagents are added, the sulphuric acid after dilution being added gradually. Great care must be taken that the solutions are all cold and the stirring is continuous to avoid the pigment being deposited in a hard sandy form. Zinc yellows thus prepared are not liable to change during washing in a manner analogous to the lead compounds.

II.—Pigments containing Chromium Oxide.

Chromium oxide alone is of no value as a pigment, as useful shades can only be prepared from mercurous chromate or from a mixture of ammonium bichromate and picric acid, both of which processes are far too expensive. Of the various pigments containing chromium oxide by far the best is Guignet's green, an oxyhydrate of chromium of the formula $Cr_2O(OH)_4$. This being absolutely unchanged by light and being scarcely affected by any chemical action, is much employed for lithography, bank note and calico printing. The process for its manufacture consists in melting together at a low red heat potassium bichromate and boric acid, the resulting chromium borate being decomposed by the action of water into the oxyhydrate. Formerly the fusion was conducted in ordinary reverberatory furnaces, but now muffles are generally employed, in which the temperature is much more easily regulated. Other pigments of this class mostly contain chromium phosphate, the best, having regard to the cost as well as the colour, being Plessy's green. This is prepared by reducing a mixture of bichromate and monocalcium phosphate with sugar. Other pigments of considerable technical interest are the chromium silico phosphates and their double salts with the phosphates of the alkaline earths. Under certain conditions it is possible to prepare from them colours of unsurpassable beauty and purity. They are made by reducing with sugar a mixture of bichromate, silico phosphoric acid and calcium or barium phosphate. By the simple precipitation of chromium salts by solutions of silico phosphates no useful results are obtained.—F. H. L.

The Discovery of Ultramarine. J. Heintze. J. prakt. Chem. **43**, 98—105

At the time when Gmelin and Guimet were disputing as to the priority of discovery of artificial ultramarine, the chemist to the Royal Porcelain Manufactory at Meissen, Kotting, independently discovered a method of manufacture of that substance. In the spring of 1828, this chemist, whose claims have not been fully recognised, was engaged in an attempt to make a lead free fusible glass, using for this purpose a mixture of sodium silicate and pure clay, and, after strongly heating the same, observed that a blue coloured substance was produced in small amount. He continued his experiments now with the object of discovering a suitable method of manufacturing the blue substance, and found that he could regularly produce it from a mixture of sodium sulphate, silica, charcoal, and clay. Subsequently, however, he modified the composition of this mixture and selected soda crystals, kaolin, powdered brimstone, and charcoal, as the best materials. The manufacture of ultramarine at Meissen was abandoned in 1870, but as the quality of the product made there was, in its time, considered superior to most of that made elsewhere, the author gives a detailed account of the method of manufacture followed there.—T. H.

Manganese Sulphide as a Pigment. P. de Clermont and H. Guiot. Bull. Soc. Chim. 1891, **5**, 480—482.

The flesh-coloured, hydrated manganese sulphide which is obtained by the addition of ammonium sulphide to a solution of manganese chloride, on standing, or more rapidly on boiling with water, changes colour to green. This green sulphide when washed and dried, yields a powder of the same colour, which is also unstable, being oxidised by mere exposure to air. It is, however, rendered permanent by removing its water of hydration, which is effected by heating it moderately in a current of hydrogen sulphide, carbon dioxide, or ammonia. Thus prepared it is suitable for application in paper staining, printing, &c.—E. B.

Action of Metals, Salts, Acids, and Oxidising Agents on India-Rubber. W. Thomson and F. Lewis. Proc. Manchester Lit. and Phil. Soc. [4] **4**, April 1891. (See also this Journal, 1885, 710.)

The method adopted was to take a fine sheet of india-rubber spread on paper and vulcanised by the cold process with a mixture of chloride of sulphur and carbon bisulphide, and to examine the action on this of the various substances; on breaking the paper the fine sheet of caoutchouc was left free, so that its stretching properties could be examined.

Action of Metals.—The various metals, whose action was studied, were used in the form of filings sprinkled on the rubber. The whole was then kept at a temperature of 60° C. for ten days. Copper was found to have by far the most injurious action. Platinum, palladium, aluminium, and lead have a very slight action, but magnesium, zinc, cadmium, cobalt, nickel, iron, chromium, tin, arsenic, antimony, bismuth, silver, and gold have none.

Action of Metallic Salts and Oxides.—Saturated solutions were made in water and painted on small pieces of the rubber, or in the case of insoluble substances pastes were made with water and painted on, the whole being then allowed to dry. The heating was subsequently carried out as before. The following compounds of copper entirely destroyed the rubber:—Sulphate, chloride, nitrate, ferrocyanide, oxide, sulphide, also arsenic iodide, silver nitrate, strontium chlorate, vanadium chloride, manganese oxides, bismuth chloride. The following had an injurious effect:—Ferrous nitrate, sodium nitrate, uranium nitrate, ammonium vanadate. The following had very little action:—Lead chromate, ferrous sulphate, zinc acetate, zinc chloride, tin perchloride; whilst the behaviour of about 60 salts having no action whatever, was examined.

Exceedingly small quantities of copper salts are injurious to rubber, and it was found that wherever the cloth used in making proofed cloths contained even traces of copper, the rubber became gradually hardened and destroyed. With reference to the use of the various blacks the authors point out that manganese oxides should not be present, but they assert that logwood chrome blacks may be used with impunity.

Action of Acids.—Very dilute solutions of hydrochloric, sulphuric, chromic, citric, or tartaric acid are stated not to be prejudicial, but nitric acid rapidly attacks rubber. A solution of sulphuric acid containing about 10 per cent. of H_2SO_4 destroys the properties of the rubber.

Action of Hydrogen Peroxide.—Since ozone rapidly attacks india rubber, and in view of the fact that chromic acid has only slight action, samples of rubber were placed in both acid and alkaline solutions of hydrogen peroxide for a month. Such treatment has no appreciable injurious action.—T. L. B.

The Applications of Gutta-percha. Lagarde. Ann. Télégraphiques, **18**, 1891, 5. Proc. Inst. Civil Eng. **105**, iii. 93—99.

Gutta percha, as found and used, especially in the manufacture of submarine cables, is a combination of several substances. The experiments made by the author and

detailed in this paper were undertaken with the view of ascertaining the influence possessed by each of these substances on the insulating power of the gutta-percha. The substances regarded as pure gutta-percha is accompanied by two resins—fluavile and albane, which exist in varying proportions in the commercial product. The more fibrous a gutta-percha is the better is its quality for most of the purposes for which it is used. Its specific gravity is greater than that of water, but apparently less on account of the air which is enclosed. Pure gutta-percha being insoluble in ether and alcohol, while the accompanying resins are soluble in these liquids, a complete separation of the resins can be effected by boiling the raw material in absolute alcohol. The albane being soluble in boiling alcohol only, advantage is taken of this property to separate it from the fluavile. The mineral constituents of gutta-percha being present in very small proportion—in no case above $\frac{1}{2}$ per cent.—were not specially considered in these experiments. As the result of a series of tests it was found that the greater the proportion of pure gutta-percha in a given sample, the less was its insulating power, and the author therefore recommends that, in specifying the qualities to be possessed by cables insulated with gutta-percha, it is advisable to fix a maximum as well as a minimum of insulation.

Experiments were also made to ascertain the influence of the water contained in gutta-percha on its insulating power. It was found that the power of insulation diminished in proportion to the percentage of water, all other conditions being similar.

Thin sheets of gutta-percha were exposed to air and water respectively for two months, after which time it was found that the proportion of resins had increased at the expense of the pure gutta-percha. When the material contained a large proportion of water in the first instance the change took place more rapidly, and for this reason the author considers that the percentage of water in the gutta-percha insulation of cables should not exceed 5.

In order to test the influence of exposure to the air on the insulation of cables, a length of 1,000 metres (1,093 yards) was tested at intervals of one month, when the insulation was found to be better and the proportion of resins in the gutta percha greater than at the date of manufacture. It is therefore important that cable-tests should be carried out at a definite interval from the date of manufacture.

As a result of his experiments, the author recommends that, for telegraphic cables with gutta-percha dielectric, the proportion of resins contained in the material used should be specified, and that the proportion of mineral matter should not exceed $\frac{1}{2}$ per cent, and of water 5 per cent. The insulating power of the pure gutta-percha was found to be about three-quarters of that of the commercial substance before the separation of the resins.

PATENTS.

An Improvement in the Manufacture of Ultramarine. R. W. E. McIvor, London. Eng. Pat. 9200, June 13, 1890. 4*d*.

The inventor has found the following proportions of raw materials to yield excellent results:—sodium sulphide, 42 lb.; sulphur, 20 lb; kaolin (China clay), 110 lb.; soda (as carbonate), 106 lb.; or caustic soda, 40 lb. These quantities yield about 2 cwt. of ultramarine blue. The clay and soda are first roasted together at a red heat so as to effect partial double decomposition and the product is ground. "Sulphur liquor" is then made by dissolving flowers of sulphur in a solution of sulphide of sodium to saturation. The ground material is then made into a thick paste with the sulphur liquor, the paste dried in an oven and the dried mass broken into small pieces, is roasted without access of air in a closed earthenware retort first at 250° to 300° C. for an hour, then at a red heat for eight hours, and finally just below dull redness in presence of a slow regulated current of air. The retort must be quite cold before being opened.—E. G. C.

An Improved Copying Ink. W. S. Conrad, Southsea. Eng. Pat. 10,491, July 5, 1890. 4*d*.

A saturated solution of a deliquescent salt, preferably nitrate of ammonium, is added to a "strong, slowly-drying ink, containing from one-fourth to one-half glycerin, but made without acids."—E. G. C.

A Novel Manufacture of Oil Paint in Sheets, applicable for Rendering Fabrics and other Materials Impermeable to Moisture, or for Decorative and similar Purposes. J. A. Maynard, Paris, France. Eng. Pat. 11,780, July 28, 1890. 6*d*.

Unsized paper, free from blisters, &c., is coated with an aqueous solution of dextrin. When this coat is dry a layer of siccative oil paint is applied: and the sheet so obtained may be used for packing purposes, to render fabrics impermeable to water, &c.—E. G. C.

A Process for Oxidising and Drying Vegetable Oils and Utilising the same for the Manufacture of Floor Cloth and like Products. F. Walton, London. Eng. Pat. 12,000, July 31, 1890. 4*d*.

With a view to accelerate the oxidation of drying oils the inventor forces air through the oil kept at about 100° F. under a pressure of 5—10 atmospheres. The air and oil are thoroughly mixed by agitators and by perforated plates, through which latter the air is forced. Vapour of turpentine or other oxidising agent may also be mixed with the air. With the gradual solidification of the oil the speed of the agitator is reduced so that the oil is ultimately obtained in a granular condition. To prevent ignition the oil is cooled before being discharged into the open air. If to be mixed with rosins and gums to form cement for the manufacture of linoleum, &c., these substances should be fused before addition of the oil.—K. E. M.

The Application of Certain Waste Materials for the Production of a New or Improved "Mineral White," and Improvements in the Process of Manufacture. J. J. Lee, Manchester. Eng. Pat. 12,085, August 1, 1890. 4*d*.

Waste plaster of Paris moulds are scraped, brushed, or scrubbed, broken up into small pieces, subjected to heat if necessary, and then ground to fine powder.—E. G. C.

Improvements in the Manufacture of White Lead and in Apparatus employed in such Manufacture. E. V. Gardner, London. Eng. Pat. 12,414, August 8, 1890. 8*d*.

In this process white lead is manufactured from the metal by passing vapour of acetic or nitric acid mixed with aqueous vapour, carbonic acid, or air, over sheets of lead. The action is accelerated, first by maintaining a temperature of 125° F. to 135° F., and secondly by an electric current. This is generated either by a dynamo or by coupling up the lead plates with tin or other material electro-negative to lead. In this latter case the moist vapours act as the electrolyte. The chamber in which the operations take place are glazed and furnished with suitable shutters, thus enabling the progress of the operation to be observed.—V. C.

An Improvement in the Manufacture of Blocks of India-Rubber. "Charles Mackintosh and Company, Limited," and J. Bagnall, Manchester. Eng. Pat. 12,786, August 15, 1890. 6*d*.

The blocks of india-rubber from which sheets are cut ordinarily contain included air bubbles, which, when the sheets are cut, causes holes and perforations, which sometimes necessitate the removal of portions of the sheet, thereby causing much waste. This invention claims to get rid of the difficulty by exhausting the air from the cylinder in which the plastic rubber is placed before subjecting it to the pressure of the hydraulic ram.—V. C.

Improvements in the Manufacture of India-Rubber Thread. "Charles Mackintosh and Company, Limited," and J. Bagnall, Manchester. Eng. Pat. 12,787, August 15, 1890. 4*d*.

The improvement consists in the method of preparing the sheets from which the threads are cut, the actual process of cutting being the same as that ordinarily employed. In the usual method of forming the sheets the rubber is spread in the plastic state with naphtha or rolled in a calendar with or without naphtha. Either process, or combination of the two, also diminishes the strength of the rubber; and likewise fails to give sheets of uniform thinness. In the new process the sheets are cut from a cylindrical block, the sheets are then vulcanised and afterwards wound on a roller, being then cut into threads in the ordinary manner. —V. C.

Improvements relating to the Manufacture of Carbonate of Lead and to Apparatus therefor. S. K. Morris, London. Eng. Pat. 15,903, October 7, 1890. 11*d*.

Lead is reduced to fine shreds or strips by being melted, and then caused to drop through holes or apertures in a die or block into a tank of water. The shreds or strips are then subjected to the action of steam, acetic acid and carbon dioxide, the last-named being produced by the combustion of refined petroleum or some other suitable hydrocarbon.—L. G. C.

Improved Preparation for Use as a Substitute for Linseed Oil in the Mixing of Pigments. J. L. A. Bokelund, Gothenburg, Sweden. Eng. Pat. 5870, April 6, 1891. 4*d*.

This preparation consists of a mixture of rosin oil, refined mineral oil, and methylated spirit.—L. G. C.

An Improved Liquid Preparation for the Protection of Bright or Polished or Unpolished Metallic Surfaces, and which may also be used as an Anti-Fouling and Anti-Corrosive Composition. T. Maxwell, Glasgow. Eng. Pat. 6916, April 22, 1891. 4*d*.

The following ingredients and proportions are used:—Rosin, about 16 parts; naphtha, turpentine, or light mineral oil, about 16 parts; and boiled or raw linseed or other oxidisable oil, about 2 parts.—L. G. C.

The Manufacture and Production of Hydrocarbon Products or Compositions for Use for Insulating or other Purposes. J. Y. Johnson, London. From J. Weil, New York, U.S.A. Eng. Pat. 8573, May 19, 1891. 8*d*.

The patent relates to the production of a substance termed "Litho-carbon," from a natural material occurring in sand or shell rock in Texas. Litho-carbon appears to be a polymeric terpene, having the empirical formula, $C_{10}H_{16}$. It is a black, tough, flexible, solid, and somewhat plastic at ordinary temperatures. Combined with sulphur the compound serves for insulating purposes; amalgamated with india-rubber it can be used for waterproofing; in suitable solvents, as turpentine, it forms a pigment; and the material by itself will serve for a coating for tanks and the like, for holding acids.

It is prepared as follows. The broken rock containing the crude material is placed in a tank, through which the vapour of naphtha is caused to pass dissolving out the crude hydrocarbon. Superheated steam or hot air is then passed through the naphtha solution of the crude hydrocarbon, whereby the naphtha is driven off together with 0·25 to 5 per cent. of a volatile sulphur containing oil. The purified hydrocarbon which remains behind contains a small quantity of oxygen, which combines with it during the process, and the presence of which appears to be essential to its toughness and elasticity. The removal of the volatile oil retains the material with its drying quality, which the raw product does not possess.—V. C.

XIV.—TANNING, LEATHER, GLUE, AND SIZE.

Preliminary Note on the Technical Analysis of Gambier. H. R. Procter.

See pages 681—683.

PATENTS.

Improved Substitutes for Tannin. S. Thorn, Cleckheaton. Eng. Pat. 10,706, July 10, 1890. 4*d*.

The inventor substitutes "in place of this operation of inserting tannin" or other article used at present to effect the same purpose, the following operations:—The hide is treated in a bath containing 3 lb. of alum, 4 lb. of salt, and water, in suitable proportion. After drying and scouring, the "raw hide" is placed in a bath prepared from 1 lb. of dry albumen, 6 lb. of oil, and "water as required," for a length of time varying according to the weight of the hide. The hide is then dried in the usual way.—B. H.

Improvements in the Treatment of Skins and Hides. C. S. Hull and P. S. Burns, Boston, Mass., U.S.A. Eng. Pat. 8096, May 12, 1891. 4*d*.

This invention is for the use of the sulphonic acids of naphthalene (α- and β- mono- and disulphonic acids) for the purpose of neutralising the alkali employed for unhairing. A solution containing 2 to 5 per cent. of the acids is best employed and the skins or hides are subjected to the action of the acid solution for a length of time dependent on the kind of skin under treatment. As the naphthalene sulphonic acids also act as a preservative, the skins after treatment are not only freed from alkali, but may be considered "pickled" and may be transported in this condition and the tanning performed in another place. —B. H.

XV.—MANURES, Etc.

Humus. Berthelot and G. André. Compt. Rend. **112**, 916—922.

As a preliminary to the investigation of the humus of the soil the authors have made researches in the ulmin and ulmic acid produced from sugar. The account of the most important experiments and of the results form the subject of the present communication.

1,500 grms. of cane sugar in aqueous solution, boiled with pure concentrated hydrochloric acid, yielded after prolonged washing with boiling water 236 grms. of ulmic matter. The composition of this matter varies with the intensity of the action of the hydrochloric acid, but it retains neither ash nor chlorine, in one case it contained per cent. C, 66·41; H, 4·57; O, 29·02, corresponding to $C_{36}H_{34}O_{12}$, in another sample the percentage composition was C, 63·91; H, 4·58; O, 31·51, corresponding to $C_{36}H_{36}O_{14}$. In contact with water this substance behaves like a colloid, swelling up and ultimately becoming gelatinous. In contact with alkalis, potash, soda, baryta, or lime, even when extremely dilute it undergoes hydrolysis, takes up alkali from the water forming insoluble salts which offer great resistance to the action of water, more especially in the cold, but are nevertheless gradually dissociated by it. Dilute hydrochloric or sulphuric acid

decomposes them immediately and yields the acid, which becomes more hydrated the longer the contact with the alkali has been, ultimately becoming soluble in a manner similar to levulic and such like acids. With dilute ammonia (3·3 per cent.) in the cold, or very dilute (0·33 per cent.) at 100° in sealed tubes, the ulmic matter absorbs about 4 molecules of ammonia producing a gelatinous insoluble matter, which loses ammonia during the washing and drying operations, but yet after boiling with water and magnesia retains a proportion corresponding with the composition $C_{72}H_{33}NO_{26}$ which would be that of an amido acid formed from two molecules of the ulmic matter. A larger quantity of nitrogen is absorbed from the 3·3 per cent. ammonia in sealed tubes at 100°.

The potassium compounds serve for an example of the action of alkalis, when the ulmic matter is exposed for four days in excess of dilute potash, an insoluble compound of the composition $C_{36}H_{13}K_3O_{11}aAq$ is obtained, which after prolonged washing with cold water yields a soluble basic compound of the approximate composition $C_{36}H_{16}K_6O_{14}$, mAq and an insoluble compound $C_{36}H_{15}KO_{14}$ (apparently identical with Malaguti's ulmine, he overlooked the potash) which is scarcely attacked by carbonic anhydride in the cold but is decomposed at once by hydrochloric acid, yielding the acid $C_{36}H_{15}O_{14}$. The original ulmic matter is, however, capable of decomposing, to a very small extent, a solution of potassium chloride with the liberation of hydrochloric acid.

From these results the authors are inclined to regard the ulmic matter obtained by the action of hydrochloric acid on sugar as a condensed anhydride or a mixture of several anhydrides derived from certain acids resulting from the transformation of the sugar.—D. A. L.

Treatment of Vines attacked by Phylloxera with Carbon Disulphide mixed with Vaselin. P. Cazeneuve. Compt. Rend. **112**, 971—974.

The introduction of American plants to replace those destroyed by parasites in French vineyards has not arrested the use of insecticides for the protection of French vines still attacked by *Phylloxera*, and for this purpose carbon bisulphide (either pure or dissolved in water), sulphocarbonates, and submersion continue to be employed with more or less success, the carbon bisulphide is by far the more efficient, but is too volatile and does not diffuse with sufficient rapidity. When, however, it is mixed with vaselin, its volatility is reduced and its diffusibility is increased, the former proving advantageous in light and calcareous soils the latter in heavy soils, in accordance with theoretical considerations. The vaselined sulphide is applied in the same way as the ordinary sulphide, depositing some at the foot of the vine stock and spreading the rest over the surface; this treatment is found to be effectual, with it *Phylloxera* is no longer seen in the roots, vegetation is luxuriant, and numerous new rootlets indicate a decisive increase in vitality; the manuring on a test tract of land had not been altered for six years, therefore the improvement was solely due to the insecticide.—D. A. L.

Nitrogenous Constituents of Soils. Berthelot and André. Bull. Soc. Chim. 1891, **5**, 643—646.

It has been previously established (Ann. Chim. Phys. **9**, 289), that ordinary soil contains no appreciable quantity of free ammonia or ammonium salts, but amido-compounds, the slow decomposition of which by acids and by alkalis, and even by pure water at the ordinary temperature, gives rise to the ammonia found on analysis; this same decomposition brought about by water and by carbonates of the alkalis and alkaline earths, gives rise also to the ammonia, which is emitted by soils at the ordinary temperature and diffused into the atmosphere.

The amido-compounds which thus undergo decomposition are either true amides, or compounds, derived from fixed or volatile nitrogenous bases, some of which are soluble, some insoluble in water; the decomposition of these insoluble nitrogenous compounds by acids or by alkalis may give either soluble or insoluble products.

Quantitative experiments on the decomposition of the amido-compounds present in soils, under the influence of potash and hydrochloric acid, lead to the conclusion that those amido-compounds which are decomposed by cold concentrated potash, belong to two distinct groups, which are acted on at very different rates. It has also been found that the insoluble amido-compounds are decomposed by dilute acids even more quickly than by dilute alkalis. By the prolonged action of dilute alkalis the proportion of nitrogenous compounds insoluble in potash is increased, but at the same time the percentage of nitrogen which they contain is diminished. The action of alkalis at 100° and continued for 26 hours, renders soluble 93·6 per cent. of the organic nitrogen originally present in the soil; under the successive influence of alkalis and acids 95·5 per cent. of the organic nitrogen is rendered soluble.

These results indicate in what manner the insoluble nitrogen of the humic constituents of the soil may be gradually rendered available, the action of the weak acids and alkalis present in the soil being similar to that of the more energetic reagents employed in these experiments, but requiring, naturally, a longer time to produce an equal effect.—F. S. K.

Disposal and Utilisation of Fæcal Matters. L. Ketjen. Zeits. f. angew. Chem. 1891, 294—295.

See under XVIII. B., *page* 721.

Nitrification. Part IV. R. Warrington. Proc. Chem. Soc. 1891 [98], 92—94.

The first section of the paper describes early experiments, made in 1878—84, showing the existence of an agent producing only nitrites, and the means of separating it from soil. It was at first thought that the age of the culture was the factor which determined the loss of the power of producing nitrates, but this idea was negatived by subsequent experiments. Successive cultivation in ammoniacal solutions, made permanently alkaline with disodium carbonate, was found to be a certain method of obtaining a purely nitrous agent. Pasture soil yielded the nitrous agent more readily than arable soil.

The isolation and properties of the nitrous organism are next described. The gelatinous matter which appears under certain conditions at the bottom of the old cultures was in 1883 examined microscopically, and found to consist of circular corpuscles imbedded in a zoogloea. In 1886 this jelly was spread on gelatine, but it yielded no nitrifying organism. In 1889 a systematic attempt at the isolation of the organism commenced. Successive cultivations were made in an ammonium carbonate solution, supplied with phosphates, &c., but containing no organic matter. A series of transparent cultures was obtained, containing only nitrites. These cultures were spread on gelatine and Agar-agar, the composition of the jelly being made to correspond, as far as possible, with that of a nitrifiable solution. The later cultures yielded on gelatine one organism only, a short bacillus. This and all the other organisms obtained by cultivation on gelatine from nitrified solutions were seeded into both liquid and solid media susceptible of nitrification, but without result. Microscopical examination of the nitrified solutions showed that cocci were abundantly present, but these never appeared on the gelatine cultures.

The first attempts to separate the nitrous organism by the dilution method failed. By substituting an ammonium chloride solution with calcium carbonate for the ammonium carbonate, success was attained in October 1890, three nitrified cultures seeded with dilutions of 1 : 10,000, 1 : 100,000, and 1 : 1,000,000 giving no growth on gelatine.

The nitrous organism thus obtained oxidises ammonia to nitrous acid and has no effect on nitrites. It produces nitrous acid in solutions of asparagine, milk, urine, and urea. Grown in broth containing calcium nitrate, it does not reduce the nitrate to nitrite. It produces no turbidity or visible change when grown in broth or in any of the other solutions named.

The nitrous organism requires no organic matter for its nutrition; it is apparently capable of assimilating carbon from acid carbonates. The presence of either calcium or sodium acid carbonate distinctly favours nitrification; neutral sodium carbonate greatly hinders nitrification. The proof that carbon is assimilated from carbonates has been furnished by Winogradsky. The energy that is required for the decomposition of a carbonate is apparently furnished by the oxidation of ammonia or nitrogenous organic matter. Calcium acetate (0·25 grm. per litre) favours nitrification when only the nitrous organism is present.

The nitrous organism occurs as nearly circular corpuscles, varying from minute points up to nearly 1·0 μ in diameter: these circular organisms stain deeply. It also occurs as oval cocci, the length frequently exceeding 1·0 μ, the ends occasionally more or less truncated.

The remainder of the paper deals with the nitric organism. Results obtained in 1880—81 revealed the existence of an organism which energetically converted nitrites into nitrates, but was apparently unable to oxidise ammonia. In 1886 and 1890 attempts were made to separate the active organism from the 1881 cultures by growths on gelatine and potato; none of the organisms thus separated had any power of oxidising either ammonia or nitrites. Recent results show that the nitric organism develops freely in inorganic solutions containing potassium nitrite, phosphates, &c., especially if superearbonates are present. Mono-sodium carbonate, 1—4 grms. per litre, exerted a very favourable influence, 6 grms a retarding influence. Di-sodium carbonate greatly hinders its action.

The nitric organism produces neither nitrites nor nitrates in ammoniacal solutions, even when carbonic acid, or mono-sodium carbonate, or calcium acetate is supplied. In the absence of ammonia it energetically converts nitrites into nitrates; the presence of ammonia is apparently a great hindrance to its action.

An attempt to isolate the nitric organism by the dilution method failed, but apparently only one other organism (a stout bacillus growing on gelatine) was present in some of the cultures obtained. The stained preparations from these cultures contained an abundance of the minute circular organisms observed in pure cultures of the nitrous organism; the form of the two organisms is thus apparently similar.

The nitrification performed by soil thus appears to be the work of two organisms, one of which oxidises ammonia to nitrite, while the other oxidises nitrite to nitrate. The first organism is easily separated from the second by successive cultivations in solution of ammonium carbonate. The second is (probably) separated as easily from the first by successive cultivations in solution of potassium nitrite containing mono-sodium carbonate.

The paper was illustrated by photo micrographs, showing the nitrous organism as developed in ammoniacal solutions, milk, and broth; and the nitric organism grown in a solution of nitrite.

XVI.—SUGAR, STARCH, GUM, Etc.

Report to the United States Internal Revenue Department as to the Standards and Methods for the Polarimetric Estimation of Sugars. C. A. Crampton, H. W. Wiley, and O. H. Tittmann.

See pages 677—681.

The Use of Phenylhydrazine for the Detection of Sugars. Maquenne. Compt. Rend. **112**, 799—802.

See under XXIII., *page* 727.

Derivatives of Xylose. G. Bertrand. Bull. Soc. Chim. 1891, **5**, 554—557.

The author prepares xylose in the following manner:—Oat straw is first macerated twice with lukewarm water, then boiled for some hours with 10 times its weight of water containing 1 or 2 per cent. of sulphuric acid and ultimately pressed. The liquor obtained from the last operation after separation of the sulphuric acid with baryta is kept slightly acid, and is concentrated on a water-bath; it is then extracted with alcohol, and on evaporating the alcohol from the extract a yellow syrup is left, which sets to a solid mass within 18 hours, after crystallisation has been started with a crystal of xylose. The mass is dried and is purified by crystallisation from 95 per cent. alcohol, the yields varying with the original material employed; thus wheat straw yielded 2 per cent. whilst oat straw gave 4 per cent. of xylose. This glucose is derived from the matter incrusting the walls of cells and serving to consolidate them. By treating xylose with sodium amalgam in an alkaline medium a syrup is obtained, which on agitation with 1 part of 50 per cent. sulphuric acid and 1 part of benzoic aldehyde, yields a precipitate, and the latter, after washing with water and alcohol and dissolving in boiling methyl alcohol is deposited in white gelatinous flocks, they lose benzoic aldehyde on drying, but give analytical numbers approximating to xylose di-benzoic acetal $C_5H_4O_5(CH.C_6H_5)_2$. This substance resembles the corresponding sorbite compound in its alotropisms, its solubilities and its behaviour with reagents and by decomposition with dilute sulphuric acid yields xylite which has not been crystallised. It is, however, slightly dextrogyrate, a 10 per cent. solution giving $[\alpha]_D = 0° 50'$ at 12°, and when nearly dried in a vacuum and heated with excess of acetic anhydride in presence of fused zinc chloride it yields a penta-acetate, but it could not be made to combine with ethylic aldehyde. Xylose forms double salts with cadmium chloride or bromide, 1 part of xylose dissolved in 5 parts of water is agitated with 1 part of bromine until the latter is dissolved; after 24 hours the excess of bromine is boiled off, the liquid saturated with cadmium carbonate, filtered and mixed with an equal volume of alcohol, an abundant crystalline precipitate of cadmium xylonobromide $(C_5H_9O_6)_2Cd.CdBr_2 + 2H_2O$ immediately forms. To obtain the corresponding xylonochloride, which also crystallises with 2 mols. H_2O, the hydrobromic acid formed in the above operation is estimated and removed by means of lead carbonate, an impure solution of xylonic acid remains, which is saturated with cadmium carbonate. Cadmium chloride is added and the treatment continued as in the case of the xylonobromide. This reaction of xylose is very sensitive, inasmuch as these salts may be obtained with a few milligrammes of the sugar, and it moreover serves to distinguish xylose from arabinose another point of difference between these two sugars, being the non-formation of a benzoic acetal in the case of the latter sugar.—D. A. L.

XVII.—BREWING, WINES, SPIRITS, Etc.

On the Fermentation of Starch by the Butyric Ferment. A. Villiers. Compt. Rend. **112**, 536—538.

The author has already shown that the principal products of the action of *Bacillus amylobacter* on starch is dextrin (Compt. Rend. **112**, 435; this Journal, 1891, 174.)

There is formed at the same time about 0·3 per cent. of a carbohydrate, which separates from the alcohol that has been used to precipitate the dextrins. It dissolves in a fairly large quantity of warm water, and on cooling the solution deposits fine crystals having a composition corresponding to the formula $C_{12}H_{20}O_{10}$. 3 H_2O. The crystals have a slightly sweet taste, they are but slightly soluble in cold water, and the solution is dextro-rotatory, having $[\alpha]_D = + 159·4$. It is unfermentable and does not reduce Fehling's solution, and forms no compound with phenylhydrazine. When warmed with dilute mineral acids it is hydroylsed to dextrose.

A second product of the fermentation of starch by the above-mentioned bacteria is a white amorphous flocculent precipitate; it has the composition of cellulose and is transformed into glucose when heated with dilute mineral acids.—A. L. S.

On the Origin of the Higher Alcohols contained in Fermented Liquors. L. Lindet. Compt. Rend. **112**, 663—666.

Two solutions of cane sugar and two solutions of a commercial brewing sugar were prepared. One of each sugar was fermented with a small quantity of yeast, and one of each with a large quantity. The cane sugar solution seeded with the large quantity of yeast yielded an alcohol containing 1·47 cc. of higher alcohol per 1,000 cc. ethyl alcohol. The cane sugar solution seeded with the small quantity gave 2·30 cc. of high alcohols per 1,000 cc. of ethyl alcohol. With the other sugar the corresponding numbers were respectively 3·96 cc. and 5·29 cc.

Two solutions of sugar were fermented under exactly the same conditions except that to one some sterilised brewers' grains were added, which causes the fermentation to go-quicker, and in this case the amount of higher alcohols produced was less, the numbers being with grains 4·70 cc., and without grains, 5·29 cc. per 1,000 cc. ethyl alcohol. It was also found that if the fermentation takes place at a high temperature more higher alcohols are produced. At 25°—27° C., 5·9 cc.; at 18°—21° C., 5·4 cc.; at 8°—10° C., 5·2 cc. of high alcohol for 1,000 cc. ethyl alcohol are produced. These experiments show that the higher alcohols are not produced by yeast, but are formed by some other organism present as an impurity.—A. L. S.

On the Use of Liquid Carbonic Acid for the Rapid Filtration and Sterilisation of Organic Liquids. A. d'Arsonval. Compt. Rend **112**, 667—669.

The liquid to be sterilised and filtered is placed in a steel or copper tube to the end of which is fixed an unglazed porcelain tube closed at one end. The upper portion of the steel or copper tube is placed in communication with a bottle of liquid carbonic acid. The pressure of the gas forces the liquid through the walls of the porcelain tube, owing to the great pressure all the colloidal bodies pass through in the solution, and only the living organisms remain behind.

—A. L. S.

The Influence exerted by Various Neutral Potassium Salts on the Solubility of Potassium Bitartrate. C. Blarez. Compt. Rend. **112**, 808—811.

In a former paper (this Journal, 1891, 488) the author gives two formulæ representing the solubility of potassium bitartrate in solutions of potassium chloride. One of these, slightly modified, is given below:—

$$Q\phi = \frac{0·05 + 0·000005\ \phi^3}{\sqrt{K}}$$

in which ϕ = temperature in degrees Centigrade. K = Weight of potassium contained in the potassium chloride.

The author finds that the influence of other potassium salts on the solubility of potassium bitartrate may be represented by the same formula. In other words the nature of the electro-negative element combined with the potassium appears to be immaterial. This fact is well shown by the experimental results embodied in the following table:—

With Potassium Bromide.

Amount of Salt taken per 100 cc.	Corresponding Amount of Potassium.	$\sqrt{K}$.	Temperature.	Tartar found per 100 cc.	Tartar calculated per 100 cc.
Grms. 0·487	Grms. 0·160	Grms. 0·340	C. 21	Grms. 0·310	Grms. 0·312
0·915	0·300	0·550	21	0·222	0·223
1·525	0·500	0·706	21	0·174	0·177
2·000	0·654	0·810	13·5	0·076	0·076
2·135	0·700	0·835	21	0·129	0·129
3·050	1·000	1·000	15·25	0·068	0·067
1·000	1·306	1·140	14	0·053	0·055

With Potassium Iodide.

1·001	0·250	0·500	15·25	0·148	0·135
2·085	0·490	0·700	15	0·089	0·095
2·128	0·500	0·706	15·25	0·094	0·095
3·147	0·810	0·900	15	0·075	0·074
4·256	1·000	1·000	15	0·067	0·066

With Potassium Chlorate.

1·003	0·320	0·570	17	0·146	0·130
1·575	0·500	0·706	6·5	0·064	0·061
3·000	0·950	0·980	17	0·081	0·076
3·141	1·803	1·000	9	0·051	0·052

With Potassium Nitrate.

1·295	0·500	0·706	15·4	0·114	0·114
2·590	1·000	1·000	9	0·048	0·052
3·001	1·164	1·080	14·5	0·065	0·060
4·000	1·552	1·247	17	0·063	0·059

In these experiments the saline solution was agitated for 48 hours at a constant temperature with an excess of powdered cream of tartar.

It is evident from these results that the same influence is exerted on the solubility of potassium bitartrate by quantities of various potassium salts proportionate to their respective *molecular weights*. In a future paper the author hopes to show that similar laws govern the solubility of other salts in admixture.—H. T. P.

The Properties of Fig Wine. P. Carles. Compt. Rend. **112**, 811—812.

Figs are largely employed, especially in Algeria, for the production of fictitious wine. For this purpose figs from Asia Minor are preferred on account of their relative cheapness and richness in sugar. When the fruit is treated with a suitable quantity of tepid water, acidified with tartaric acid, fermentation rapidly commences, resulting in the production of a vinous liquid of about 8° alcoholic strength, and so inexpensive that it defies all competition of genuine grape wine, Algerian or otherwise. Fig wine cannot be distinguished either by taste or the ordinary methods of analysis from genuine grape wine, especially when it is mixed with a proportion of the latter. The detection of fig wine is, however, rendered comparatively easy by the fact that it contains mannitol. In order to separate the mannitol, 100 cc. of fig wine are evaporated to a syrup which is allowed to stand in a cool place for 24 hours. At the end of this time the residue will have solidified, well defined groups of crystals being formed. The crystals are washed with cold alcohol of 85 per cent. strength in order to remove impurities. The residue is mixed with animal charcoal and extracted with boiling 85 per cent. alcohol and filtered. The alcoholic solution yields on evaporation a crystalline mass of mannitol which may be recognised by its physical and chemical properties. Certain white wines from the Gironde district, as well as raisin and some other wines, contain mannitol, but only to the extent of a few decigrammes per litre; whilst fig wine contains from 6 to 8 grms. per litre. By a determination of the mannitol it is possible to detect an adulteration of normal Algerian wine with one-half or even one-fourth of fig wine.—H. T. P.

The Progress of Purification during the Rectification of Alcohol. E. Mohler. Compt. Rend. **112**, 815—818.

The author has separately collected and analysed the various fractions obtained during the rectification of raw spirit from molasses. A quantity of spirit was distilled, corresponding to 100 hectolitres of alcohol of 100 per cent. strength. Before rectification the spirit was neutralised with soda and diluted to 300 hectolitres. The rectification required 53 hours for its completion, being effected in a Savalle rectifier. Seven different fractions were collected, about two litres of each being taken for analysis. The results, which are expressed in grms. per hectolitre of 100 per cent. alcohol, are given in the following table:—

	Composition in Grms. per Hectolitre of Alcohol at 100 per Cent. of the different Qualities formed during Rectification of Raw Spirit from Molasses.							Composition in Grms. per Hectolitre of the Raw Spirit, and of the Residual Liquid left in the Retort.	
	First Runnings, Worst Portion.	First Runnings, Middle Portion.	First Runnings, Best Portion.	Fine Spirit	Tailings, Best Portion.	Tailings, Middle Portion.	Tailings, Worst Portion.	Raw Spirit.	Liquid left in the Retort.
Acids (as acetic acid)	7·20	3·00	3·04	1·80	1·80	2·40	6·00	124·00	59·56
Ethers (as ethyl acetate)	26·5	79·2	13·2	5·20	8·80	13·60	70·40	39·0	16·63
Aldehydes (as ethylaldehyde)	163·2	14·0	2·4	Very slight trace.	0	Trace	8·00	21·6	..
Furfurol	0	0	0	0	Trace	0·60	6·60	0·15	..
Superior alcohols (as amyl alcohol).	0	0	0	0	2·58	2500·00	9000·00	337·00	..
Nitrogenous bodies (as ammonia).	0·525	0·36	0·12	0·08	0·16	0·22	1·55	0·54	0·200
Total impurities per hectolitre	738·425	226·56	18·72	7·08	13·34	2516·82	9092·55	542·29	76·39
Volume in hectolitres, of each quality of spirit.	1·63	8·55	24·20	28·32	27·84	5·52	1·91	97·97	200·00
Total impurities	1203·63	1937·08	453·02	200·50	363·38	13892·84	17366·77	53128·15	15278·00

Impurities contained in the whole distillate	35417·46	Impurities contained in the raw spirit	53128·15
Impurities left in the liquid in the retort	15278·00	Impurities found in the distillate and residue	50695·46
Total	50695·46	Loss and errors of analysis	2432·69

It will be seen that 80 per cent. of the alcohol submitted to distillation is obtained almost perfectly pure, containing only 70 to 189 mgrms. of impurity per litre.—H. T. P.

On the Nitrogenous Constituents of Barley and Malt. W. J. Sykes. Trans. Inst. Brewing, **4**, 173–187.

The albuminoids present in barley and malt are albumen, globulin, albumose, peptone, and gluten; other nitrogenous bodies present are enzymes, amides, and ammonium salts. Albumen and globulin are soluble in cold water, but are precipitated when their solutions are heated, the former at 160° F. and the latter at 140° F. This does not take place when some salts, such as sodium chloride, are present. The globulin of barley (myosine) is precipitated if its solution be saturated with sodium chloride.

Albumose is soluble in water, and its solution is not precipitated by boiling, but if saturated with ammonium sulphate almost the whole of it is thrown out.

Peptone is soluble in hot and cold water, and diffusible. It is precipitated from its solution by phospho-tungstic acid or tannin.

The glutens are insoluble in water, but are soluble in slightly acid solutions, such as wort. Their solutions are slowly coagulated on boiling. They have the curious property of being slightly soluble in alcohol. Their presence in wort is shown by carefully neutralising, when a precipitate is thrown out, most of which dissolves in excess of alkali. Ritthausen gives the amounts present in barley as:—Gluten-caseine, 1·27 per cent.; gluten fibrine and mucedine, 1·7 per cent. On drying the precipitate obtained by saturating wort with ammonium sulphate a portion always becomes insoluble; this the author considers to be the gluten present. By making use of the above-described properties, a rough separation and estimation of the amounts of albuminoids present in wort and beer may be made. The only one present to any extent in beer is albumose, and this is unable to supply nitrogenous food to yeast. The best

known of the amides present is asparagine; no determination of the amounts of these bodies in wort or beer have been made; they probably form the chief nitrogenous food of the yeast.

Hilger gives the amount of ammonium salt present in barley as 0·0169 per cent., and in malt 0·0057 per cent.

The nitrogenous constituents of barley and malt may be considered to be:—

	Barley.	Malt.
Total albumen	10·56	9·68
Total soluble albumen	2·23	4·05
Albumen precipitated on boiling	0·79	0·79
Albumose	0·55	1·11
Amide	6·98	2·24

—A. L. S.

Alcoholic Fermentation and the Transformation of Alcohol into Aldehyde by the Lily of the Valley Fungus. G. Linoissier and G. Roux. Bull. Soc. Chim. 1890, **4**, 697—706.

Already abstracted from Compt. Rend. **110**, 868—870 (see this Journal, 1890, 879).—C. A. K.

Manufacture of Beer from Maize.

The *Handels Museum* of July 2nd states that a new brewery product, namely, beer made from maize, is being manufactured and consumed in increasing quantities in France. The cost of production is said to be much below that of beer made from barley, notwithstanding that the beer itself is in no way inferior to the latter. The new beverage is not the result of any improved process, but is made by malting maize, of which it is a pure product, and not (as is done in some districts) the result of mixing maize meal with the worts of barley malt. Owing to the high price of malt, brewers have for a long time been driven to use unmalted cereals for brewing purposes. Experiments have been made with wheat, maize, rice, potato meal, maize syrup, &c.; in such cases there was an insufficient development of the saccharin principle, and, owing to a lack of soluble nitrogenous bodies fermentation did not proceed satisfactorily. Hence the beer became spoiled by a second fermentation, and further, there was a lack of albuminous matter and phosphates which constitute the nutritive properties of beer. These defects are all said to be remedied by using maize malt.

PATENTS.

Method for Producing a Non-Alcoholic Beer or Beverage. L. Hoff, Hamburg, Germany. Eng. Pat. 13,092, August 20, 1890. 4*d*.

Beer of good quality is boiled until all the alcohol is expelled, it is then charged with carbonic acid and bottled. If necessary flavouring matters may be added.—A. L. S.

Improvements in Brewing Stout and Porter. J. Rose, Nettleton. Eng. Pat. 17,329, October 29, 1890. 4*d*.

The patentee prepares a wort by mashing together ground oats or malted oats, malted barley and black malt, boils this with soda, cools, and ferments as usual.—A. L. S.

Improved Method in Fermenting Mash, Dough, Wort, and the like. C. Funk, Charlottenburg, Germany. Eng. Pat. 8512, May 19, 1891. 4*d*.

One hundred grms. of "glycero-phosphoric acid" are to be added to one hectolitre of the solution to be fermented, and if necessary, also "mineral nitritive salts."—A. L. S.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

(*A.*)—CHEMISTRY OF FOOD.

Notes on Certain Reactions for Tyrotoxicon. H. A. Weber. J. Amer. Chem. Soc. 1890, **12**, 485—487.

See under XXIII., *page* 728.

PATENTS.

An Improved Method of Preparing Peptonised Soluble Meat and Peptone. N. Etienne and A. Delhaye, Angréau, Belgium. Eng. Pat. 10,961, July 14, 1890. 6*d*.

The meat after removal of the tendons and grease is chopped and mashed, and then mixed with about half its weight of water and heated by steam under pressure at a temperature above 150° C. and under 175° C. for one hour. Part of the albuminoid matter is transformed into propeptone and peptone, which go into solution with the extractive part of the meat. The mass is expressed and a friable residue remains equal to about one-third the weight of the fresh meat used. This residue is treated on the water-bath with an equal weight of concentrated hydrochloric acid until the fibro-muscular tissue is quite disintegrated and decomposed, and the product is filtered. The residue now remaining is sold as manure. The liquors obtained are neutralised with carbonate of soda and then contain peptone and sodium chloride in solution. If pure peptone is desired the liquid is decolourised by animal charcoal and dialysed to remove the salts in solution. If only a meat extract is required the liquors from the squeezing of the meat after treatment with water as above described and the neutralised liquor from the acid treatment are mixed and evaporated in a vacuum until sufficiently concentrated. Modifications of the process are described.—H. S. P.

Improvements in Sterilising Milk and other Substances. W. Budenberg, Dortmund, Germany. Eng. Pat. 20,640, December 17, 1890. 8*d*.

The substance is sterilised by heating once or more often in a chamber filled with steam at 100°—105° C., after being introduced into bottles fitted with ground stoppers of peculiar construction. One or more holes or grooves are made in the neck of the bottle, and corresponding holes or grooves are made in the stopper in such a way that, by turning the stopper, communication may be made or closed at will between the interior of the bottle and the outer air. During the process of sterilisation, communication between the interior and the exterior is left open, but the upper part of the hole or groove is filled with wadding. No risk of breaking through increased pressure is therefore incurred, as in the usual process of sterilising in hermetically sealed bottles. When the disinfecting chamber is opened and the bottles are allowed to cool, the air enters through the holes or grooves, but the band or plug of wadding stops all micro-organisms. When the contents are quite cold, the stopper is turned so as to close the communication with the outer air, the wadding is removed, and the bottles are ready for transport.

With "saddle-shaped" forms of stopper, the bottle may be used as a feeding-bottle for infants.—P. J. H.

Improvements in Centrifugal Apparatus for Testing the Composition of Milk and other Compound Fluids. S. C. Hauberg, Copenhagen, Denmark. Eng. Pat. 5175, March 23, 1891. 6*d*.

The improvement consists in a mechanical device for rotating the disc in which the testing bottles are held. There is a hemispherical depression in the centre of the rotating disc or table which allows it to be fitted horizontally upon the top of an upright shaft or spindle. The top of

the shaft is hemispherical and fits into the hollow in the disc. The shaft is rotated by a belt, and the table fitted upon the top of it then rotates by friction. A drawing of the apparatus is given.—H. S. P.

(*B.*)—SANITARY CHEMISTRY.

The Pollution and Self-Purification of Streams. T. P. Stearns. Rep. of the State Board of Health of Massachusetts, 1890, 783; Proc. Inst. Civil Eng. Abstracts, **105**, iii. 9—11.

The author examines various sewage-polluted watercourses, rendered foul by the populations of townships on their banks. In these the amount of free ammonia varies from 0·02 to 0·216 parts per 100,000, while he states that several instances could be enumerated where streams containing from 0·01 to 0·03 part of free ammonia per 100,000 parts, were found to be free from offensive odours. To keep within safe limits it is assumed that volumes of from 2·5 to 7·0 cub. ft. of water per second per 1,000 persons, and containing free ammonia, from 0·1116 to 0·0399 part per 100,000 should be regarded as doubtful. With smaller volumes of water the pollution is so great as to be inadmissible; with larger volumes the dilution is such, from the standpoint of offensiveness, as to be clearly admissible. If certain manufacturing uses are to have weight, it might be expedient to insist upon even greater dilution than this. From the standpoint of domestic supply it cannot, so far as is at present known, be pronounced that any degree of dilution will render sewage-polluted water entirely safe.

Upon the question of self-purification, a most important one, when the water has to be used subsequently for drinking purposes, the author insists upon the need of bacteriological as well as chemical investigation. From the analyses of the Blackstone River, Massachusetts, at three different points, the author concludes that between the townships of Worcester and Uxbridge, a flow of 16 miles, the quantity of albuminoid ammonia was reduced by rather more than one half, viz., from 826 to 306 lb. The proportions present of other constituents are discussed, and the state of things prevalent in other polluted streams is examined. The author remarks that while the rapid decrease in the amount of free ammonia below the cities mentioned points to the self-purifying power of rivers, no indication is afforded whether there is a similar decrease in the number of disease-germs. Moreover, it cannot be ascertained that there is any corresponding destruction of the organic matter which the sewage brings into the stream.

The Filtration of Water through Filters of Calcined Infusorial Earth. H. Nordtmeyer. Zeits. fur Hygiene, **10**, 1891, 145; Proc. Inst. Civil Eng. Abstracts, **105**, iii. 13—14.

Attention is directed by the author to a filter composed of a hollow cylinder formed of calcined fossil-meal, or diatomaceous earth. The manufacture of these cylinders was at first attended with considerable difficulties, but these have now been overcome. The extreme brittleness of the calcined material also offers certain objections to its use, but Berkefeld has overcome all obstacles and has produced the requisite hollow cylinders, closed at one end, from selected specially prepared fossil-meal.

The specific gravity of the denser cylinders is 0·90, but a very porous variety, which can also be made, has a specific gravity of only 0·72. Exclusive of pores the specific gravity is 2·1, so that it may be assumed that the cavities occupy 65·7 per cent. of the bulk. It is found on microscopic examination of a very thin section that these pores are extremely minute, and they are filled with very fine spicule, which cross one another in every direction and form a sort of delicate internal network. The substance is such a very bad conductor that it must not be exposed too suddenly to heat, and it may best be sterilised by being placed in cold water and raised to the boiling point for three-quarters of an hour. Several series of experiment with liquids containing micro-organisms, which were carried out by the author, are detailed, the results being given in a tabular form. The parts of the apparatus and its construction are described by reference to a diagram. The filter is fitted up with rotatory brushes to cleanse the exterior surface of the cylinder from time to time, when it is being used for very foul liquids. The author states that the filter yields a reliable filtrate, free from germs for a lengthy period, that the germs then found are those of saprophytes, which have grown through the filter, and these may be reduced to a minimum by vigorous rinsings. It will yield a volume of two litres of water per minute, or an amount of filtered liquid far in excess of other domestic filters producing a filtrate free from germs. By mechanical cleansing it can always be restored to its original working condition, and it is thus capable of being used for very turbid liquids.

On the Success Attained by various Systems of Clarifying Sewage-Water at Frankfort-on-Maine. B. Lepsius. Deutsch. Vierteljahrsschr. fur offentl. Gesundheitspfl. 1891, 230; Proc. Inst. Civil Eng. Abstracts, **105**, iii. 16—17.

The experiments here recorded have been carried out during the past three years, at the Frankfort works, under the supervision of a Commission consisting of Dr. Spiess, Mr Lindley, Dr. Libbertz, and the author. Certain of the results obtained have been already published, and an account of the works is there given. In all eight series of experiments have been conducted, with five different systems of clarification. The various processes investigated were as follows:—

(*a.*) Precipitation with sulphate of alumina and lime. Series I. to III.

(*b.*) Precipitation with lime alone. Series IV.

(*c.*) Simple deposition, without chemicals. Series V.

(*d.*) Precipitation with sulphate of iron and lime. Series VI. and VII.

(*e.*) Precipitation with phosphoric acid and lime. Series VIII.

The volume of sewage dealt with was about 30,000 cubic metres (6,600,000 gallons) per diem, and upwards of 1,000 complete and comprehensive analyses were carried out.

In its mean composition the Frankfort sewage, though considerable fluctuations were observed, does not differ materially from that of other towns, London, Paris, Dantzig, Berlin, and Breslau, with which it is contrasted in a special table. By means of a set of graphic diagrams are shown the results of the various purification processes, as evidenced by the character of the effluent as compared with the raw sewage, and the author sums up the general effect of the different modes of treatment. In all cases the suspended matters were far more efficiently dealt with than those in solution, and the appearance of the sewage water, as tested by the eye alone, was greatly improved.

In dealing with the amount of organic matter present, special consideration is given to the phosphoric-acid treatment, and a graphic diagram is appended to show the proportion of the phosphates removed at each different stage of the process, and carried off in the effluent. From this it appears that though all the added phosphoric acid is expended in enriching the sludge, the amount of phosphoric acid present in the deposit from untreated sewage is nearly twice as great as is that in the sludge from the phosphate process. The figures in milligrammes per litre are as follows:—

Phosphoric Acid Originally Present.

1. In raw sewage	67·4
2. Added to secure precipitate	17·6
Total	85·0

Phosphoric Acid after Treatment.

1. In deposit in sand chamber	29·4
2. In sludge	17·4
3. In effluent	38·2
Total	85·0

Hence, instead of securing a sludge valuable for agriculture, more than twice the quantity of the phosphoric acid employed for the precipitation is carried away in the effluent, viz., 38·2 milligrammes per litre, of which about half is in suspension, and half in solution. The author points out that from this point of view it would be better not to treat the sewage with phosphate of lime at all, but to clarify it by simple deposition, and then to add the phosphate to the sludge.

In conclusion, it is stated that the experiments have demonstrated that the effect of chemical precipitation is not so greatly superior to the purification obtained by simple deposition in tanks, as to warrant the adoption of any of the above processes in preference to simple mechanical treatment. This, of course, does not hold good for sewage treatment generally, but it applies only to the conditions prevalent in the present works. It is proved, however, that in every case where tanks approaching the dimensions of those at Frankfort are available, more especially where the length of the tanks is equally great, it is possible to obtain, by purely mechanical means, results comparing favourably with the clarification attained elsewhere in tanks of smaller size only by means of chemical treatment, and therefore at a greater cost.

The Schwartzkopff System of Sewage Treatment (Berlin). B. Proskauer. Zeits. für Hygiene, **10**, 1891, 51; Proc. Inst. Civil Eng. Abstracts, **105**, iii. 18—19.

The Berlin University Hygienic Institute having been requested to report on the Schwartzkopff process, to decide upon the extent to which the offensive constituents of fæcal matters were eliminated by this system of treatment, the necessary bacteriological researches were entrusted to Dr. Plagge and Dr. Petri, under the superintendence of Dr. Koch; and the author was instructed to undertake the chemical investigations, and to report generally upon the experiments. The machine factory where the system is in use contained a set of water-closets, dry-closets, and urinals, resorted to daily by about 700 workpeople. The cesspit of the water-closets receives also the liquids from the urinals, which are flushed with water. The fæcal matters are raised from the cesspit into a mixing tank close alongside, where they are pulped by mechanical means and mixed with chemicals which consist of: 1. Milk of lime; 2. solution of sulphate of magnesia; 3. solution of crude superphosphate; 4. solution of chloride of magnesium.

The general results of the investigation are summed up in a series of eleven conclusions, from which it follows that the process is capable of completely removing all suspended matters; but it produces but little effect upon the soluble ingredients, especially the nitrogenous substances and the ammonia. The chemical action is almost entirely due to the added lime. The treatment has a certain disinfecting action upon the sewage, and leads to a most marked reduction of the micro-organisms in the effluent; the sludge, on the contrary, remains in this respect but little affected. Other conclusions have reference to the liability of the effluent to putrefy, and to the imperfect degree of disinfection attained in the case of the poudrette. It is laid down that the effluent should not, without further treatment, be passed into the sewers, and the peat-filtration process is declared to be a disadvantage rather than otherwise.

On the Necessity for the Systematic Inspection of Wells in Cities and Towns. D. Woodman. J. Amer. Chem. Soc. 1891, **13**, 44—51.

Determinations of the ammonia (free and albuminoid), chlorine and hardness in the water of 32 wells in the neighbourhood of Newark, New York State, U.S.A. are given. Fifteen of these well waters were found to be unfit for use, the free ammonia reaching a maximum of 0·74 parts per 100,000 in one instance, and the albuminoid ammonia 0·05 parts in 100,000, also in one case. Of these 15 samples only one contained less free ammonia than the water from a neighbouring river, opposite to a sewer outlet. A large proportion of chlorine characterised all the waters examined. The author concludes with remarks upon the necessity for a periodical inspection of wells.—C. A. K.

On the Precipitation of Suspended Clay by Aluminic or Ferric Hydroxides or by Means of Calcium Hydrate. A. R. Leeds. J. Amer. Chem. Soc. 1891, **13**, 100—102.

In order to hasten the deposition of the extremely finely divided clay often existing in river waters, an addition of alumina, iron salts, or lime is frequently made. The author has investigated the action more particularly of the latter substance, on impure kaolin suspended in water. As kaolin is formed by the weathering influence of water, containing dissolved carbonic acid on felspars, it seemed probable that by reversing the action, and causing lime to act on kaolin suspended in water, a portion of the basic hydrogen of the kaolin might be replaced by lime. This hypothesis was confirmed by experiment, the amount of lime absorbed varying from 20—40 per cent. of that theoretically required to replace the whole of the basic hydrogen. For this reason, lime is to be preferred for treating waters which need both softening and clarification, and which contain no appreciable amount of dissolved peaty extractive matter. In the case of waters contaminated with peaty substances, alumina is the only clarifying agent admissible; for both lime and ferric hydrate form soluble compounds with humus bodies. In fact, in some instances, when ferric hydrate is used, the yellow colour is greater after than before treatment.—H. T. P.

Disposal and Utilisation of Fæcal Matters. L. Ketjen. Zeits. f. angew. Chem. 1891, 294—295.

In parts of Amsterdam where the sewerage of 50,000 people, amounting to 54,750 cubic metres, is treated by the Liernur system, the cost has been reduced from 61 cents (Dutch) to 44 cents per head by the treatment of the liquid portions. These are mixed with lime and heated by steam in an apparatus similar to that used for working up gas liquors. By this treatment the nitrogenous matter is reduced to 0·00848 per cent., being evolved as ammonia, is collected in sulphuric acid, and the resulting ammonium sulphate sold; the water is sterilised and is separated from the calcareous solid residue by filter-pressing. In an experimental apparatus 8,750 cubic metres of sewage water required 123,000 kilos. of quicklime, 153,000 kilos. of coal, 72,000 kilos. of sulphuric acid 60° B. Labour costing 2,498 florins (Dutch).

The water had the following average composition per cent.:—

	Per Cent.	
Dry matter	2·018	
Free ammonia	0·193	0·326
Ammonium salts	0·078	
Organic ammonia	0·055	
Phosphoric acid	0·131	
Potash	0·069	

The filter-pressed limey cake has the composition—

	Per Cent.	
Moisture	41·603	
Calcium carbonate	52·270	
Nitrogen	0·518	Of which 0·0323 per cent. is ammonia.
Potash	0·155	
Phosphoric acid	1·157	
Various matters	5·307	

And is regarded by A. Mayer of manurial value for soils poor in lime, for the improvement of acid meadows, for autumn dressings of clayey soils, and especially for bean, clover, and pea crops.

The results have proved so satisfactory that a plant of a capacity of 250 cubic metres per 24 hours to deal with all the liquid of the sewage of Amsterdam is in course of construction.—D. A. L.

On the Utilisation of Chalybeate Springs for the Water Supply of Towns. C. Piefke. J. f. Gasbeleuchtung, **34**, 61—64 and 84—88.

The water on which the author's experiments were carried out was of the ordinary chalybeate kind, containing from 1 to 15 mgrms. of iron per litre in the form of ferrous carbonate, together with a large excess of free carbonic acid gas. On exposure to the air, the water became rapidly clouded owing the loss of carbonic acid and consequent precipitation of ferric hydrate, and only after standing about two days was the iron sufficiently reduced in amount to allow the water to remain clear. A small sample filtered through paper gave the following results:—

	Mgrms. per Litre.		
	CO_2 free and combined (as bicarbonates).	Free CO_2	Iron as FeO.
Fresh.....	131·5	78·5	3·24
After 6 hours	118·1	61·1	0·30
After 21 hours	106·0	48·0	0·72
After 24 hours	100·0	42·0	0·59
After 30 hours	97·0	39·0	0·45

This method for the removal of the iron becomes impracticable on the large scale as it involves the loss of two of the most valuable characteristics of spring water, viz., its uniformly low temperature, and its freedom from micro-organisms. The removal of the excess of carbonic acid, part of which is probably loosely combined with the iron in the form of a bicarbonate, by means of milk of lime is also unavailable for the same reason. If the water is broken up into the form of a spray and allowed to fall through the air from a height of about 6 ft., some carbonic acid is given off, but the loss is smaller than is generally imagined. Far better results are obtained by raising the water by means of a pump fitted with a long suction pipe; so much gas being given off in the partial vacuum, that on issuing into the air, the water becomes immediately cloudy. The ferric hydrate, however, precipitated by any of these methods is in such a fine state of division that much of it passes through the sand filters.

It is found that, on allowing the water to run over large surfaces of broken stones, the greater part of the iron crystallises out as ferrous carbonate, which is gradually converted by the air into ferric hydrate. This substance, not being crystalline, and adhering so strongly to the stones that a powerful jet of water is unable to remove it, prevents the further deposition of crystals, but at the same time apparently acts as a carrier of the oxygen of the air to the ferrous carbonate; hence, if the stream of water is continued over the stones after their having received the coating of ferric hydrate, the iron is almost instantaneously removed, and the excess of carbonic acid gas is free to escape into the air.

The apparatus for the purification of the water on this principle consists of a cylindrical vessel of 0·75 m. diameter, filled with coke to a height of 1·5 m. The water is pumped up from the wells to the top, falling on a metal plate perforated with very small holes so as to expose to the air as large a surface as possible. It then passes through the coke column, the exit pipe being made sufficiently large to prevent any portion of the coke from being covered with water, to a sand filter of the ordinary construction. The first water experimented on contained from 3 to 4 mgrms. per litre of iron (calculated as FeO), and the apparatus was found capable of dealing with from 2 to 4 cbm. per hour, the ground space occupied by the "aerator" being 1 sq. metre. The passage through the coke occupied about 30 seconds, and the ferric hydrate was found to be precipitated in particles of sufficient size to be completely retained on the sand. Other experiments were tried on a water containing 6·72 mgrms. of iron per litre, the coke column being 2 m. high and 0·99 m. in diameter, the speed of flow being 7 cbm., or 9 cbm. per 1 sq. m. of ground space per hour. In both cases the whole of the iron present in the water, except that actually dissolved, was removed, the filtrate remaining perfectly clear even on long exposure to the air.

The following table gives the results of various experiments, and shows that the removal of the iron is the more rapid the more the water originally contains, this being due to the greater rapidity with which the "aerator" becomes saturated with ferric hydrate.

Source of Sample.	Mgrms. per Litre.		Litres per 1 Sq. M. per Hour.	Speed of Flow through Aerator in Seconds.
	FeO.	CO_2 Free.		
Well.....	2·17	29·0		
Exit of aerator..	0·26	17·0	2,300	30
Exit of filter	0·10	11·0		
Well.....	1·82	25·0		
Exit of aerator..	0·30	13·0	2,300	30
Exit of filter	0·15	8·0		
Well.....	2·88	42·0		
Exit of aerator..	0·60	18·0	7,000	13
Exit of filter	0·20	12·0		
Well.....	2·94	40·0		
Exit of aerator..	0·50	30·0	6,000	15
Exit of filter	0·15	12·5		

—F. H. L.

PATENTS.

An Improved Sewage Filter. J. Lowe, Manchester. Eng. Pat. 16,836, October 22, 1890. 6*d*.

This filter is intended for town sewage. It consists of a large, cylindrical, wrought-iron vessel, capable of sustaining a steam-pressure of 200 lb per sq. in., and fitted up with valves, pipes, and a filter-bed impervious to all solid matter. The crude sewage is driven through the filter by means of the steam-pressure.—P. J. H.

Improvements in Apparatus for Automatically Regulating the Supply of Precipitating Materials to Sewage, and for other Analogous Purposes. J. E. Keirby, Swinton. Eng. Pat. 2729, February 14, 1891. 8*d*.

The supply of precipitant is regulated by the raising or lowering of a cone in the mouth of the supply-hopper; this is worked by means of a wheel and chain connected with a float placed in the sewage chamber, or in the main outfall drain. The flow of sewage may be registered by connecting the float-chain with a dial or other indicator.—P. J. H.

(C.)—DISINFECTANTS.

PATENTS.

Improvements in the Manufacture of Disinfectants or Antiseptics. J. Y. Johnson, London. From F. von Heyden, Radebeul, Germany. Eng. Pat. 9103, June 12, 1890. 6*d*.

The invention consists in obtaining aqueous solutions of the cresols, xylenols, and higher-boiling phenols, which can be diluted to any desired extent without separation of the phenols, these higher-boiling phenols being superior to other phenols as disinfectants. The solutions can be made by dissolving the phenols in aqueous solutions of the sodium salts or other alkaline or alkaline-earth salts of various organic acids, among which are mentioned the *o*-hydroxy-

benzene carboxylic acids, the *o*-hydroxybenzene sulphonic acids, benzoic acid, benzene, carboxylic acids, and benzene sulphonic acids, and their homologues. The salts of the corresponding acids of the naphthalene series may also be used. As an example the following is given: "When to 12 parts by weight of sodium salicylate, 10 parts by weight of water are added, no solution takes place at low temperatures, but when 5 parts by weight of cresol are added and mixed with these ingredients a clear solution is obtained which can be diluted as required without separation of the cresol." These solutions are suitable as surgical antiseptics. A table of the various organic salts and the proportions in which they should be mixed with water and the phenols is given.

A valuable disinfecting fluid can also be made by mixing cresol with caustic soda or calcined lime, and water.

—H. S. P.

A Method of rendering Antiseptic and Preparing Gauze, Lint, Ligatures, and other Fabrics for Use in Surgery. C. R. C. Tichborne and F. T. Henston, Dublin. Eng. Pat. 11,985, July 31, 1890. 4*d*.

The gauze, &c. is rendered antiseptic by depositing zinc sulphite in the fibre. The fabric is boiled in water for some time; to this zinc sulphate in the proportion of 12 oz. to 2 galls. is then added, and after boiling again, an equivalent amount of sodium sulphite (in concentrated boiling solution) and also a small amount of some antiseptic non-poisonous dye are further added. The whole is allowed to stand till quite cool, say 8—12 hours. To free the fabric from soluble by-products it is then run twice, by means of rollers, through running water, to which an antiseptic has been added.

The zinc sulphite may also be deposited in the fibre, by using other salts, such as zinc chloride and calcium sulphite; or (2) by means of a solution of zinc sulphite in sulphurous acid, the sulphurous acid being afterwards driven off by heat or neutralised.—P. J. H.

XIX.—PAPER, PASTEBOARD, Etc.

PATENTS

A New or Improved Metallic Foil-Coated Air-tight and Grease-proof Paper. F. W. Crowther, London. Eng. Pat. 7971, May 22, 1890. 4*d*.

The inventor coats a grease-proof paper such as that known as vegetable parchment paper, with tin or other metal.

—E. J. B.

Process of Impregnating Fibrous, Porous and Cellular Bodies, Working the Impregnating Material or Compound, and the New Article resulting therefrom. B. J. B. Mills, London. From E. T. Greenfield and J. Nagel, New York, U.S.A. Eng. Pat. 10,807, July 11, 1890. 6*d*.

The inventors impregnate such articles as paper tubes with melted pitch by a series of short immersions alternated with rests. In this way the impregnation is effected without the charring which would ensue if the article were allowed to remain in the melted pitch.—E. J. B.

Improved Apparatus for Recovering Sulphurous Acid used in the Manufacture of Paper Pulp from Wood. C. Kellner, Vienna. Eng. Pat. 7362, April 29, 1891. 6*d*.

The inventor describes and gives drawings of an arrangement for condensing the steam and sulphurous acid gas given off during the operation of boiling wood in a solution of an acid sulphite.—E. J. B.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES AND EXTRACTS.

Action of Sunlight on Organic Compounds. H. Klinger and O. Standke. Ber. **24**, 1340—1346.

See under IV., *page* 690.

The Simultaneous Action of Air and Light on a number of Organic Compounds. A. Bidet. Bull. Soc. Chim., 1891, **5**, 13—20.

See under IV., *page* 693.

Aspergillin: a Pigment Analogous to Blood-Hæmatin. G. Linossier. Compt. Rend. **112**, 489—492.

The spores of *Aspergillus niger* contain a black pigment which may be extracted with dilute aqueous ammonia and precipitated from this solution by hydrochloric acid. A voluminous, flocky precipitate is thus obtained which dries up to a black mass. This pigment in its physical, and certain of its chemical, properties closely resembles blood-hæmatin: both substances, for example, contain a little iron; both are reducible by sodium hyposulphite, and their reduction products re-oxidisable to the original substances by exposure to air. The author is further investigating the chemical and physiological properties of this pigment.—E. B.

Pyrogenic Transformation of Camphophenolsulphonic Acids into Homologues of Phenol. P. Cazeneuve. Compt. Rend. **112**, 730—732.

When a mixture of the barium salts of the five camphophenolsulphonic acids previously described (compare this Journal, 1890, 647) is submitted to dry distillation, hydrogen sulphide, sulphurous anhydride, carbonic anhydride, methane, and probably propane, or propylene, are evolved, and a liquid distils over. This liquid contains very small quantities of hydrocarbons and considerable quantities of phenols; ortho- and meta-cresol were isolated from the mixture; analyses of the higher boiling fractions gave results agreeing with those required by mixtures of cresols, propylphenols, and cymophenols.—F. S. K.

Terebenthene. R. Varet. Compt. Rend. **112**, 732—734.

Gustavson has shown that, when cymene is treated with bromine in presence of aluminium bromide it is decomposed quantitatively into pentabromotoluene and isopropyl bromide; the author has made some analogous experiments with terebenthene, which is considered by some to be a hydrocymene, and finds that it behaves quite differently.

When essence of terebenthene is warmed gently with anhydrous aluminium chloride a violent reaction takes place and a tarry product, from which cymene and toluene can be isolated, is obtained. On gradually adding aluminium chloride to a well-cooled carbon bisulphide solution of terebenthene an energetic reaction occurs and the terebenthene is converted into meta- and tetra-terebenthene, small quantities of cymene and other hydrocarbons being also produced. When terebenthene is gradually added to a well-cooled solution of bromine, containing aluminium chloride in suspension, hydrogen bromide is evolved, and various bromo-derivatives of polymerides of terebenthene are formed, together with small quantities of isopropyl bromide.—F. S. K.

The Conversion of Cupreine into Quinine. E. Grimaux and A. Arnaud. Compt. Rend. **112**, 774—775.

Cupreine, which has been prepared from the *Quina cuprea* and *Remijia pedunculata* by Paul and Cownley, is a base soluble in alkalis, and is apparently phenolic in character. The relationship of cupreine, $C_{19}H_{22}N_2O_2$, to quinine,

$C_{19}H_{24}N_2O_2$, is the same as that of phenol to its methyl ether. The transformation of cupreine into quinine is effected by treating a solution of cupreine in methyl alcohol with sodium and then with methyl iodide, the temperature, starting from zero, being gradually raised during several hours. Under these conditions quinine itself is not formed, but quinine mono- and dimethyl iodides. When operating in a closed vessel with an excess of methyl iodide only the latter body is produced. Methyl-cupreine dimethyl iodide agrees in all its properties with quinine-dimethyl iodide, as is shown by the following figures:—

	Quinine dimethyl iodide.	
	Synthetical.	Natural.
Melting point (with partial decomposition)	167—168° C.	167—168° C.
Rotatory power α_D	−150°8	−151°6
Percentage of iodine	41·34	41·77

If the methyl iodide be replaced by methyl chloride, free quinine is formed. A mixture of one molecule of cupreine, one atom of sodium, and one molecule of methyl chloride, dissolved in methyl alcohol, is heated to 100° C. in a closed tube. The product of the reaction is evaporated to dryness, washed with a dilute soda solution in order to remove any unaltered cupreine, and finally extracted with ether, which dissolves the quinine. After conversion into sulphate of quinine the product resembles the natural article in all respects. It is an interesting fact that ethyl derivatives do not occur in vegetable products. Thus, the alkaloid of the hemlock consists of a mixture of cicutine and methyl-cicutine; morphine is accompanied in opium by methyl morphine, or codeine; quinine is shown to be methyl-cupreine; and eugenol, and the essences of gaultheria and anise-seed, &c., are the methyl ethers of phenolic bodies. The cause of this phenomenon must be sought for in the mode of nutrition of plants, which absorb carbonic acid from the air and transform it by reduction into methyl aldehyde and then into methyl alcohol.—H. T. P.

A Vegetable Hæmatin, Aspergillin. G. Linossier. Compt. Rend. **112**, 807—808.

In this paper the author shows that *aspergillin*, which he has recently prepared from *Aspergillus niger*, (Compt. Rend. **112**, 489, see preceding page), is in no way identical with *palmellin* obtained from *Palmella cruenta*, and described by Phipson in 1879.—H. T. P.

Isocinchonine. E. Jungfleisch and E. Léger. Compt. Rend. **112**, 942—944.

Hesse has recently expressed an opinion that his isocinchonine (this Journal, 1888, 350) is identical with the *cinchonigine* obtained by the authors. The latter have repeated Hesse's experiments dissolving in the cold, 60 grms. of cinchonine sulphate in 360 grms. of pure concentrated sulphuric acid, pouring into cold water after 24 hours at 17°, then supersaturating with soda, cooling and extracting with ether. The ethereal extract left on evaporation, Hesse's isocinchonine, was dissolved with the aid of heat in dilute hydrochloric acid, and when neutralised and cooled the solution yielded *cinchonigine hydrochloride*; the mother-liquor after concentration was treated with soda; the alkaloids thus liberated, extracted with ether and treated with colourless hydriodic acid in slight excess, yielded crystals of cinchonihine hydriodide, after removal of all the cinchonigine and cinchonihine, 11·8 grms. of the former and 12·7 of the latter were obtained, a non-crystallisable base remained. These results indicate that Hesse's isocinchonine is really a mixture. The authors deny the imputation as to the questionable purity of their materials.—D. A. L.

Condition of Tartaric Acid in Aqueous Solutions. Aignan. Compt. Rend. **112**, 951—953.

In order to decide whether tartaric acid in solution existed as a polymer or hydrate in state of dissociation, the author has made comparative osmometric observations with solutions of tartaric acid and solutions of sugar, and his results support the view that tartaric acid in aqueous solution exists in the state of a polymer $(C_4H_6O_6)_2$ partially dissociated and conforms with a law based on the results of Biot's experiments to the effect that:—the proportion of the compound $(C_4H_6O_6)_2$ dissociated by solution is equal to the proportion of solvent in the liquid examined.—D. A. L.

Compounds of Mercuric Chloride. G. André. Compt. Rend. **112**, 995—998.

Crystals of the composition $4\,ZnCl_2, HgCl_2, 10\,NH_3 + 2\,H_2O$ are obtained when boiling mercuric chloride is gradually added to saturation to a hot solution of zinc oxide dissolved in concentrated ammonium chloride. The crystals are readily soluble in hydrochloric acid, insoluble in, but decomposed by, hot water, yielding an anhydrous mixture of zinc oxychloride and oxydimercurammonium chloride. A crystalline double chloride of analogous character and composition, $2\,ZnCl_2, HgCl_2, 6\,NH_3 + \frac{1}{2}\,H_2O$, is obtained by dissolving simultaneously 20 grms. zinc oxide and 20 grms. yellow mercuric oxide in a boiling solution containing 100 grms. of ammonium chloride. By agitating 1 mol. of mercuric chloride in aqueous solution with 2 mols. of aniline a white precipitate of the composition $NH_2C_6H_3HgCl_2$ is formed, but by mixing aqueous or alcoholic solutions of mercuric chloride and aniline with excess of aniline, compounds are obtained containing excess of mercury in relation to the chlorine, probably as oxide. When, however, mercuric chloride in the proportion of 1 mol. is added gradually to a proportion of 8 mols. of aniline in boiling solution, a yellow substitution product of the composition $5\,NHC_6H_3HgCl + 2\,HgCl_2$ is precipitated, which is very stable; heating with water or alcohol, even for hours, simply converts it into $3\,NHC_6H_3HgCl + 2\,HgCl_2$. Of the corresponding benzylamine compounds, $C_6H_5.CH_2.NH_2.HgCl_2$ is obtained as a white precipitate by adding one molecular equivalent of benzylamine in solution to 4 molecular equivalents of boiling mercuric chloride, or by boiling 1 mol. of mercuric chloride with 2 mols. of benzylamine, both dissolved in alcohol, whereas the compound $NHCH_2C_6H_5.HgCl$ is obtained as a white precipitate by pouring 1 molecular equivalent of mercuric chloride into 4 mols. of benzylamine in boiling aqueous solution. This compound is insoluble, whilst the additive compound just mentioned is soluble in boiling water.—D. A. L.

Antiseptic Properties of Amethylcamphophenolsulphone. P. Cazeneuve and Rodet. Bull. Soc. Chim. 1891, **5**, 649—650.

Amethylcamphophenolsulphone is only a feeble antiseptic agent compared with the true aromatic phenols, and it has no poisonous effects on animals. Its antiseptic action on *Bacillus anthracis* begins to be manifest in solutions containing 1 part in 100, on *Bacillus fluorescens liquefaciens* in solutions containing 1 part in 70, and on *Micrococcus pyrogenes aureus* in solutions containing 1 part in 50.—F. S. K.

Methyl Iodide. L. H. Friedburg. Jour. Amer. Chem. Soc. 1891, **13**, 144.

Instead of the usual method of preparation, the following were tried:—

(*a.*) Iodine was dissolved in methyl alcohol, and sulphuretted hydrogen was then passed to decolourisation of the solution. In addition to methyl iodide, sulphur compounds were obtained.

(*b.*) Instead of sulphuretted hydrogen in the preceding, sulphur dioxide was used. Methyl iodide was formed in small quantity, but the main product consisted of various ethers.—T. L. B.

Note on Acid Calcium Tartrate. L. H. Friedburg. Jour. Amer. Chem. Soc. 1891, **13**, 144.

The method of purifying the mother-liquors from the tartaric acid manufacture being to form acid calcium tartrate, the author proposes the use of the solution of tartrate so obtained for the *manufacture* of the salt contained in it. The salt could then be used advantageously either alone or mixed with cream of tartar for baking powders.

T. L. B.

PATENTS.

An Improvement in Ozone Water and in the Method of Making same. J. C. Dittrich, New York, U.S.A. Eng. Pat. 3118, February 20, 1891. 4*d*.

The invention has for its object the making of ozonised water which will keep for an indefinite length of time even when exposed to light or to a high temperature. This is accomplished by adding a phosphite or hypophosphite to the water, to the amount of about 1 part of the phosphite or hypophosphite in 1,000 parts of water, either before or after charging the water with ozone.—H. S. P.

Ozonizing Apparatus. J. Guenet, Paris, France. Eng. Pat. 6374, April 14, 1891. 6*d*.

This is an apparatus for making ozone, and a drawing of the apparatus accompanies the specification. It consists of an "ozonising tube," an induction coil, and bellows with compressed air reservoir, the whole enclosed in a case. The ozonising tube is of glass, and within it are placed three or more smaller glass tubes. The large outer tube is connected by two terminal screws with the induction current from the induction coil. Around the inner smaller tubes platinum wires are coiled which are twisted together at one extremity of the tubes and connected with one of the terminals on the larger outer tube. Rods made of any good metal conductor are placed inside the smaller tubes and the ends of these rods are connected to each other by a platinum wire and this is connected to the other terminal on the outer tube. Compressed air is forced through the large outer tube, and when an electric current is passed through the apparatus by attaching the coil to a battery, the air becomes ozonised and is drawn off at an exit tube attached to the large outer tube.—H. S. P.

XXIII.—ANALYTICAL CHEMISTRY.

APPARATUS.

Note on the Calibration of Burettes. D. Carnegie. Chem. News, **64**, 42—43.

The method of calibrating burettes given in the text-books is roughly as follows:—

The burette is filled with water, and successive portions —corresponding to 5 cc. or so—are run out into dry beakers. From the weights of these successive portions a table of corrections can easily be deduced. This method, in the case of an ordinary 50 cc. burette and with 5 cc. tests, involves at least 11 weighings and 10 level-readings.

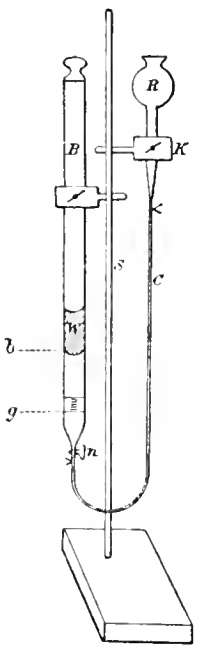
The method of calibration the author would suggest is, he believes, more accurate than the above, and involves no weighing whatever; for it is quite a matter of indifference to the chemist, whose measurements are all relative, whether he adopts as his unit the true cubic centimetre or an arbitrary one.

The principle of the method consists in causing a constant volume of liquid to slide in the burette (so that it may be made to assume any desired position therein), and then reading off its length in terms of the burette divisions.

In the Fig. the burette B is attached by means of caoutchouc tubing C to a reservoir R, which is filled with water, and which can easily be raised or lowered by sliding the clamp K along S. On the surface of the water in the burette there is a small column of carbon bisulphide W, which obviously can be made to assume any desired position in the burette by either raising or lowering R, and then turning the stopcock *n* very gently.

In the first experiments mercury was used in place of water in R, and water instead of carbon bisulphide as a movable index. But this combination was unsatisfactory; it was found to be exceedingly difficult to read the level *l*, both on account of the convexity of the mercury surface and also on account of the peculiarly disturbing light reflection from the bounding water-mercury surface.

The combination, water and carbon bisulphide, works admirably if the following precautions be taken:—



The burette must be *thoroughly cleaned* from grease and dust before calibration. The reservoir R is then filled with freshly-distilled water, and matters are so arranged that the level of the water stands at *g*, the *lowest* graduation of the burette. A long thistle funnel is then inserted into the burette, and a small quantity (say 5 cc.) of recently distilled carbon bisulphide is poured gently on the surface of the water. Under these circumstances the carbon bisulphide, in spite of its higher specific gravity, floats on the water, and exhibits two easily localised concave menisceuses. It is well to shake the carbon bisulphide up with distilled water so as to thoroughly saturate it, and to tint it slightly with iodine before pouring it into the burette.

The method of procedure is obvious. In altering the position of the carbon bisulphide index, it is well to let it rise a little higher in the burette than the required graduation, and then lower it by careful manipulation of the stopcock *n*. The burette should of course be kept stoppered as much as possible during the calibration.

The method works satisfactorily *only* when the calibration is effected as described—from below upwards.

The readings obtained can be used for calibration as described in detail in Bunsen's "Gasometry."

In order to avoid errors of parallax in reading off the levels of the carbon bisulphide column, the author has a silver strip on the back of the burette. This mirror strip, which does away with all floats and similar devices for avoiding errors of parallax in the subsequent use of the burette, is easily made as follows:—The burette, having

been thoroughly cleaned externally, is corked air-tight, and then inverted in a tall cylinder containing an alkaline silvering fluid.* After some time it is withdrawn, and allowed to become *thoroughly air-dried*. The silver can then be easily removed from the front and sides by scraping, followed by a final rubbing with a rag moistened with dilute nitric acid. The strip of silver backing the burette is then fixed by one or two coats of varnish.

In reading such a burette it will be found advantageous to look at the menisens through a slit cut in a sheet of white *glazed* paper, held at an angle to the vertical. The burette graduations are also rendered very much more distinct by rubbing the front of the burette first with a piece of flannel on which a paste of turpentine and mercuric iodide has been placed, and then with a dry cloth.

Employment of the Calorimetric Bomb for Determining the Heat of Combustion of Coal. Scheurer-Kestner. Bull. Soc. Chim. 1891, **5**, 941—945.

Abridged abstracted from Compt. Rend. **112**, 233—236; this Journal, 1891, 659.

INORGANIC CHEMISTRY.—QUALITATIVE.

The Influence exerted by Various Neutral Potassium Salts on the Solubility of Potassium Bitartrate. C. Blarez. Compt. Rend. **112**, 808—811.

See under XVII., *page* 717.

Detection of the Sulphur not Combined with Hydrogen in Illuminating Gas. "L. Ilosvay de N. Ilosva." Bull. Soc. Chim. 1890, **4**, 714—715.

Paper soaked in thallous hydrate is readily blackened when held over a Bunsen burner that has struck back. This blackening is not due either to hydrocarbons or to sulphuretted hydrogen contained in the gas, but, according to the authors, to the sulphuretted hydrogen formed as a product of the incomplete combustion of the bodies containing carbon combined with sulphur which are in the gas. The hydrogen with which the liberated carbon enters into reaction may be either free or combined. The decomposition takes place at a temperature between 355 and 360° C. To test for the presence of such sulphur compounds in coalgas, it suffices to hold a piece of lead acetate paper over a Bunsen flame, burning at the bottom, for one minute. The sulphuretted hydrogen contained as such in the gas will take considerably longer to blacken the paper.

C. A. K.

A New Method for the Separation of Iron from Cobalt and Nickel. G. A. Le Roy. Compt. Rend. **112**, 722—723.

In estimating nickel and cobalt by the electrolytic method usually employed, the presence of manganese is without influence on the result, but iron, if present, must be previously removed; the author describes a process by which the tedious separation of the iron before electrolysing is obviated.

The metals, in the highest state of oxidation, are dissolved in sulphuric acid, a very small quantity of a non-volatile organic acid, such as citric acid, is added, and then a concentrated ammoniacal solution of ammonium sulphate; the solution is then electrolysed with a current from two Bunsen cells (= 300 cc. of explosive gas per hour), whereon the manganese is deposited at the positive pole and the nickel and cobalt, together with the iron, at the negative pole. When deposition is complete, the negative electrode is washed with distilled water, and then immersed in a fresh concentrated ammoniacal solution of ammonium sulphate, where it serves as the positive electrode, a clean piece of platinum, previously weighed, serving as the negative electrode. A current (= 100 cc. of explosive gas per hour) is then passed through the solution; under these conditions the metals on the positive electrode are oxidised and the nickel and cobalt pass into solution, being finally deposited in the metallic state on the negative electrode; the iron, on the other hand, is transformed into insoluble ferric hydrate, and remains attached to the positive electrode or suspended in the solution.—F. S. K.

New Process for Estimating the Oxygen dissolved in Water. G. Linossier. Bull. Soc. Chim. 1891, **5**, 63—66.

The principle of the method is as follows:—The oxygen is absorbed by an alkaline solution of ferrous tartrate, added drop by drop to the water, phenosafranine being used as indicator. So soon as the free oxygen has disappeared the first drop of ferrous salt added in excess decolourises the liquid. The estimation is carried out in a half-litre flask, furnished in its lower portion with a stop-cock. Into this flask are introduced 400 cc. of mercury, then 20 cc. of soda (36° B.), 20 cc. of a 20 per cent. solution of Rochelle salt, a drop or two of an alcoholic solution of phenosafranine, and lastly water. A two-holed rubber stopper is then placed in the neck of the flask, care being taken that no air remains in the flask; through one hole of the stopper is introduced the socket of a Mohr's burette previously filled with a standard solution of ferrous sulphate; the other communicates with a tap funnel for the introduction of the water to be examined. When all is ready the lower cock is opened, and if the apparatus proves to be tight, ferrous sulphate solution is very carefully run in until the rose colour of the solution in the flask first disappears; 50 cc. of the water to be examined are now introduced by the aid of the tap funnel, mercury escaping from the lower cock as the water flows in from the funnel. The rose colour reappears, and the solution is then directly titrated with the ferrous sulphate until the colour once more disappears. Agitation is easy and complete by aid of the mercury in the flask.

A second determination may be carried on directly the first is ended, by simply introducing another 50 cc. of water and again titrating; and the number of successive determinations is limited only by the capacity of the flask. The first two determinations are generally slighly low.

With regard to the calculation of results it is stated that the quantity of dissolved oxygen as calculated directly from the amount of iron solution is lower than the quantity obtained by extraction with the pump. Keeping the same proportion of soda and Rochelle salt, however, the relation of iron solution used to oxygen dissolved in the water is a constant one, and therefore all that is necessary is to ascertain once for all the factor for the iron solution by aid of a known oxygen solution. There is no necessity to continuously standardise the ferrous sulphate solution, as this may be kept for a very considerable time if strongly acidified with sulphuric acid and it kept under oil. The presence of nitrates and nitrites is stated not to impair the accuracy of the results; among organic substances only such as exercise an energetic reducing action, for instance glucose, form an obstacle to the use of the process.—T. L. B.

Estimation by Titration of Dissolved Carbon Dioxide in Water. A. R. Leeds. J. Amer. Chem. Soc. 1891, **13**, 98—99.

The amount of lime required to precipitate the dissolved calcium and magnesium carbonates in natural waters is generally under estimated, because any excess of carbon dioxide above that necessary to form calcium and magnesium bicarbonates is in most cases neglected. The free carbon dioxide may be readily estimated in waters by adding a few drops of a solution of phenol-phthalein and titrating with decinormal sodium carbonate until a pink tinge is obtained.

* Suitable fluids are described in Roscoe and Schorlemmer's "Treatise on Chemistry," vol. II., Part I., p. 53.

This occurs when all the carbon dioxide is combined as sodium bicarbonate. In the case of soft waters 500 cc. of the sample may be taken for titration, whilst of hard waters 100 cc. are sufficient. Too small an amount of the indicator should not be employed; about 10 drops of a strong solution added to 100 cc. of water will suffice.

—H. T. P.

Are Chemists generally prepared to Abandon Clark's Method for Estimation of Hardness in Waters? A. R. Leeds. J. Amer. Chem. Soc. 1891, **13**, 114—119.

The objects in view when hardness is determined are as follows:—

1. *Simply to place the water in the category of hard or soft waters.*

2. *Soap-destroying power.* For factory use the soap-destroying power is best found by actual trial with the water and soap to be employed. The results obtained by Clark's method unless special care be taken and time be of little moment, often vary widely from the true calcium carbonate equivalent, and do not necessarily indicate the real soap-destroying power.

3. *Boiler-incrusting solids.* Any deductions made from the results of the soap test, as regards scale-forming properties of a water, are little better than guess-work.

4. *Character and amount of chemicals required to precipitate the scale-forming substances.* Here again the process is faulty. In practice, a trial should always be made by adding the calculated amounts of reagents (generally lime or soda, or both) to the water, for the actual and theoretical results after treatment frequently differ.

For these reasons the author has abandoned Clark's process. A number of experiments, however, were made to test the capabilities of the method.—H. T. P.

Electrolytic Quantitative Separation of Metals. T. O'Connor Sloane. J. Amer. Chem. Soc. 1891, **13**, 140—142.

The author considers that greater recognition of the influence of difference of potential is required. For the decomposition of every solution a definite and absolutely fixed voltage is required; the strength of current affects only the condition of the deposit. The ampèrage of the current should not be broadly stated without reference to absolutely fixed conditions of electrodes. It would seem obvious, he continues, that a definite and absolutely fixed difference of potential being required for the decomposition of each compound, the voltage could be made the basis for analytical work; it would be possible to effect successive separation of metals from the same solution by modifying the voltage. It is suggested that work be done on these lines, two factors always being stated — difference of potential, and ampèrage per unit area of cathode.—T. L. B.

A Rapid Method of Estimating Nitrates in Potable Waters. G. Harrow. J. Chem. Soc. (Trans.), 1891, 320—323.

This method depends upon Griess's nitrite test with α-naphthylamine and sulphanilic acid, the nitrates present being reduced to nitrites by the addition of a small quantity of zinc-dust. The test solution used consists of 1 grm. α-naphthylamine, 1 grm. of sulphanilic acid, 25 cc. of concentrated hydrochloric acid dissolved in water boiled with animal charcoal and diluted to 500 cc. Standard solutions of potassium nitrate are also prepared containing respectively 1·0, 0·1 and 0·01 part of nitrogen per 100,000. 50 cc. of the water to be tested and of each of the standard nitrate solutions are placed in separate beakers standing on a sheet of white paper; 10 cc. of the test solution are added to each and then a small quantity (7—8 mgrms.) of zinc-dust. After 15 minutes a comparison of the colours will indicate approximately the amount of nitrates present in the water under examination, and an accurate determination may be obtained by using Nessler glasses and determining the degree of dilution required to bring the colour obtained from the water under examination equal to that of the weakest standard. The advantages claimed for this process are its rapidity and simplicity and the small quantity of water required.—A. K. M.

ORGANIC CHEMISTRY.—QUALITATIVE.

The Use of Phenylhydrazine for the Detection of Sugars. Maquenne. Compt. Rend. **112**, 799—802.

Phenylhydrazine is a very useful reagent for precipitating and distinguishing certain sugars when in admixture with other bodies; but it fails when only small quantities of the sugar under examination are available, and when other reducing bodies are present. For instance, it is impossible by the use of phenylhydrazine alone to distinguish dextrose and mannose from levulose. The author finds, however, that the weight of osazone precipitated in a certain time under standard conditions varies widely for the different sugars, but is a constant quantity for each particular species. The numbers given in the following table were obtained by heating to 100° C. for 1 hour a mixture of 1 grm. of sugar, 100 cc. of water, and 5 cc. of a solution containing per 100 cc. 40 grms. of phenylhydrazine and 40 grms. of glacial acetic acid. After cooling, the precipitate was collected on a tared filter-paper, washed with 100 cc. of water, dried at 110° C., and weighed.

Sugar employed.	Weight of Osazone.	Remarks.
	Grm.	
Sorbin, crystallised ...	0·82	Turbidity in 12 minutes.
Levulose, crystallised .	0·70	Precipitate after 5 minutes.
Xylose, crystallised ...	0·40	Precipitate after 13 minutes.
Glucose, anhydrous ...	0·32	Precipitate after 8 minutes.
Arabinose, crystallised	0·27	Turbidity in 30 minutes.
Galactose, crystallised	0·23	Precipitate after 30 minutes.
Rhamnose, crystallised	0·15	Precipitate after 25 minutes.
Lactose, crystallised ..	0·11	Precipitate only after cooling.
Maltose, crystallised ..	0·11	Precipitate only after cooling.

Using solutions of only half the above strength, the sugars come practically in the same order, excepting that levulose takes the lead. It is easy by this method to distinguish between glucose and galactose, for instance, but it is most useful in the study of the polyglucosos. It is only necessary to compare the weight of osazone yielded by the inversion products of the sugar being examined, with the amount of osazone obtained from a mixture of glucoses most likely to be similar in composition to the said inversion products. Various polyglucoses were treated in this manner, sulphuric acid being used to effect the inversion. Below are the results obtained:—

	Nature of the Sugar.	Weight of Osazone.
		Grm.
1.	Cane sugar	0·71
	Dextrose and levulose (of each, 0·526 grm.)	0·73
2.	Maltose	0·55
	Dextrose (1·052 grm.)	0·58
3.	Raffinose, crystallised.....	0·48
	Levulose, dextrose, and galactose (of each 0·303 grm.)	0·53
4.	Lactose, crystallised.....	0·58
	Dextrose and galactose (of each, 0·500 grm.) ...	0·39

Operating in this manner the author confirms the observation of Alekhine that melezitose yields only dextrose on complete inversion.—H. T. P.

The Properties of Fig Wine. P. Carles. Compt. Rend. **112**, 811—812

See under XVII., *page* 718.

The Detection of Margarin in Butter. R. Lézé. Compt. Rend. **112**, 813—815.

1·5 cc. of a strong solution of cane sugar are placed in a test-tube marked at 10 cc. The tube is placed in warm water, and the butter to be tested is added in small quantities until the 10 cc. mark is reached. A cork is then inserted, the butter and syrup are rapidly mixed by shaking, and the tube is fastened to one end of a length of cord and whirled round quickly for a short time. Under these conditions pure butter yields a clean transparent layer of butter-fat and a voluminous layer of a whitish emulsion. In the case of margarin, or butter containing margarin, the separated fat is milky and turbid, owing to the presence of emulsified air, which margarin always contains. By means of this test it is possible to detect an adulteration of butter with 20 per cent. or even 15 per cent. of margarin. Another distinction between the two fats is that melted margarin or butter containing margarin remains fluid much longer than melted pure butter. Pure butter becomes solid and opaque when the margarin is still fluid and semi-transparent. Of course, in making comparisons of this kind, it is necessary to work under strictly identical conditions throughout.—H. T. P.

Reaction for Tartaric Acid. E. Mohler. Bull. Soc. Chem. 1890, **4**, 728—729.

A ONE per cent. solution of resorcinol in strong sulphuric acid gives a reddish-violet colouration with tartaric acid when the mixture is heated gently to about 125° C.; the colour darkens on further warming; at 190° C. carbonisation ensues. The reaction serves as a delicate test for tartaric acid, a few drops of the reagent being added to the residue left after evaporating the suspected solution to dryness. $\frac{1}{1000}$ mgrm. of the acid can be detected in this way. Neither succinic, malic, citric nor benzoic acid react in this way. Salts of the acid can be similarly tested; in presence of organic matter the tartaric acid must first be isolated. Nitrous and nitric acid must also be absent, since they both give a blue colouration with resorcinol which masks the other reaction. Attempts to isolate the colouring matter were unsuccessful; it is destroyed on the addition of water.

Pyrogallol and phloroglucinol give analogous reactions, the former producing a violet, the latter a red colouration. —C. A. K.

Notes on Certain Reactions for Tyrotoxicon. H. A. Weber J. Amer. Chem. Soc. 1890, **12**, 485—487.

THE author has examined numerous examples of poisonous cheese for the presence of tyrotoxicon, by Vaughan's test. The test consists in digesting the sample with water at the ordinary temperature, and extracting the aqueous solution with ether after making it alkaline with sodium carbonate. After distilling off the ether, the residue is tested by means of ferric chloride and potassium ferricyanide when Prussian blue is precipitated and by the addition of a few drops of a mixture of phenol and strong sulphuric acid, when a reddish yellow colouration ensues which turns permanently violet after standing for some hours. All the samples examined gave these two reactions, but when tested physiologically they failed to show the presence of tyrotoxicon, which is an active poison. The above reactions are therefore not due to tyrotoxicon at all, but according to the author's results to the presence of an organic base, probably an amine on the one hand, which gives the Prussian blue reaction, and to butyric acid on the other hand, which gives the colouration with phenol. Both these substances are liable to occur in any old sample of cheese, milk, or cream, and would be extracted together, probably in the form of a salt, on treatment with ether. It is these bodies also which cause the orange-red colouration that diazobenzene gives with phenol, when the former is extracted from whey by means of ether, a reaction the diazobenzene does not give alone.—C. A. K.

The Detection of Rosin Oil in Fatty and Mineral Oils, especially Train Oil. A. Grittner. Zeits. f. angew. Chem. 1891, 265—266.

THE rosin oils examined by the author gave the characteristic colour when treated either by Morawsky's process (this Journal, 1889, 572) or by Holde's (this Journal, 1888, 526; and 1890, 419). Dark coloured rosin oils are best examined by the latter method owing to the deep colour of their solution in acetic anhydride. Mixed with rape oil, rosin oil may be detected by Holde's test when only 1 per cent. is present, the limit in the former case being 0·5 per cent. The use of the weaker sulphuric acid (sp. gr. 1·53) is advisable when only small amounts of rosin oil are expected, as it remains almost colourless when shaken with pure rape oil, while acid of the sp. gr. 1·624 becomes dark yellow.

Train oil must be extracted with 90 per cent. alcohol, and the clear alcoholic solution examined; the acid being best added down the side of the tube so as not to mix with the solution. Morawsky's reaction is also here more delicate, but if the train oil is dark in colour Holde's must be employed. When rosin, shellac, or other resins are present the oil must be saponified and the rosin oil looked for in the unsaponifiable portion, as these substances also give the red colour. Mineral oils when dark in colour should be treated with the weaker acid, especially as the rosin oil reaction is given just as sharply as with the stronger.

Schadler's process of mixing five parts of train oil with one of syrupy phosphoric acid to obtain a red colour when rosin oil is present, is not reliable, the colour being at best only faint, and very different in appearance with different samples of rosin oil.—F. H. L.

ORGANIC CHEMISTRY—QUANTITATIVE.

Report to the United States Internal Revenue Department as to Standards and Methods for the Polarimetric Estimation of Sugars. C. A. Crampton, H. W. Wiley, and O. H. Tittmann.

See pages 677—681.

Preliminary Note on the Technical Analysis of Gambier. H. R. Procter.

See pages 681—683.

Analysis of a Mixture of Bees'-wax, Paraffin, Stearin, and Stearic Acid. F. Jean. Bull. Soc. Chim. 1891, **5**, 3—5.

THREE to four grms. of the mixture are heated to boiling in a flask with 50 cc. of 96 per cent. alcohol, the solution allowed to cool, and titrated with semi-normal alkali, employing phenolphthalein as the indicator. As the bees'-wax is only very slightly soluble in cold alcohol, the total acidity may be taken as due to the stearic acid. To determine the paraffin and the melissyl alcohol (of the bees'-wax), 3—4 cc. of 50 per cent. caustic soda solution are added to the contents of the flask, neutralised as above, and the whole saponified by heating to boiling for one hour, the flask being connected with an upright condenser. After the saponification is completed, the excess of alcohol is distilled off, the residue transferred to a crucible, mixed with dry silica and asbestos, and then dried at 100° C. This dried residue is next powdered and extracted with either chloroform or with petroleum ether, which dissolves the paraffin and the

melissyl alcohol. To separate the two constituents taken up by the solvent, the latter is distilled off and the residue dried at 100° C. and weighed. A portion of this residue is then heated with 4—5 cc. of acetic anhydride in a flask connected with an upright condenser for one hour, whereby the melissyl alcohol of the bees'-wax is converted into the acetyl ester, which is soluble in hot glacial acetic acid. To determine the proportion of the residue soluble in acetic acid, the mixture, after treatment with acetic anhydride, is transferred to a 10 cc. graduated glass tube; the glacial acetic acid is next added up to about the 9 cc. mark on the tube, which is then heated on the water-bath to 90° C., corked, well shaken, and again placed in the water-bath. After standing some time the volume of insoluble matter floating on the acid is read off and calculated as paraffin (1 grm. paraffin = 1·35—1·40 cc.). This weight deducted from the weight of the residue from the chloroform extract gives the weight of the melissyl alcohol of the bees'-wax. The portion of the saponified mixture obtained as above, which is insoluble in chloroform, consists of the soaps obtained from the stearic acid, the stearin, and the cerotic acid of the bees'-wax. To determine the stearin the mixture is dissolved in hot water, filtered from the silica and asbestos previously added, and the filtrate treated with a slight excess of dilute nitric acid, which separates the fatty acids present. These are filtered off and the glycerol (originally combined with the stearin) determined in the filtrate, after neutralising the latter and precipitating with lead acetate, by means of potassium bichromate. From the quantity of glycerol found, that of the stearin can be readily calculated. Finally the cerotic acid is taken by difference.—C. A. K.

Adulteration and Analysis of Bees'-wax. A. and P. Buisine. Bull. Soc. Chim. 1891, **5**, 651—660. (See also this Journal, 1891, 52—53.)

The substances most frequently employed for the adulteration of bees'-wax are paraffins, fossil waxes, ceresine (a fossil wax purified by treatment with sulphuric acid and subsequent distillation with superheated steam) and vegetable waxes, such as those of Carnauba, Japan, and China; stearic acid, suet, wax, or waxy acids extracted from the grease of the "suint" or sweat of sheep, rosin, and organic or mineral powders are also sometimes used. Mixtures of the substances named above are also employed, and so cleverly, that adulteration is difficult or impossible to detect by the usual methods of analysis, namely, those proposed by Becker, Hehner, and Hübl, which depend on a determination of the free and combined fatty acids in the sample. If, for example, a mixture of 9·48 parts of stearic acid, 38·84 parts of suet, and 53·68 parts of paraffin is used, the results of analysis as regards the fatty acids are identical with those obtained in the case of pure bees'-wax. It is necessary, therefore, to adopt other means for the detection of adulteration, and, in addition to the determination of the fatty acids, to estimate the iodine value, and the percentage of alcohols and hydrocarbons; although the results obtained in this way with different samples of pure bees'-wax are variable within certain limits, the complete analysis gives data sufficient for the detection and estimation of any added impurity when the properties of the latter have been previously determined.

In the following table the results of an examination of the most common adulterants of bees'-wax are given; the methods employed were the same as those previously described in the case of yellow and bleached bees'-wax (Bull. Soc. Chim. **3**, 867, and **4**, 165; this Journal, 1891, 52—53).

	I.	II.	III.	IV.	V.	VI.	VII.
	°C.						
Japan wax	47—54	2	18—28	216—222	6—7·55	69—74	0
China wax	53·5	2	22	218	6·85	72·3	0
Vegetable waxes	47—54	2	17—19	218—220	6·6—8·2	73—74	0
Carnauba wax	83—84	0	1—6	79—82	7—9	73—76	1·6
Mineral waxes	60—80	0	0	0	0—0·6	0	100
Paraffins	38—74	0	0	0	1·7—3·1	0	100
Wax from "suint"	62—66	0	95—115	102—119	13—18·5	0	14—18
Waxy acids from "suint"	59—62	0	155—185	159—189	2·6—2·8	0	0
Suet	42—50·5	0	2·75—5	196—213	27—10	52—60	0
Stearic acid	55·5	0	204	209	1	0	0
Rosin	..	0	168	178	135·6	35	0
Yellow bees'-wax	62—64	0—1	19—21	91—97	8—11	54—57·5	12·5—14·5
Bleached bees'-wax	63—64	0—2	20—25	93—110	2—7	53—57	11—13·5

Column I. gives the melting point of the substance.

Column II. gives the quantity of acids soluble in water, column III. the quantity of free acids, and column IV. the total quantity of acids contained in 1 grm. of the substance; the results are expressed in mgrms. of KOH.

Column V. gives the quantity of iodine fixed by 100 parts of the substance, column VI. the volume of hydrogen in cc. (measured at 0° and 760°) evolved from 1 grm. of the substance on treatment with potash, and column VII. the percentage of hydrocarbons.

By comparing the results of the analysis of the sample of bees'-wax with those given in the above table the nature of the added impurities can be determined; the composition of the mixture can then be calculated on the basis of the values given above, and the analysis verified by comparing these numbers with those determined experimentally.

—F. S. K.

Method of Determining Indigotine for Commercial Purposes. F. A. Owen. J. Amer. Chem. Soc. 1891, **13**, 32—33.

About 2 or 3 grms. of the sample are shaved off and coarsely powdered, and from this quantity 2 portions of 1 grm. each are accurately weighed out. In one of these determine the moisture by drying at 100° on a watch glass, and use the residue for the determination of the ash. The second portion is finely ground and then triturated several times in a glass mortar, and the whole transferred to 200 cc. flask. 3 grms. of zinc-dust and 60 cc. of ammonia (concentrated) are added, the flask then filled up with water to $\frac{1}{2}$ cc. above the 200 cc. mark and shaken. From half an hour to 2 hours is required for the reduction, during which period the shaking of the flask is continued at intervals. When the reduction is complete the froth will subside and the solution will become pale yellow, or with some samples which contain chlorophyll or other non-reducible green colouring matter, greenish-yellow. 50 cc.

of the solution are then removed by a pipette from the flask to a beaker, or porcelain dish, 5 or 6 drops of ether added and the whole agitated by blowing air through the pipette. The precipitated indigotine is acidified with hydrochloric acid, heated to boiling and collected on a tared filter-paper. Finally it is dried at 100° C. and weighed. The results are accurate, and it is not necessary to take any special precautions to prevent the absorption of moisture by the precipitate during the weighing. Lots when bought and retested should show no variation from the sample, except in the percentage of moisture, which will be higher than in the sample. Indigo often loses 20 per cent. on drying, and yields as much as 80 per cent. of indigotine on the dried sample.—C. A. K.

ANALYTICAL AND SCIENTIFIC NOTES.

On the Intensity of Transmitted Light when the Co-efficient of Transmission of the Medium is a Function of Time. Jas. Bottomley, Mem. and Proc. of the Manchester Literary and Phil. Soc. **4**, 1890—1891.

A HIGHLY mathematical treatise, in which, however, at its close the author observes that "the subject of his paper manifestly admits of several practical applications, as for instance *inter alia*, the quantitative determination of colouring matter undergoing change, in cases where the balance could not be used on account of the minute quantity of the body to be estimated, or an account of its instability."

Action of Sunlight on Organic Compounds. H. Klinger and O. Standke. Ber. **24**, 1340—1346.

See under IV., *page* 690.

The Simultaneous Action of Air and Light on a Number of Organic Compounds. A. Eidet. Bull. Soc. Chim. 1891, **5**, 13—20.

See under IV., *page* 693.

The Action of Running Water on Certain Minerals. J. Thoulet. Compt. Rend. **112**, 502—503.

THE loss of weight of calcareous minerals on exposure to the action of water, is much greater in the case of running, than in that of stagnant water. The author agrees with the theories of Mohr, and John Murray and Irvine, regarding the absence of limestone in the ocean depths.—E. B.

On the Use of Liquid Carbonic Acid for the Rapid Filtration and Sterilisation of Organic Liquids. A. D'Arsonval. Compt. Rend. **112**, 667—669.

See under XVII., *page* 717.

Action of Certain Reducing Agents on Sulphur and Selenium. E. Trautmann. Bull. Soc. Ind. Mulhouse, 1891, 87—88.

AN odour of hydrogen sulphide manifested itself on acting with tin and hydrochloric acid on an alcoholic solution of an aromatic nitro-compound which had been accidentally mixed with finely-divided sulphur; when the product of the reaction was poured into excess of water, a precipitate of stannous sulphide was produced. As the sulphur in question had been precipitated by acid from yellow ammonium sulphide, the presence of sulphurous acid was excluded, and the inference is, therefore, that hydrogen sulphide is produced by the action of nascent hydrogen on an alcoholic solution of sulphur.

Pursuing the subject, the author finds that in the presence of glacial acetic acid, a mixture of pure sulphur, tin, and hydrochloric acid, gives a more abundant yield of hydrogen sulphide than the same mixture in the presence of alcohol, and that, provided the sulphur be very finely divided, the gas is disengaged in small quantity, even in the absence of an organic solvent; moreover, a solution of stannous chloride in hydrochloric acid has a feeble action on sulphur. An acetic acid solution of sulphur also evolves hydrogen sulphide on treatment with zinc.

Selenium behaves similarly to sulphur in the above reactions.—E. B.

The Ferment-Action of Bacteria. T. L. Brunton and A. Macfadyen. Proc. Roy. Soc. **46**, 542—553.

THE experiments show that bacteria which liquify gelatin do so by means of a soluble enzyme which is capable of withstanding a slightly higher temperature than the bacteria themselves. By precipitating liquefied gelatin by alcohol, a precipitate was obtained which possessed the power of liquefying gelatin. A more active preparation was obtained in a similar manner from meat broth in which the bacteria had been cultivated. Acidity hinders, alkalinity favours the action of this enzyme. When the bacteria are grown in a solution containing starch, they secrete a diastatic enzyme which is quite distinct from the enzyme which liquefies gelatin. They will also grow in solutions of dextrose, and will disintegrate muscle, but will not grow in solutions of cane sugar or have any effect on fats.—A. L. S.

The Borderland between Physics and Chemistry. G. F. Barker. J. Amer. Chem. Soc. 1891, **13**, 11—29.

A PRESIDENTIAL address to the American Chemical Society. —C. A. K.

Alteration of the Density of Water on Heating. D. Mendeleeff. J. Russ. Chem. Soc. **23**, 183; J. Russ. Chem. Soc. 1884, 7; J. Chem. Soc. (Trans.) 1884.

THE expansion of water on rising the temperature of heating, in spite of its great scientific and practical importance, cannot be considered either theoretically fully explained or practically exhausted. All the existing determinations after all necessary but not sufficiently exact corrections, differ much too widely to be considered sufficient at the present state of scientific measurements and weighing up to the millionths.

Although this communication of the author, being the result of his working over the existing data on the subject, and forming but preliminary remarks, to be followed by his own experimental investigation, yet he proposes a new equation covering all that is known concerning the density of water. It is this:

$$S_t = 1 - \frac{(t-4)^2}{(A+t)(B-t)C}$$

A, B, and C being constants whose exact amounts hardly can be found on account of the want of exactness in the usual corrections. (For instance, the co-efficient of expansion of mercury and glass is considered constant, while this is not the case.)

In three elaborate tables the author shows:—

I. The existing data concerning the density of water by 13 different investigators.

II. Averages of the above data.

III. The author's figures calculated by means of his formulæ.

The principal data of the three are condensed into one table as follows:—

$t°$ C.	Average of all existing Data on the Density of Water on Hearing.	Volumes Calculated by Means of Mendeleeff's Formula, v_t.	Calculated Sp. Gr. of Water, s_t.	Possible Errors of Modern Determinations in Millionths.
°				
− 10	..	1,001,722	0·998281	∓ 49
− 5	1,000,662	1,000,676	0·999325	∓ 20
0	1,000,122	1,000,127	0·999873	∓ 12
+ 5	1,000,008	1,000,008	0·999992	± 3
+ 10	1,000,263	1,000,262	0·999738	± 15
15	1,000,847	1,000,849	0·999152	± 26
20	1,001,733	1,001,731	0·998272	± 35
25	1,002,871	1,002,880	0·997128	± 43
30	1,004,248	1,004,276	0·995743	± 49
40	1,007,700	1,007,725	0·992334	± 53
50	1,011,933	1,011,967	0·988174	± 65
60	1,016,915	1,016,926	0·983356	± 72
70	1,022,513	1,022,549	0·977948	± 80
80	1,028,819	1,028,811	0·971996	± 92
90	1,035,719	1,035,692	0·965537	± 109
100	1,043,180	1,043,194	0·958595	± 133
120	..	1,060,693	0·943314	± 190
140	..	1,079,667	0·926241	± 650
160	..	1,102,216	0·907263	± 700
180	..	1,128,167	0·886393	± 750
200	..	1,158,114	0·863473	± 800

—N. W. T.

PATENTS.

An Improved Stand for Chemical or other Purposes. A. W. Ellis, London. Eng. Pat. 3187, February 21, 1891. 8*d*.

An outer tube is fitted over the upright rod of the retort stand. The rings, &c., are clamped upon this tube, and the tube can be raised or lowered and held in any desired position by a collar and set-screw. The advantage of the contrivance is that when the rings have once been arranged as desired, the retort or other apparatus upon them can be raised or lowered by one movement instead of having to readjust each ring separately. Various modifications of the contrivance are described.—H. S. P.

Improvements in Centrifugal Apparatus for Testing the Composition of Milk and other Compound Fluids. S. C. Hauberg, Copenhagen, Denmark. Eng. Pat. 5175, March 23, 1891. 6*d*.

See under XVIII. *A., page* 719.

Trade Report.

(*From the Board of Trade and other Journals.*)

TARIFF CHANGES AND CUSTOMS REGULATIONS.

Great Britain and Ireland.

General Order as to Methylated Spirit.

Inland Revenue, Somerset House,
London, W.C., 20th July 1891.

Ordered—

That the attention of the officers of the Department be directed to the following regulations which are to be observed with regard to the preparation of methylated spirits for sale by retailers:—

1. An authorised methylator must in the presence of the proper officer of Inland Revenue mix with and dissolve in all methylated spirits, to be supplied to a retailer of methylated spirits for sale by him, a quantity not less than three-eighths of 1 per centum by volume of mineral naphtha of a specific gravity of not less than ·800. The mineral naphtha must before the mixing thereof be approved by the Board, samples being taken and dealt with as directed in Licence Instructions, page 69, paragraph 4.

New forms of requisitions have been prepared for obtaining methylated spirits for sale by retailers, and supervisors should apply to the Controller of Stamps and Stores for a proper supply.

2. Essential oil or other flavouring matter must not, without the express sanction of the Commissioners of Inland Revenue, be added to or mixed with methylated spirits.

3. A retailer of methylated spirits must not sell *or have* upon his premises for sale methylated spirits containing any essential oil or other flavouring matter, or in which mineral naphtha has not been dissolved.

4. In any case where methylated spirit for sale by retail is supposed from its odour to contain essential oil or other flavouring matter, or where the spirit, by remaining clear when diluted with water, shows the absence of mineral naphtha, a sample should be forwarded to the laboratory under the usual regulations.

5. A person who has been authorised to *receive* methylated spirits for *use* in any art or manufacture carried on by him, whether he holds or does not hold a licence as a retailer of methylated spirits, must obtain all methylated spirits from an authorised methylator only, and in the manner directed by sub-section 4 of section 124 of Spirits Act, 1880.

6. When in any case it is, from local circumstances, deemed desirable that an account should be kept by a retailer of methylated spirits in accordance with the terms of the 126th section of 43 & 44 Vict. c. 24., the supervisor should at once report the circumstances, and, if enjoined, the account should be in the following form:—

Methylated Spirit Retailer's Stock Account.

Requisition.			Permit.				Account of Sales.				
Date.	No. of	Gallons requisitioned.	Date.	From what Methylator received.	Of what Place.	Gallons.	Date.	Full Name of Person to whom Sold.	Of what Place and Address.	Trade or Occupation.	Gallons or Part of a Gallon Sold.

The present stocks of ordinary methylated spirits for sale by retail should be disposed of before the 1st January 1892. The other regulations specified are to be in force from the 1st September 1891.

A copy of this order should be delivered to every authorised methylator and every retailer of methylated spirits, and a memorandum must be entered of such delivery in the store and general register of the station."

Russia.

New Customs Tariff.

Sir R. B. D. Morier, Her Majesty's Ambassador at St. Petersburg, in a despatch to the Foreign Office, dated the 9th July, encloses a French translation, as published in the *Journal de St. Petersbourg*, of an article which has appeared in the "Ministry of Finance Gazette," on the new Russian tariff (see below).

The article points out that in the tariff of 1869, ultra-protection was abandoned for moderate protection, which favoured the importation of manufactured goods; since then partial measures of a protective character had to be resorted to, so as to protect national industries, which were in the first phases of development, against foreign competition; and, in addition to these measures, the law making it obligatory to pay all Custom-duties in gold raised the import duties by 30 per cent. in 1877, by 10 per cent. in 1881, and by 10 per cent. to 20 per cent. on most articles in 1885.

This gradual return to the system of ultra protection has greatly contributed towards the development of the manufacturing industries of Russia, which, producing only 217,900,000 roubles in 1867, increased to 316,900,000 roubles in 1876, and amounted to 562,300,000 roubles in 1888. This production is distributed as follows among the different branches of industry :—

	1867.	1876.	1888.	Increase of 1888 over 1876.
	Millions of R.	Millions of R.	Millions of R.	Per Cent.
Cotton yarns and tissues	72·6	102·7	253·5	146·8
Woollen yarns and tissues	19·2	55·5	68·4	23·2
Dye works, cloth-printing works, &c.	32·0	37·7	73·6	95·2
Flax and hemp yarns ...	15·0	20·1	29·2	45·2
Silk industry	4·3	8·2	12·1	51·2
Paper making, wall-paper, &c.	5·3	9·8	16·2	56·3
Chemical products and dyestuffs.	4·6	5·5	15·6	183·6
Leathers, &c	16·1	26·6	34·2	28·6
Articles of glass, crystal, &c.	3·5	5·2	9·0	73·0
Earthenware and porcelain ..	1·3	2·2	4·0	81·8
Machinery production ..	11·0	14·1	16·9	6·5

The article then continues with the statement that, on the other hand, the gradual increase of the duties reduced the imports from 142,561,000 credit roubles in 1876 to 329,930,000 roubles in 1888.

The *Board of Trade Journal* for August (pp. 118—165) also contains a statement of the import duties now leviable in Russia on the principal articles of British produce or manufacture. This tariff came into force on the 13th July 1891.

The following classification has been adopted :—Yarn and threads, woven manufactures, metals (unwrought and wrought), earthenware and porcelain, glass and glasswares, hides, skins and leather (unwrought and wrought), india-rubber and gutta-percha, paper, &c., chemicals, salt, oils, minerals, &c, articles of food, and miscellaneous articles.

The following is a statement of the duties now leviable upon chemicals :—

Tariff Classification.	Tariff Rates of Duty.		English Equivalent.		
			£	*s.*	*d.*
CHEMICALS :					
Alkali :	Rbls. cop.				
Carbonate of soda and carbonate of potash.	Pond 0·55	Cwt.	0	5	5
Bicarbonate of soda and bicarbonate of potash.	„ 0·90	„	0	8	10
Caustic soda, crude	„ 0·80	„	0	8	10
Do., purified.....	„ 1·00	„	1	19	5
Alum :					
Alum, crystallised	„ 0·30	„	0	2	11½
Do., calcined or in powder	„ 0·35	„	0	3	3½
Arsenic, white	„ 0·55	„	0	5	5
Barytes :					
Sulphate of baryta.....	„ 1·00	„	0	9	10
Caustic baryta.....	„ 1·20	„	0	11	10
Bleaching Materials :					
Chloride of lime and bleaching liquid.	„ 0·70	„	0	6	10½
Chromate of potash.....	„ 2·65	„	1	6	1
Borax, refined	„ 1·20	„	0	11	10
Brimstone :					
Crude :					
Imported at Baltic ports or at ports in the Government of Archangel, or across the western land frontier.	„ 0·02	„	0	0	2½
Imported at ports of the Black Sea or Sea of Azov.	„ 0·05	„	0	0	6
Refined, and flowers of sulphur..	„ 0·20	„	0	1	11½
Copperas :					
Green copperas	„ 0·22	„	0	2	2
Other kinds	„ 1·00	„	0	9	10
Epsom salts	„ 0·15	„	0	1	5½
Sal-ammoniac	„ 1·35	„	0	13	4
Saltpetre :					
Nitrate of potash	„ 0·65	„	0	6	5
Nitrate of soda	„ 0·06	„	0	0	7

Switzerland.

Classification of Articles in Customs Tariff.

Note.—Quintal = 220·4 lb. avoirdupois. Franc = $9\frac{6}{10}d$.

The following decisions affecting the classification of articles in the Swiss Customs tariff were given by the Swiss Customs authorities in the months of May and June last :—

Paper chemically prepared for photography.—Category 270*a*. Duty, 16 francs per quintal.

Steatite of sulphate of copper (for checking the diseases of the vine and potatoes), a powder composed of about 90 per cent. of soapstone and 10 per cent. of sulphate of copper (vitriol).—Category 16. Duty, 30 cents. per quintal.

Antikampine (derived from tar, used for the destruction of worms and caterpillars).—Category 16. Duty, 30 cents. per quintal.

Cable grease (mixture of greases and graphite used for putting round cords, cables of iron wire, electric cables, &c.).—Category 18. Duty, 2 francs per quintal.

Italy.

Customs Duties on Mineral Oils.

Note.—Quintal = 220·4 lb avoirdupois. Franc = $9\frac{6}{10}d$.

Mr. H. N. Dering, Her Majesty's Commercial Attaché at Rome, in a despatch to the Foreign Office, dated the

* From correspondence between the Chairman of the London Section and the Inland Revenue, we can state that this order will not affect those authorised users of methylated spirit for manufacturing purposes who also hold a retailer's licence, to whom stock of both kinds is permitted.

24th July, forwards copy and translation of a law which has recently been passed by the Italian Parliament, and which has been published in the *Official Gazette*, modifying the tariff for mineral oils and regulating their classification for Customs purposes. According to this law, the duty on heavy mineral, resin, and tar oils is fixed at 8 francs per quintal, and on other kinds at 47 francs per quintal.

Tunis.

Tariff Changes.

Mr. R. Drummond-Hay, Her Majesty's Consul at Tunis, in a report to the Foreign Office, dated the 6th July, encloses copy of a Beylical decree of the 23rd June 1891, published in the *Journal Officiel Tunisien* of the 2nd July, removing the prohibition on the importation into Tunis of nitrate of soda, sulphur, and saltpetre, and specifying the articles included in that category, which will be exempted from duty if imported for agricultural purposes and for the treatment of diseases of the vine. The following are the articles so exempted :—

Guanos, phosphates, and superphosphates, bone powder, phosphated gypsum, horn manures, fish manures, metallurgical phosphates, dried blood, burnt leather, sulphate of ammonia, sulphate of potash, sulphate of iron, nitrate of potash, nitrate of soda, chloride of potassium, chemically composed manures, sulphur sublimate, triturated sulphurs, sulphate of copper, nicotine, ammoniate of copper, sulphuric acid, ammonia, and powders and liquids used in the treatment of diseases of the vine.

The Bahamas.

Tariff Changes.

By Ordinance No. 7 of 1891, tallow, rosin, caustic soda, potash, palm oil, electrical apparatus and appliances, metal roofing, and crude petroleum are added to the free list, and a drawback of 90 per cent. of Customs duty is allowed on kerosene oil used as fuel in the working of steam engines.

GENERAL TRADE NOTES.

The Uses of Peat in the Arts and Industries.

The *Handels Museum* of 16th July publishes an extract from an article by Dr. Leo Pribyl, who maintains that peat is a valuable raw material, the uses of which, except as fuel and litter, are as yet very limited. The fibre is unsurpassed as a packing material for use in the case of breakable merchandise, being much superior to straw, hay, &c., owing to its greater elasticity and dryness. In the case of consignments consisting of liquids, it possesses the advantage of being peculiarly adapted for absorbing any of the contents which may have escaped through breakage, and thus preventing damage which might result to other consignments through damp. In the shape of dust and litter it is especially adapted for preserving perishable articles. Meat when packed in it will keep fresh for weeks, and will eventually dry up, the moisture being absorbed by the peat. In this way fresh sea fish has been sent from Trieste to Copenhagen, and has reached its destination in perfect condition. Peat is also successfully used for preserving fresh fruit; even grapes may be made to retain their fresh appearance for months, and, owing to the high prices of this fruit in spring and summer, would amply repay the trifling expense incurred by the use of peat dust. Experiments have shown equally satisfactory results in the case of pears, apples, plums, &c., as also in the case of cabbage, turnips, and potatoes, peat packing having the advantage, not observable with other packing materials, of preventing the sprouting of potatoes in spring. The question as to the best method of preserving eggs for the winter months is an important one, and still remains without any satisfactory answer. Possibly the preservative qualities of peat might here again be illustrated, and a satisfactory solution of this important question be arrived at.

It has been found a drawback in the use of artificial saline manure that in wet weather it forms itself into hard lumps which cannot be scattered by the manure spreading machines, a difficulty which may be obviated by the use of a small quantity (2·5 per cent. has been found to be sufficient in the case of kainite) of peat dust with the manuring salt.

As a substitute for ashes and straw in filling up the partition walls of cellars and ice-house broken peat is most suitable, as the effect of moisture on the ashes or straw is such as to render their immediate removal a necessary condition for the continued use of such places. Ice has been preserved for eight days in a cement barrel when covered with dry peat litter. Two pieces of ice were exposed to the sun's rays in Braunschweig, one of them was covered with wood shavings, and the other with a layer of equal depth of peat litter. The former had thawed in 72 hours, when it was found that the latter was still almost entire. From this it is seen that peat is a bad conductor of heat, and is consequently well adapted for isolating purposes.

Peat dust has been recommended as an excellent ingredient for use in the manufacture of light porous bricks, being mixed with the clay previously to baking. Bricks of this kind are much sought after in certain branches of architecture. But still further industrial uses are found for peat. The peat bogs of Northern Germany and of Sweden are being worked by joint stock companies with a view to obtaining the elastic fibre which, when free from dust, is used for weaving into carpets and other textile fabrics. Considerable capital is invested in these undertakings in Oldenburg and Sweden. The paper industry too, in the manufacture of peat cellulose, has shown a decided preference for this tender and pliant fibre, so that it may be justly said that at the present time the supply of good peat is inadequate to meet the demand, considering the varied uses of this unpretentious raw material.

The chemical industry is using peat in the manufacture of charcoal, peat-coke, peat-gas, &c., thus converting a cheap raw material into a valuable industrial product. Boghead-naphtha, tar, solar oil, paraffin, acetic acid, and gas have been produced from peat, and it has even been used in tanning. It has been for years used in Germany for absorbing waste liquids and refuse in factories, and in this way has furnished large quantities of valuable manure in certain districts.

An enumeration of the manifold uses of peat will prove that this raw material, which has hitherto been considered of little importance, and which nature has provided in such abundance, even if it be in many districts partially distributed, is destined not only to benefit agriculture by its valuable properties and chemical composition, but to lay the foundation of a flourishing and wide spread industry. A new era has been entered upon in the sanitation of towns by using peat, and it is to be hoped that advantage will be taken of the undoubted benefit arising from its use both as regards the health of urban populations and the promotion of agricultural interests by the supply of large quantities of manure. In this way extensive and unproductive tracts of bog land would be converted into valuable properties, and a flourishing industry would provide work and wages for thousands of hands.

The Netherlands Margarine Trade.

In a report dealing principally with the trade in American oleo oil as a material for the manufacture of margarine in the Netherlands, the United States Consul at Rotterdam writes as follows :—

Oleo oil of the value of 10,000,000 dollars was imported into the Netherlands from the United States during the calendar year 1890. It was purchased by the makers of Dutch "margarine" (substitute butter) whose present consumption of American oil exceeds by more than 100 per cent. the consumption of five years ago.

Other European countries sending oleo oil to this foremost margarine market of the world are England, France, and Austria. These supply only 20 per cent. of the whole, however, the remaining 80 per cent. coming from the United States; and the oleo products of these European

countries, in comparison with the American product, is distinctly inferior in quality and price.

From 1886 to the close of 1890 the prices of oleo oil in the Netherlands markets tended steadily downward, the range being from 100 to 112 florins per 100 kilogrammes (18 to 21 cents per pound) in 1885—86 down to 45 to 60 florins per 100 kilogrammes (8 to 11 cents per pound) in 1890. Within the present calendar year, there has been a marked and sustained rise owing to depleted stocks.

The chief city of export of oleo oil in the United States is Chicago. During 1890 it sent to this market quite 60,000,000 lbs., or more than one-half of the total American supply. Other export cities of importance are New York, Philadelphia, Omaha, Kansas City, and Boston.

The trade in American oleo oil for the Netherlands centres in Rotterdam. There are in this city eight importers and 15 brokers dealing exclusively in the product. One of the great Chicago packers has here his own representative sent from Chicago, while the others are represented by resident firms of established standing and reputation.

The large margarine factories in the Netherlands number 32. In Rotterdam, 5; Oss, 4; Nymwegen, 4; Bois le Duc, 3; Haarlem, 2; Helmond, 2; and in Dordrecht, Oosterhout, Asten, Alkmaar, Amsterdam, Waspik, Zwammerdam, Gouda, the Hague, Middleburg, Oldenzaal, and Weesp, 1 each.

These factories differ greatly in size, capacity, and value. All however, are modern in equipment, and those more recently built represent large investments, proving the faith of their Dutch owners in the future of margarine. One plant lately erected in Rotterdam cost 500,000 guilders (200,000 dollars), and ranked among the imposing structures of the city.

Possibly the most representative among margarine factories of the Netherlands is one situated at Oss, in the province of North Brabant. It is owned and operated by Anton Jurgens, whose family through four successive generations have made butter on the site of the present factory. The buildings and grounds are extensive, the machinery employed is ingenious, efficient, and costly, and from end to end the establishment is a marvel of Dutch orderliness and cleanliness.

This factory produces and ships regularly 25 tons of margarine per week. It gives steady employment to 200 heads of families, many of whom are expert workmen. It consumes each week an average of 125,000 litres of milk, the yield of 10,500 cows owned by 2,000 small farmers living in the adjacent country districts.

The little city of Oss has 6,000 inhabitants. It has four margarine factories, but no other industry of note. Directly or indirectly its 6,000 people, as also the majority of the farmer folk for miles around, get their very comfortable living out of the margarine industry, which has become, here, as elsewhere, in Holland, a permanent local beneficence.

The above reported increase of oleo oil imports into the Netherlands of more than 600 per cent., within five years, indicates a corresponding increase in the exports of margarine. The factories here are employed chiefly in supplying a foreign demand, the estimated home consumption of margarine being only 10 per cent. of the total output.

Statistics relating to margarine exports are, however, unobtainable. There are, so far as I am able to learn, no records of value for purposes of comparison, either public or private. Commercial statistics in the Netherlands are kept but indifferently well at best, and as to margarine, until the enforcement in January 1890 of the national law requiring all margarine to be branded, it had uniformly been classified with other dairy products, never separately.

Experts in the trade agree that the present exports are considerably more than twice as large as those of five years ago, and that the foreign market is steadily increasing.

The countries principally purchasing the Netherlands margarine are Great Britain, Belgium, and Germany, countries, it is significant to note, whose cities, above all other cities of Europe, teem with workpeople earning small wages, to whom cheap food is essential.

The glimpse thus afforded of the growth and present extent of a permanent and valuable industry of the Netherlands, which had its exceedingly unpopular beginning less than 20 years ago, suggests a glance at the cause of such growth and at the methods whereby it has been attained.

The step preliminary to the manufacture of margarine in the Netherlands was the adulteration of cream butter. In 1872—74 the world-famed Holland dairies, in sharp competition with the butter makers of other countries, began to employ syrup and glucose for enlarging and cheapening their product. The adulteration increased from 10 to 25 per cent., then to 50 per cent. As the proportion of new ingredients grew, the necessity for substances absolutely wholesome became imperative.

Repeated and expensive experiments under widely vary conditions proved oleo oil to be possessed of actual and high merits as a food substance, and it was a matter of course—oleo being in far larger supply than the cream of the dairy—that the animal oil should succeed speedily to the place of the chief ingredient.

Substitute butter from oleo oil, manufactured by approved methods, is a food article of demonstrated merit, and has come to stay, so far at least as European countries are concerned. It cannot be legislated out of existence. By legislation its production cannot even be greatly restricted. Attempts in this direction avail nothing on behalf of the farmer, and directly injure the armies of wage-earners in cities who need cheap wholesome food. Legislation can compel the margarine to be branded and sold for what it really is, thus benefiting the honest manufacturer not less than the consumer; but at that point legislation in the Netherlands has been wisely content to stop.*

Farmers in the Netherlands who own cows and have hitherto made butter have been forced to admit, as a result of experience, that the manufacture or sale of substitute butter, though ever so extensive, does not appreciably injure farm profits. If one be a large farmer with good dairy facilities and able to produce good dairy butter, he finds now a more exclusive market and better prices than in the days when every owner of a cow made butter. If, however, one lack facilities for the best butter making, and if one be owner of a few cows, he is able to command at the margarine factory an established all-the-year-round price for his milk that yields larger net profits than did the erstwhile sale of his indifferent butter. Large dealers, also, who formerly conducted trade in butter, find the present business in margarine no less profitable.

Consciously or ignorantly, in European countries and, I think, also in the United States, a very large percentage of the less well-to-do people must eat substitute butter. I have official statistics before me as I write which show, after a trifle computation, that if all the milk of all the cows in Great Britain were devoted to butter making, the utmost possible average product of a year would be just 4 oz. per head of the population. European workpeople conclude thus, that it is for them, to a very considerable extent, a matter of substitute butter or no butter food whatever. They conclude also, as the fast increasing sales of margarine abundantly prove, that the cleanly, healthful, nutritious substitute made by known and reputable manufacturers is far preferable to doubtful butter of unknown composition and origin.

In the calendar year 1885 the estimated total output of Netherlands margarine (the finished butter product) was 92,100,000 American pounds; in the calendar year 1890 the estimated total was 165,000,000 pounds, an increase in the annual output within five years of 72,600,000 pounds. Of the above given total product for the year 1890, it is estimated that 127,600,000 pounds were exported, while only 37,400,000 pounds went into home consumption.

The foreign countries to which Netherlands margarine is at present exported are, in the order of their importance as margarine buyers, England, Belgium, France, Spain, Portugal, Sweden, Norway, Denmark, the Transvaal, and the Dutch, English, and Portuguese colonial possessions.

* The law of the Netherlands permits oleo oil (the raw material) to enter duty free, thus giving to the margarine industry a positive encouragement.

At the present time, seven-tenths of all the oleo oil (the raw material) used in the manufacture of margarine in the Netherlands comes from the United States.

Production of Sulphur in Italy.

In a recent report the French Consular Agent at Bologna supplies the following particulars of the production of sulphur in Italy, and specially in the Province of Romagna:—

It is estimated that in 1850 Sicily supplied about 500,000 quintals of sulphur annually, and that was sufficient for the needs of Europe, for war and industry. Agriculture has also required this commodity largely, and whilst in face of constantly growing demands, Sicily multiplied its production, and since 1855 the deposits situated at the extremity of Romagna, towards Montefeltro, have been worked. In 1878, the Sicilian production amounted to 2,500,000 quintals, and the Romagna production to 500,000 quintals, together 3,000,000 quintals of raw sulphur valued at 1,200,000*l.*, or 8*s.* per quintal on an average, but a little less in Sicily and a little more in Romagna. This price was a reduced one by reason of the excess of production, for a few years back raw sulphur was worth more than 11*s.* in Sicily and as much as 13*s.* in Romagna.

The demands of North America have absorbed the surplus production, and the prices amounted to 10*s.* (Romagna, 1884), falling to 8*s.* in 1885, and dropping as low as 6*s.* 6*d.* in 1889 and on the 1st September 1890. It may safely be affirmed that below 8*s.* all the workings were carried on at a loss in the Romagna district; several were suspended and the production was reduced to 200,000 quintals in 1886. It has since further diminished, but statistics are not forthcoming for a more recent date.

Romagna was first affected by the fall in prices, because its production is the most costly. Notwithstanding the employment of machines and horses, its deeper deposits entail more labour than the Sicilian, and at a greater cost, one reason being that children must not be employed.

The greater part of the capital sunk has been lost. Many of the workmen have emigrated, and, in order to give employment to a few others, in certain places they have been allowed to do piece-work, two-thirds of the ore extracted being given up to them. The refiners have obtained the sulphur from Sicily in order to make up for the dearth of local extraction, and to keep their works going.

Sicily has experienced still lower prices (5*s.* 6*d.* per quintal of raw sulphur in 1889), and it has resisted hitherto the relative exhaustion of its sulphur mines; but at present its production does not equal the demand. According to the Customs statistics, the maximum of working was reached in 1889 and amounted to 3,319,016 quintals of raw or refined sulphur. The export was 3,287,081 quintals, of which 1,107,672 were despatched during the first quarter. But, during the first quarter of 1891, there were only exported 736,378 quintals from Italy. This falling off is entirely due to the scarcity of the commodity, and not to a smaller demand, for the price of raw sulphur has risen higher than in 1884, and bids fair to exceed the prices of 1874; the price-list of the Bologna Exchange gives it at 11*s.*, but at Romagna it is stated to be 13*s.*, that is to say, double the price of last year. The result has been a great revival in this industry among the owners of mines from Forti to Fossombrone, but what seriously affects it is the absence of capital.

Mineral Discovery in Mytelene.

A correspondent of the *Journal de la Chambre de Commerce de Constantinople* writes from Mytelene (the capital of the island of the same name) that a mineral has been discovered in the district of Plomari having the properties of talc. A chemist, who has pursued his studies in France, has erected a small establishment for the preparation of this product, and the first trials have been more or less successful, and this mineral, existing in large quantities at several places in the island, may one day supplant talc, which will largely affect the imports from Genoa, which annually amount to about 2,000,000 kilogrammes of talc.

The Mineral Production of Italy in 1889.

The total production of Italian mines in 1889, according to *Industries*, shows an increase of 38,240 tons over 1888, valued at about 230,000 dollars, an increase of 3·13 per cent. in quantity and 2·19 per cent. in value. The production of 1888 compared with that of 1887 showed an increase of 1 per cent. in quantity and 4·6 per cent. in value. The increase in 1889, both as regards quantity and value, is mainly due, in order of importance, to the larger production of zinc ores, mercury, coals, lead ores, iron pyrites, asphaltum, and bitumen, antimony, and auriferous ores. The decrease occurred mainly in sulphur, copper ores (only in value), silver ores, iron ores, salt, and boric acid. The following table shows the production of Italian mines in 1889:—

Products.	No. mines worked.	Production. Quantity.	Production. Total value.	No. of Men employed.
		Tons.	Lire.*	
Iron ores	43	173,189	1,887,231	1,118
Manganese ore	5	2,263	51,801	46
Copper ores	16	48,244	1,311,528	1,300
Zinc ores	102	97,059	8,257,775	10,587
Lead ores		36,894	7,062,348	
Silver ores		1,997	1,718,663	
Gold ores	20	10,232	508,427	151
Antimony ores	5	563	100,072	328
Mercury (metal)	9	385	2,274,150	533
Iron pyrites	4	17,022	216,494	343
Coals	37	340,320	2,858,154	2,714
Sulphur	119	371,494	24,652,876	20,028
Salt	19	28,090	556,633	635
Asphalt, bitumen, and petroleum, also mineral waters.	28	33,521	620,532	996
Aluminite	1	5,800	140,000	76
Boric acid	11	2,473	1,236,550	99
Graphite	7	1,531	10,271	27
Total	726	1,222,187	53,553,805	18,581

* One lire is equivalent to 19·3 cents.

The following table shows the production of metallurgical and chemical works in Italy in the year 1889:—

Products.	No. of Works.	Production. Quantity.	Production. Total Value.	No. of Men employed.
		Tons.	Lire.	
Pig iron	11	53,473	2,123,096	227
Iron and steel	323	181,623	50,343,398	14,518
		157,899	35,185,837	
Gold	3	212	569,848	89
Lead	1	18	6,176,100	700
Silver		23	5,025,750	
Copper and its alloys	9	6,904	12,246,004	1,038
Antimony	1	1,969	280,066	44
Mercury	3	378	2,274,150	13
Salts	77	430,639	2,919,092	5,037
Aluminite and sulphate of alumina.	8	4,047	456,840	125
Refined sulphur	17	53,316	1,958,586	260
Patent fuel	22	520,150	16,515,900	618
Total	475	1,370,961	139,074,963	23,308

The imports and exports of mineral substances during the year were as follows:—

IMPORTS.

Products.	Quantity.
	Tons.
Lead ores	2,421
Coal	3,369,117
Petroleum	71,331
Pig iron	191,082
Iron and steel	399,245
Tin-plates	8,475
Copper and its alloys	6,310
Lead	..
Alum and sulphate of alumina	1,487

EXPORTS.

Products.	Quantity.
	Tons.
Iron ores	183,281
Lead ores	7,439
Copper ores	9,034
Zinc ores	107,036
Sulphur	331,392
Salt	110,115
Asphalt	4,825
Boric acid	1,943
Graphite	1,376
Mercury	391

PRODUCTION OF ALUMINIUM IN THE UNITED STATES.

The Cowles process, now carried on by the Cowles Electric Smelting and Aluminium Company at Lockport, N.Y., which was the pioneer of electro-metallurgical processes for the reduction of aluminium, was established in 1885. Since that time its production has been as follows: aluminium bronze, 1885, 4,000 to 5,000 lb., valued at 1,600 to 2,000 dols.; 1886, 50,000 lb., valued at 20,000 dols.; 1887, 144,764 lb., valued at 57,000 dols. Ferro-aluminium (containing from 5 per cent. to 10 per cent. aluminium), 1886, 2,000 to 3,000 lb., valued at from 780 to 1,170 dols.; 1887, 12,617 lb., valued at 16,621 dols. The total aluminium alloys produced by this company in 1889 was 171,759 lb. The production of aluminium by the Pittsburg Reduction Company in 1889 was 19,200 lb., which was sold at 2 dols. per lb. in quantity. The total production of aluminium in the United States in 1889, including that contained in alloys, was 47,068 lb., valued at 97,335 dols.

The imports of aluminium into the United States are given in the following table:

Years.*	Quantity.	Value.	Years.*	Quantity.	Value.
	Lbs.	Dols.		Lb.	Dols.
1870	..	58·00	1880	330·75	1,092·00
1871	..	31·00	1881	517·10	6,071·00
1872	..	..	1882	566·50	6,195·00
1873	*2·00	1·00	1883	125·25	5,079·00
1874	*650·00	214·00	1884	525·00	8,446·00
1875	*455·00	1,555·00	1885	139·00	1,736·00
1876	120·00	1,412·00	1886	152·00	5,362·00
1877	131·00	1,551·00	1887	1,260·00	12,112·00
1878	251·00	2,267·00	1888	1,418·53	14,086·00
1879	284·41	3,127·00	1889	998·84	6,688·07

* Probably alloys.

† Fiscal years ending June 30th to 1886, calendar years subsequently.

France was the only country which produced aluminium commercially until a few years ago. It had never be seen in any quantity until the Paris Exposition of 1855, where it was shown in ingots and in the form of manufactured articles of various kinds. Among ornamental articles it was noticed that a small body of the Imperial Guard wore breastplates of aluminium. The price of the metal was then 2,000 francs a kilo. The production was as follows: 1863, 1 ton; 1867, 1·7 tons; 1872, 1·8 tons. Later statistics give the aluminium product of France as follows: 1886, 2,430 tons, valued at 243,000 francs; 1887, 2,040 kilos., valued at 204,200 francs; 1888, 2,955 kilos., valued at 295,500 francs. Allowing the French production to have been 1·5 tons a year from 1860 to 1880 and 2·5 tons from that to 1889, inclusive, we should have 31·5 + 22·5 = 54 tons, or about 60 short tons, in the 30 years.

The production of aluminium in England in 1888 was 5,000 lb., valued at 5,000*l.*; in 1889, 12,000 lb., valued at 6,000*l.* There was an English manufacture of aluminium from about 1860 to 1874, but no statistics of its production are obtainable. It could not have been very considerable, as the price of the metal was then very high. The Castner process was inaugurated in England in 1888. Supposing 5,000 lb. per annum to represent the English production from 1883, when the Webster process was put in operation, to 1888, we have 30,000 lb. which, with the 12,000 lb. for 1889, equalling 42,000 lb., or 21 tons, may be regarded as the English production up to the beginning of 1890. The French and English production would therefore amount to about 82 tons. The Aluminium and Magnesium Fabrik, at Hemelingen, near Bremen, has been in operation since the latter part of 1887, and has supplied all the aluminium produced in Germany. The production of this country is given as follows: 1887, 1,700 kilos.; 1888, 8,400 kilos.; 1889, 9,500 kilos.; total, 19,600 kilos.

Adding this total to the figures representing the sum of the French, English, and the American production from all sources, exclusive of alloys, which is nearly 94 short tons, we get in round numbers, 116 short tons, which therefore represents the total production of aluminium from 1860 to 1889, inclusive.

PRODUCTION OF OZOKERITE IN THE UNITED STATES.*

Ozokerite, or "mineral wax," belongs to the series of hydrocarbon compounds which include marsh gas, petroleum, and paraffin, it being very similar in appearance to the latter. It is colourless to white when pure, but frequently occurs leek-green, yellow, and brown. Prior to 1888 the only locality producing this mineral oil was in the province of Galicia, in Austria. Mining began there in 1862, and though at first it was found exceedingly difficult to obtain sufficient capital to push the enterprise, it has increased rapidly since that date, and at present there are 35 companies engaged in the industry in the province of Galicia alone. For 26 years production was limited to this locality, but in 1888 American ozokerite began to receive the attention of the trade, and considerable work was begun upon a newly discovered vein in Utah. The mineral had been known to exist in Utah for some years, but whether in paying quantity was not satisfactorily determined until August 1888.

During 1888 and 1889 most of the work was done in the way of development, but in the latter year there were incidentally produced 75,000 lb. of crude ozokerite. Of this product, 33·33 per cent. is lost in refining, the amount of refined ozokerite being 50,000 lb., valued at 2,500 dols. The product of 1888 was estimated at 65,000 lb. of crude mineral. The product for 1890 will probably exceed 300,000 lb.

Refined ozokerite is used for nearly all the purposes to which ordinary bees'-wax is applicable. It possesses nearly all the properties of bees'-wax except stickiness, but in cases where that quality is essential it is necessary only to mix the mineral with ordinary bees'-wax. Crude ozokerite, like other hydrocarbon compounds, is used to a considerable extent as an insulator for electrical wires.

* From Census Bulletin, No. 73.

The following table shows the quantity and value of crude and refined ozokerite imported into the United States from 1873 to 1889, inclusive :—

Years.	Quantity.	Value.	Years.	Quantity.	Value.
	Lb.	Dols.		Lb.	Dols.
1873	25,135	4,244	1882	272,509	29,322
1874	380	40	1883	565,658	52,774
1875	7,430	1,026	1884	617,992	69,026
1876	16,525	2,229	1885	1,036,438	123,976
1877	101,604	11,720	1886	800,496	71,220
1878	69,884	7,878	1887	718,769	59,084
1879	44,963	6,016	1888	1,164,940	89,131
1880	103,973	14,057	1889	1,078,725	86,682
1881	98,911	12,792			

An Increasing Demand for Graphite.

The successful experiments which have been made in the use of graphite as a lining for converting vessels, it being a material specially adapted to withstand the cutting action of the acid slag, has brought about a scarcity in the supply of old crucibles, and bids fair to open a new market for burned graphite, says the *American Manufacturer*. Old crucibles, which could be had a year ago at 1 dol. per ton, cannot now be obtained in any quantity for 10 dols. per ton.

The present supply of graphite for use in making crucibles for steel-making comes from Ceylon. Elaborate experiments have been made with the plumbago mined in the United States, in the hope of making crucibles for this purpose therefrom, but so far with but indifferent success, or, at the most, with less success than with the imported article, nor has it been possible to sell the home product so cheaply.

Within the last year the price of plumbago delivered in New York has advanced nearly 60 per cent., due primarily to two causes—the quantity mined has fallen off, and the demand, especially outside the United States, has increased. The total amount of plumbago exported from Ceylon for the year ending June 1st, 1890, was 161,874 cwt. For the year ending June 1st, 1891, it was 148,043 cwt., a falling-off of over 8 per cent. At one time three-fourths of the entire production of the island came to the United States, but at present this country does not receive one-half, and the proportion that it does receive is on the decrease. In the year ending June 1st, 1890, 68,726 cwt. of Ceylon graphite came to America, and in the year ending June 1st, 1891, only 35,936 cwt.

Germany is becoming a large factor in the trade in the matter of consumption, its increased use by the Krupp works being responsible for this. The imports of Germany for the year ended June 1st, 1889, amounted to only 3,094 cwt. In 1890 it was 14,215 cwt. and in 1891 about 11,000. The falling off noted from 1890 to 1891 was about proportionate to that in the output, and not due to any lack of demand on the part of that country. During the fiscal years of 1890 and 1891 the imports of graphite in England amounted to 61,949 cwt. and 57,906 cwt. respectively.

The price of plumbago varies according to its quality. It is divided into four grades, viz., large lump, ordinary lump, chip, and dust. The present ruling figures are as follows: Lump (ordinary), 4·50 dols. to 5 dols. per cwt.; chip, 3·60 dols. to 4 dols.; dust, 2·80 dols. to 3·50 dols. There is a very great scarcity of good plumbago in the market to-day, and no cargoes of any consequence are expected in this country before 1st September.

The quality of plumbago depends as much upon its physical structure as upon its chemical analysis. There is a deposit of this mineral near Reading, Pa., which in analysis is practically identical with the best Ceylon article, yet the best efforts of crucible makers have failed to produce crucibles therefrom equal to those of the Ceylon graphite.

Discovery of Coal near Middlesbrough.

The discovery of coal at Cowpen, near Middlesbrough, has been the topic of the past few days. What makes the find particularly interesting is the fact that it has been stated by scientists that there could not be coal beneath the salt-beds. The coal found at Cowpen, however, is beneath the salt. Some time ago salt was struck at Cowpen at a depth of between 700 and 800 feet, and the Newcastle Chemical Company, continuing to bore, struck a few weeks ago a fair quantity of natural gas. Still boring experimentally, they last week found a 2-foot seam of coal at a depth of nearly 2,000 feet. It is stated that the firm have reasons for believing that there is more coal beneath the present find.—*Ironmonger*.

The New Florida Phosphate Law.

A bill regulating the mining of phosphate rock in the beds of the navigable rivers of Florida was passed by the Legislature last month, on the last day of the session, and having been signed by the Governor, has become a law. By its provisions the Governor, Comptroller, and Attorney-General of the State are constituted a board of phosphate commissioners, which has the management of the phosphate interests of the State in the beds of the navigable streams. The right to mine these deposits is to be granted upon the following terms: for each ton of rock analysing less than 55 per cent. phosphate of lime, the State is to receive royalty of 50 cents; for rock analysing between 55 per cent. and 60 per cent. phosphate of lime, 75 cents; and over 60 per cent., 1 dol., accounts and payments to be rendered quarterly to the State Treasurer. The board is authorised to grant the exclusive right to mine rock from the beds of navigable streams, within certain well-defined limits, in no case exceeding 10 miles by course of stream, for a period not to exceed five years, preference being given to riparian owners and to those who have commenced or prepared to mine in good faith before the passage of the Act. Provision is made for the appointment of an inspector of phosphates as the executive officer of the board, and suitable penalties are imposed for non-compliance with the terms of the law.

As was to be expected, this law has elicited much opposition, and will undoubtedly lead to litigation between the State and many of the companies which claim vested rights in the river phosphate deposits. Very many of the mining companies are unaffected, however; the law not applying in cases of navigable streams or parts thereof that are not meandered and the ownership of the lands embracing which is vested in a legal purchaser.

It is not probable that the burden imposed by the new law will have serious effect upon the industry. The Florida river phosphate can be produced and loaded upon vessels at Gulf of Mexico ports as cheaply as South Carolina rock at Charleston. Under the present conditions, the former paying a royalty of 1 dollar per ton and the latter 2 dollars, the relative position of the two is the same as before the passage of the new laws in each of the States, the advantage still being strongly in favour of the Florida rock. Whatever may be the result of the new Florida law, the industry is likely to make great progress in that State during the present year. The trouble in South Carolina between the State and the Coosaw Mining Company is still unsettled, and river-mining industry there is practically at a standstill, Florida rock taking its place in the market to a considerable extent.

BOARD OF TRADE RETURNS.

Summary of Imports.

	Month ending 31st July	
	1890.	1891.
	£	£
Metals	2,120,311	1,840,628
Chemicals and dyestuffs	601,100	635,782
Oils	629,464	726,156
Raw materials for non-textile industries	4,492,390	3,967,914
Total value of all imports	33,082,629	32,824,111

Summary of Exports.

	Month ending 31st July	
	1890.	1891.
	£	£
Metals (other than machinery)	4,117,287	3,246,514
Chemicals and medicines	731,141	668,479
Miscellaneous articles	3,143,249	2,657,990
Total value of all exports	24,321,336	21,945,112

Imports of Chemicals and Dyestuffs for Month ending 31st July.

Articles.	Quantities.		Values.	
	1890.	1891.	1890.	1891.
			£	£
Alkali ... Cwt.	3,186	5,012	2,309	3,992
Bark (tanners, &c.) ,,	82,515	11,333	18,279	22,415
Brimstone ... ,,	22,393	56,155	5,286	16,167
Chemicals ... Value £	..	..	126,953	120,719
Cochineal ... Cwt.	163	270	922	1,628
Cutch and gambier Tons	2,296	1,704	63,201	31,558
Dyes :—				
Aniline ... Value £	..	..	18,056	20,360
Alizarine ... ,,	..	..	27,198	26,500
Other ... ,,	..	..	1,887	1,552
Indigo ... Cwt.	1,039	485	15,171	8,418
Madder ... ,,	1,111	831	1,403	1,107
Nitrate of soda ... ,,	88,188	18,897	36,972	8,153
Nitrate of potash ... ,,	25,278	24,768	22,285	21,989
Valonia ... Tons	3,085	1,167	62,328	23,204
Other articles ... Value £	..	..	107,890	127,990
Total value of chemicals	..	..	601,100	635,782

Imports of Metals for Month ending 31st July.

Articles.	Quantities.		Values.	
	1890.	1891.	1890.	1891.
			£	£
Copper :—				
Ore ... Tons	7,747	5,061	62,712	29,137
Regulus ... ,,	11,311	8,989	347,775	259,707
Unwrought ... ,,	4,686	3,361	270,204	185,739
Iron :—				
Ore ... ,,	449,571	292,190	352,694	212,481
Bolt, bar, &c. ... ,,	12,525	8,751	124,687	88,100
Steel, unwrought ... ,,	634	744	7,052	7,512
Lead, pig and sheet ,,	13,035	13,585	170,312	173,144
Pyrites ... ,,	54,929	48,341	104,785	81,611
Quicksilver ... Lb.	88,736	83,683	11,391	8,739
Tin ... Cwt.	37,336	57,629	175,855	260,113
Zinc ... Tons	4,867	5,986	109,696	135,899
Other articles ... Value £	..	..	383,778	398,446
Total value of metals	..	..	2,120,311	1,840,628

Imports of Raw Materials for Non-Textile Industries for Month ending 31st July.

Articles.	Quantities.		Values.	
	1890.	1891.	1890.	1891.
			£	£
Bark, Peruvian ... Cwt.	6,564	3,752	17,778	7,509
Bristles ... Lb.	270,015	488,641	10,587	71,160
Caoutchouc ... Cwt.	16,368	15,082	159,219	150,592
Gum :—				
Arabic ... ,,	3,116	4,783	9,912	11,495
Lac, &c. ... ,,	7,643	5,652	32,858	17,529
Gutta-percha ... ,,	4,051	5,009	43,657	68,644
Hides, raw :—				
Dry ... ,,	33,604	37,033	94,820	108,550
Wet ... ,,	36,381	48,553	81,167	111,629
Ivory ... ,,	1,272	1,084	69,021	52,080
Manure :—				
Guano ... Tons	..	147	..	709
Bones ... ,,	1,790	6,451	9,140	30,450
Paraffin ... Cwt.	39,536	38,074	51,426	56,135
Linen rags ... Tons	3,328	2,889	30,062	26,517
Esparto ... ,,	17,081	20,477	77,767	96,298
Pulp of wood ... ,,	14,237	10,913	76,548	62,531
Rosin ... Cwt.	149,047	200,503	37,977	54,758
Tallow and stearin ,,	174,867	123,718	223,276	158,752
Tar ... Barrels	28,615	10,183	18,965	5,527
Wood :—				
Hewn ... Loads	262,012	220,726	585,900	479,012
Sawn ... ,,	834,605	683,487	1,914,144	1,474,811
Staves ... ,,	17,101	13,812	82,326	49,079
Mahogany ... Tons	2,367	1,973	25,083	17,515
Other articles ... Value £	..	..	810,777	856,302
Total value ...	..	..	4,492,390	3,967,914

Besides the above, drugs to the value of 74,691*l.* were imported as against 58,068*l.* in July 1890.

Imports of Oils for Month ending 31st July.

Articles.	Quantities.		Values.	
	1890.	1891.	1890.	1891.
			£	£
Cocoa-nut..... Cwt.	1,065	18,075	1,534	26,698
Olive ..... Tuns	1,983	3,157	77,335	127,267
Palm ..... Cwt.	90,123	91,729	101,909	101,908
Petroleum ..... Gall.	10,025,318	9,417,850	209,089	197,196
Seed ..... Tons	1,232	985	32,181	27,503
Train, &c..... Tuns	1,857	3,007	16,461	62,912
Turpentine ..... Cwt.	61,224	76,727	94,390	105,914
Other articles .. Value £	..	..	66,562	76,518
Total value of oils ...	..	..	629,464	726,156

Exports of Metals (other than Machinery) for Month ending 31st July.

Articles.	Quantities.		Values.	
	1890.	1891.	1890.	1891.
			£	£
Brass..... Cwt.	10,774	10,825	50,302	46,811
Copper:—				
Unwrought ..... „	81,325	55,121	245,064	155,251
Wrought..... „	20,611	23,394	73,777	77,184
Mixed metal .... „	18,328	21,969	136,318	62,319
Hardware ..... Value £	..	..	246,611	221,118
Implements..... „	..	..	116,625	115,808
Iron and steel..... Tons	394,721	290,803	2,945,101	2,178,450
Lead ..... „	4,036	4,635	58,196	64,252
Plated wares... Value £	..	..	31,799	36,208
Telegraph wires, &c. „	..	..	56,575	150,754
Tin ..... Cwt.	9,325	8,920	45,780	42,129
Zinc ..... „	15,057	14,122	14,839	14,650
Other articles .. Value £	..	..	95,964	81,514
Total value	..	..	4,117,287	3,246,514

Exports of Drugs and Chemicals for Month ending 31st July.

Articles.	Quantities.		Values.	
	1890.	1891.	1890.	1891.
			£	£
Alkali..... Cwt.	494,818	456,156	167,342	175,379
Bleaching materials „	145,442	129,845	40,055	44,799
Chemical manures. Tons	36,550	32,416	189,686	162,772
Medicines..... Value £	..	..	91,443	81,826
Other articles... „	..	..	242,615	203,703
Total value	..	..	731,141	668,479

Exports of Miscellaneous Articles for Month ending 31st July.

Articles.	Quantities.		Values.	
	1890.	1891.	1890.	1891.
			£	£
Gunpowder..... Lb.	1,189,800	930,500	27,225	23,811
Military stores.. Value £	..	..	133,637	112,105
Candles..... Lb.	1,122,400	1,388,300	22,110	28,380
Caoutchouc ..... Value £	..	..	102,327	102,450
Cement..... Tons	54,397	50,108	113,154	98,496
Products of coal Value £	..	..	91,640	101,825
Earthenware ... „	..	..	214,843	168,303
Stoneware ..... „	..	..	16,901	13,725
Glass:—				
Plate..... Sq. Ft.	240,151	249,185	15,406	18,156
Flint..... Cwt.	9,406	10,150	22,191	20,282
Bottles..... „	86,878	66,035	41,331	31,019
Other kinds.... „	14,651	17,281	14,028	13,749
Leather:—				
Unwrought .... „	14,123	12,006	101,948	111,625
Wrought ..... Value £	..	..	31,913	33,284
Seed oil..... Tons	4,716	5,302	113,364	120,782
Floorcloth ..... Sq. Yds.	1,111,800	1,717,100	73,871	77,006
Painters' materials Val. £	..	..	147,007	142,777
Paper ..... Cwt.	86,454	91,939	148,615	154,096
Rags..... Tons	5,299	4,227	40,256	29,395
Soap ..... Cwt.	52,705	44,430	54,282	48,916
Total value	..	..	3,143,229	2,657,369

Monthly Patent List.

* The dates given are the dates of the Official Journals in which acceptances of the Complete Specifications are advertised Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the said dates.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

Applications.

11,999. C. H. Roeckner, F. L. Roeckner, and R. L. Roeckner. Improved means and apparatus for clarifying and purifying liquids. July 15.

12,053. L. Damaze. Improvements in apparatus for measuring temperatures and pressures. July 15.

12,111. W. McLaren and P. Holmes. Improvements in or relating to the refrigerating medium employed in "freezing" and similar machines. Complete Specification. July 16.

12,124. R. Anderson. Improvements in liquor-raising apparatus. July 17.

12,174. C. Gautsch. Improved apparatus for use in the preparation of chemical solutions or liquids for the extinguishing of fire. July 17.

12,389. H. C. Sergeant. Improvements in compound compressors for air and other gaseous or aeriform bodies. Complete Specification. July 21.

12,391. M. Hongmann. Improved apparatus for heating gases. July 21.

12,401. L. Cyec. Improvements in means or apparatus for drying or extracting moisture. July 21.

12,469. E. Hesketh and A. Marcet. Improvements in machinery or apparatus for producing cold by the employment of carbonic anhydride. July 22.

12,516. C. Ferguson. Improvements relating to the revivification of charcoal. July 23.

12,542. L. Donard and G. Boulet, jun. Improvements in evaporators. Complete Specification. July 23.

12,676. E. Hesketh and A. Marcet. Improvements in machinery or apparatus for producing cold by the employment of carbonic anhydride. July 25.

12,700. J. A. Mays. Improvements in the separation and concentration of solids. July 27.

12,796. B. Rettenmeyer. Improvements in cooling apparatus for liquids. Complete Specification. July 28.

12,815. R. P. Barnstead, R. H. Spalding, and J. C. Bullard. Improvements in water-distilling apparatus. Complete Specification. July 28.

12,858. W. Ackroyd and W. Emmott. Improvements in refrigerating apparatus. July 29.

12,998. G. Rodger. Improvements in or connected with means or apparatus for heating metals by liquid or gaseous fuel. July 31.

13,069. C. Ferguson. *See* Class XVI.

13,086. T. O. Harrison and W. Watson. The manufacture of a preparation or composition for preventing or lessening corrosion or incrustation in steam boilers. August 1.

13,222. E. Freund. Improvements in filtering apparatus. August 5.

13,323. J. H. Minto. Improvements in apparatus for charging liquids with gases. August 6.

13,447. A. Colson. Improvements in column stills for distillation of gas liquor and other liquids. Complete Specification. August 8.

13,522. J. Reed. Improvements in or connected with condensers. August 11.

13,523. J. Reed. Improvements in or connected with evaporators, in part applicable to feed-heaters and condensers or distillers. August 11.

13,612. R. Kron. *See* Class XXII.

Complete Specifications Accepted.*

1890.

10,374. J. Gamgee. Process and apparatus for condensing or liquefying vapours or gases. August 12.

13,284. J. Foster. Evaporating apparatus. August 12.

14,380. L. Johnstone. *See* Class IX.

15,698. R. A. Robertson (of Mirrlees, Watson, and The Yaryan Co., Lim.) and D. Ballingall. Apparatus for evaporating, concentrating, and distilling liquids. August 12.

15,930. C. Kellner. *See* Class XIX.

15,931. C. Kellner. *See* Class XIX.

17,218. J. Zeller. Process for obtaining a new material from bituminous slate, and its application as a filtering medium, and as a colouring matter. August 19.

* *See* Note * on previous page.

1891.

7867. W. P. Thompson. — From Wirth and Co. Evaporating apparatus for concentrating liquids. July 29.

7869. W. P. Thompson. – From Wirth and Co. Evaporating apparatus for concentrating liquids of a pulpy nature. July 29.

8551. J. H. Day. Process and apparatus for moulding plastic or viscous substances into the form of thin bands or ribbons. July 29.

9351. J. Zubr. Retort furnaces. July 29.

11,043. G. W. Miller. Faucets for measuring fluids. August 5.

II.—FUEL, GAS, and LIGHT.

Applications.

11,885. J. Bartlett. Fuel block and fire-lighter combined. July 13.

12,256. J. Stevenson. Improvements relating to a method of transporting and delivering purifying material used in the manufacture of gas, and to apparatus therefor, such apparatus being applicable also for other purposes. July 18.

12,396. H. H. Leigh.—From T. Bauer and G. Mendheim, Germany. Improvements in coke ovens. July 21.

12,572. G. E. Stevenson. Improvements in apparatus for charging inclined gas retorts. July 24.

12,818. A. Hiekenbooper. Improvements in gas retort chargers. Complete Specification. July 28.

13,036. G. Webb, jun., and G. H. Rayner. Improvements in the manufacture of oxygen gas. July 31.

13,089. P. Dvorkovitz, The Kerosene Co., Lim., and The Tank Storage and Carriage Co., Lim. A new or improved method of and apparatus for distilling liquid hydrocarbons. August 1.

13,153. R. Barton. An artificial fuel compound. August 4.

13,179. D. C. Fischel. Improvements in artificial fuel. Complete Specification. Filed August 4. Date applied for January 5, 1891, being date of application in United States.

13,404. C. C. Black and S. Alford. An improved method for utilising the non-combustible portion of coal and other inflammable material, and furnace refuse generally. August 8.

13,431. J. H. Fergusson. Improvements in or connected with the manufacture of illuminating gas. August 8.

13,506. P. Dvorkovitz. Improvements in the manufacture of illuminating gas. Complete Specification. August 10.

13,550. W. L. Wise.—From Solvay and Co., Belgium. Improvements in the purification of gas. August 11.

Complete Specifications Accepted.

1890.

13,332. H. Stevenson. Method and apparatus for heating. July 29.

14,109. J. A. Rossiter. Means for generating heat. August 12.

14,112. S. A. Johnson. Effecting combustion of fuel, and prevention of smoke in steam boilers. August 5.

14,618. W. B. Lampard. Apparatus for charging inclined gas retorts. July 22.

16,207. F. Siemens. Means of utilising waste gases in regenerative gas furnaces. August 12.

1891.

9171. E. Luhmann. Extraction of gases from fluids. August 5.

IV.—COLOURING MATTERS AND DYES.

Applications.

12,441. A. Ashworth. Improvements in the production colouring matters. July 22.

12,557. R. Hirsch. Improvements in the manufacture of aniline. July 24.

12,589. H. H. Lake.—From Kalle and Co., Germany. Improvements in the manufacture of colouring matters. July 24.

13,677. B. Willcox.—From The Farbenfabriken vormals F. Bayer and Co., Germany. Improvements in the manufacture and production of colouring matters derived from anthraquinone and alizarin blue. August 13.

13,693. A. Lembach, F. Schleicher, and C. J. Wolff. A new soluble quinoline derivative. Complete Specification. August 14.

Complete Specifications Accepted.

1890.

14,621. B. Willcox.—From The Farbenfabriken vormals F. Bayer and Co. Production of rosaniline derivatives or leuco bodies of the tri- or di-phenylnaphthyl-methane series, and colouring matters therefrom. July 22.

14,836. J. Y. Johnson.—From The Badische Anilin and Soda Fabrik. Production of a sulpho acid suitable for dyeing and printing. July 22.

15,345. B. Willcox.—From The Farbenfabriken vormals F. Bayer and Co. Production of blue colouring matters. July 22.

15,346. S. Pitt.—From L. Cassella and Co. Manufacture of azo-dyestuffs, and of materials for their production. August 5.

15,347. S. Pitt.—From L. Cassella and Co. Production of azo-colours in substance or on the fibre. August 12.

15,778. M. Lange. Separating orthotoluol-sulphonic and paratoluol-sulphonic acids. July 29.

15,803. J. Y. Johnson.—From the Badische Anilin and Soda Fabrik. Production of a new naphthalene derivative for manufacture of dyestuffs. August 5.

16,666. J. R. Geigy. Production of a yellow colouring matter or dye. July 29.

16,868. J. Y. Johnson.—From The Badische Anilin and Soda Fabrik. Manufacture and production of a new blue basic dyestuff. August 5.

17,168. J. Y. Johnson.—From The Badische Anilin and Soda Fabrik. Manufacture of sulpho-acids of a red basic naphthaline colouring matter. August 19.

17,218. J. Zeller. *See* Class I.

19,167. J. Y. Johnson.—From The Badische Anilin and Soda Fabrik. Manufacture of sulpho-acids of a red basic naphthaline dyestuff. July 22.

1891.

9636. B. Willcox.—From The Farbenfabriken vormals F. Bayer and Co. Production of black azo-colours upon fibres. August 19.

V.—TEXTILES, COTTON, WOOL, SILK, Etc.

Applications.

11,937. W. H. Bailey. Improvements in the method of and apparatus for washing and cleansing wool and other fibres. July 14.

12,679. F. V. M. Raabe. Improvements in the manufacture of yarns from certain vegetable waste fibres. July 25.

12,681. W. E. Gedge.—From F. Mommer and Co., Germany. An improved process and apparatus for treating textile fibres in bobbins with a liquor. July 25.

12,708. W. Ellis and S. E. Stirzaker. Improvements in the treatment of wool for removing vegetable matter, burrs, and the like therefrom. July 27.

12,817. A. J. Boult.—From B. Beyer, Germany. A process of treatment of waste raw silk or "burr" with a view to its employment for manufacture of underclothing or the like. Complete Specification. July 28.

13,072. J. P. A. Blaye. Improved process and means for the chemical treatment of ramie fibre, flax, or hemp, in either a green or dried state. August 1.

Complete Specifications Accepted.

1890.

13,965. K. T. Sutherland and G. Esdaile. Treatment of long-staple stalk-fibres, such as China-grass, flax, to give them a more even staple when artificially shortened. July 22.

1891.

7458. S. C. Dhondy. Sizing compounds for cotton yarn. August 5.

11,717. A. Frayssè. Treatment of samples of crude wool for estimating purposes. August 19.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

Applications.

11,847. J. Frost and E. Cuno-Kayser. Improvements in the production of dyes on textile fibres and other like materials. July 13.

11,936. F. Hurter. Improvements in bleaching wood, cane, or other fibrous materials, and the preparation of an agent to be employed therein. July 14.

11,943. W. P. Thompson.—From G. Raeithel and J. Rosenthal, Germany. Improvements in the apparatus for clarifying, by means of filtration, dye-vats. July 14.

12,471. R. J. Loeffler and E. Knr. A method and apparatus employed in dyeing, drying, and otherwise treating textile materials. July 22.

13,102. G. A. Cannot. Improvements in the process of and apparatus for bleaching and treating the fibre of peat, or other fibrous substances. August 1.

13,509. C. F. Pike. Improvements in the method of and in apparatus for bleaching and treating textile fabrics August 11.

VII.—ACIDS, ALKALIS, AND SALTS.

Applications.

11,965. P. de Wilde. Method of utilising the "Weldon" plant for the manufacture of precipitated phosphates. Complete Specification. July 14.

12,317. F. M. Lyte and C. H. M. Lyte. Improvements in the production of chlorine and certain by-products. July 20.

12,522. E. Brochon. An improved process and apparatus for enriching or concentrating phosphates of lime. July 23.

12,538. F. M. Lyte. *See* Class X.

12,621. R. W. Forrest and W. Forrest. Improvements in obtaining cyanides or cyanogen compounds. July 25.

12,763. W. Donald. Improvements in treating chlorides to obtain chlorine, hydrates, and other salts or chemical compounds. July 28.

13,334. A. L. H. Knoop. Improvements relating to the extraction of carbonic acid from minerals, and to apparatus therefor. Complete Specification. August 6.

13,409. W. H. Higgin. See Class XIX.

13,424. G. I. J. Wells. Improvements in apparatus for the extraction of ammonia, applicable for ammonia-soda works and the like. August 8.

13,684. C. R. C. Tichborne, A. E. Darley, S. Geoghegan, and M. F. Purcell. An improved process and apparatus for the manufacture of solid carbonic acid (CO_2). August 13.

Complete Specifications Accepted.

1890.

14,484. T. Raynaud. Production of soda and chlorine. July 22.

15,394. E. Richters. Utilising the silicic fluoride obtained by the treatment of certain phosphates with sulphuric acid. August 12.

16,460. D. Gamble.—From A. R. Pechiney. Manufacture of chlorate of soda. August 19.

1891.

9646. F. Luhmann. Process for production of carbonic acid. August 5.

10,158. E. Luhmann. Production of carbonic acid from bicarbonate of soda. August 5.

VIII.—GLASS, POTTERY, and EARTHENWARE.

Applications.

11,858. W. Walker. Improvements in glass furnaces. July 13.

12,016. C. Huelsen. — From O. Balthasar, Germany. Process for producing china flowers serving as lamp shades or globes. July 15.

12,852. F. T. Power. Improvements in or relating to ovens or kilns for the firing of bricks, tiles, potters' goods and the like, by gas. July 29.

13,354. H. Lane and A. Chamberlain. Improvements in annealing furnaces. August 7.

13,567. F. Urban. Improvements in the manufacture of glass hollow ware. August 11.

13,738. W. Schleuning. Improved process of producing imitation terra cotta. August 14.

Complete Specifications Accepted.

1890.

14,774. J. J. de Jongh. Glass tiles suitable for roofs in conjunction with sheets of corrugated iron. July 22.

16,153. D. Rylands. Manufacturing glass conduits or tubes for electrical or other purposes. August 19.

16,422. C. K. Mills.—From J. B. Granjon and F. Allemand. Moulding and firing hollow articles. August 19.

1891.

8090. G. Gehring. Enamel for metals, glassware, earthenware, and other materials. August 19.

10,218. O. Bekken. Manufacture of slabs or tiles. August 19.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, and CEMENTS.

Applications.

12,219. W. J. Reagan and R. R. Longley. An improved composition of matter for plastering walls, &c. Complete Specification. Filed July 18. Date applied for January 20, 1891, being date of application in United States.

12,429. F. J. Reynolds and J. Brown. Producing an improvement in building cements. July 22.

12,633. T. D. Harries. An artificial stone. July 25.

12,664. C. Smith.—From J. G. Maardt, Denmark. Improvements in white decorative stucco or parqueting. July 25.

12,730. F. Wachsmath. Process for use in the manufacture of gypsum objects. July 27.

12,806. J. Mactear and D. A. Sutherland. Improvements in the treatment of stone for hardening the same. July 28.

13,016. G. Williams. Improved process of manufacturing hydraulic cement. July 31.

13,035. C. Roswag. Improvements in and relating to the preparation of refractory materials. July 31.

13,255. C. Scheurenberg. Process for the manufacture of artificial stones. August 5.

13,191. C. H. Köpke. An improved fireproof material. Complete Specification. August 10.

13,616. C. Bloemendal. An improved process and apparatus for producing hydraulic mortar. August 12.

Complete Specifications Accepted.

1890.

10,962. R. G. de Vasson and The Société dite La Suberine. Manufacture of plastic compounds for building and other purposes, and apparatus therefor. July 22.

12,607. C. George. Manufacture of artificial stone. July 29.

13,595. H. P. Williams and E. G. Williams. Improved artificial asphalte. August 19.

14,380. L. Johnstone. Rotative furnaces or kilns for treating and recovering waste gases from raw or partially raw materials, applicable especially in the manufacture of cement. August 5.

1891.

9189. W. Corbould. Manufactured whiting. July 29.

10,080. A. Schöfer. Apparatus for drying cement, clay, and other materials for burning or calcining. July 23.

11,259. E. E. A. Sorel. Materials for the manufacture of bricks and other articles, the building of fortifications and the protection of vessels. August 12.

X.—METALLURGY, MINING, Etc.

Applications.

12,116. H. H. Lake.—From J. C. Pennie, United States. Improvements in apparatus for disintegrating ores and other substances, and particularly for separating metals and metallic compounds from their gangue. July 16.

12,156. N. Lébédeff. Improvements in smelting iron, nickel, and copper. July 17.

12,165. J. Wilmotte. An improved converter for the manufacture of iron and steel. Complete Specification. July 17.

12,292. I. Willey and C. D. Bartle. Improvements in slime separators for use in the treatment of tin and other ores. July 20.

12,298. W. S. Simpson. Improved means and apparatus for facilitating the casting of metal articles in vacuo. July 20.

12,405. J. W. Richards. Improvements in the manufacture of galvanised iron. Complete Specification. July 20.

12,538. F. M Lyte. An improved process for the production of lead, conjointly with the production of chlorine, and of certain sulphates as by-products. July 23.

12,675. N. Lébédeff. Improvements in the reduction of metals from their combinations with oxygen. July 25.

12,813. A. Crossley. Improvements in apparatus for producing ferro-ferric and ferric oxides. July 28.

12,841. L. Cameron. Improvements in the manufacture of steel. July 29.

12,917. F. W. Harbord and W. Hutchinson, jun. Improvements in utilisation of tin plate scrap. July 30.

13,029. C. Roswag. Improvements in and relating to the extraction of copper and other substances from ores and the like, and to the treatment of the products obtained therefrom. July 31.

13,068. B. Rösing. Improvements in treating lead for purifying it, and for obtaining litharge, or for separating the lead from the precious metals contained in it. August 1.

13,354. H. Lane and A. Chamberlain. Improvements in annealing furnaces. August 7.

13,395. E Meyer. Improvements relating to the extraction of aluminium hydrate or aluminium salts from aluminium silicates or clay August 7.

13,670. The London Metallurgical Co., Lim., and S. O. Cowper-Coles. Improvements in coating or plating metals and metallic articles, applicable also for the manufacture of bullets. August 13.

13,711. M. Mannaberg and J. Cliff. Improvements in the manufacture of steel. August 14.

13,713. M. Mannaberg and J. Cliff. Improvements in the construction of steel smelting furnaces. August 14.

13,739. C. James. An improved method of treating leady copper "mattes" and ores. Complete Specification. August 14.

13,740. C. James. An improved method of smelting complex silver ores. Complete Specification. August 14.

13,796. H. Pidot. Iron silver. August 15.

Complete Specifications Accepted.

1890.

10,940. H. A. von Vught. Preparation for hardening iron all through. July 22.

11,877. H. H. Lake.—From La Société Vanzetti Sagramoso and Co. Manufacture of steel. July 29.

14,768. F. W. Martino and F. R. Martino. Metallic alloys. July 22.

15,174. C. L. C. Berton. Recovery of tin and iron from waste pieces or clippings. July 29.

15,475. G. A. Decosse and V. Lespinats. Process for making all kinds of rolled iron. July 22.

16,344. R. S. Casson. Manufacture of steel and ingot iron. August 19.

1891.

4793. W. B. Middleton. Treatment of steel. July 29.

8881. F. J. Page and H. A. Anderson. Soldering aluminium. July 22.

9341. J. H. Rogers. Apparatus used in the manufacture of tin and terne plates. August 19.

11,083. J. Bowing. Method of treating blue billy or purple iron ore, iron, sand, and similar substances, for the purpose of preparing them for the reducing furnace. August 19.

XI.—ELECTRO-CHEMISTRY AND ELECTRO METALLURGY.

Applications.

12,036. S. W. Maquay. Improvements in primary batteries. July 15.

12,069. H. D. Fitzpatrick.—From K. F. Scholler and R. H. Jahr, Germany. An improved electrode plate for electric collectors. Complete Specification. July 16.

12,296. A. S. Elmore. Improvements in apparatus for the manufacture by electrolysis of tubes and other articles of circular section. July 20.

12,313. E. C. C. Jungnickel. Improvements in electric batteries. July 20.

12,322. A. J. Boult.—From J. H. Bassler, United States. Improvements in or relating to electrical welding. Complete Specification. July 21.

12,491. C. L. Baker and Woodhouse and Rawson United, Lim. Improvements in the construction of rheostats or similar electrical instruments. July 23.

12,592. H. H. Lake.—From Lacombe and Co., France. Improvements relating to the manufacture or preparation of carbons for electric lamps or lighting apparatus. July 24.

12,611. J. W. Swan. Improvements in or connected with the electrolytic deposition of copper. July 24.

12,898. T. Parker. Improvements in means to be employed in the electrical deposition of copper. July 29.

12,946. I. A. Timmis and W. H. Walenn. Improvements in the electro-deposition of platinum. July 30.

13,208. E. Casper.—From E. Viarengo, Italy. Improvements in the manufacture of wire, bars, bands, and sheets of copper by electrolysis, and in apparatus therefor. August 4.

13,446. W. J. S. Barber-Starkey. An improvement in secondary voltaic batteries. August 8.

13,460. The London Metallurgical Co., Lim., and S. O. Cowper-Coles. Improvements relating to the coating of articles with a new metallic alloy by electro-deposition. August 8.

Complete Specifications Accepted.

1890.

11,065. G. A. Oneken. Impregnation of organic fibrous and cellular matter by means of an electric current, and apparatus therefor. July 22.

11,601. A. H. Cowles. — From F. W. Matthiessen. Obtaining metals in molten condition from their fused oxides by electrical action. August 12.

14,411. J. T. Niblett. Secondary batteries. July 22.

14,624. A. S. Elmore. Manufacture of metallic articles by electrolysis, and apparatus for that purpose. August 19.

14,693. J. P. Bayly.—From J. Silieco. Galvanic battery. August 5.

16,054. H. G. C. Serrin. Electric batteries. August 19.

16,279. N. Slawianoff. Process and apparatus for electrical casting of metals. July 22.

16,280. N. Slawianoff. Means of preventing blow-holes and other defects in castings by electricity. July 22.

16,399. A. J. Boult.—From L. A. J. Joray. Electro-deposition of metals. August 19.

20,712. E. Ortelli. Improvements relating to electric batteries. July 29.

1891.

8941. A. J. Boult.—From E. E. Ries. Method and apparatus for electrical hardening and tempering. July 29.

9762. S. C. C. Currie. Secondary or storage batteries. July 29.

XII.—FATS, OILS, AND SOAP MANUFACTURE.

Applications.

11,889. O. C. Hagemann.—From E. K. Mitting, United States. Improvements in the treatment and purification of soapmakers' spent lye for extracting glycerin therefrom. July 13.

12,168. S. I. Browne and C. S. Browne. Improvements in the manufacture of soap. July 17.

13,180. H. Pfotzner. Improvements in apparatus for smelting tallow. August 4.

13,799. H. Monie and S. M. Rutnagur. Improved detergents. August 15.

Complete Specifications Accepted.

1890.

10,753. A. F. St. George. Treatment of linseed and other oils employed in varnishes. August 19.

15,404. W. Majert. Manufacture of spermine. July 29.

1891.

9991. A. Siebels. Manufacture of iodine soaps. July 22.

10,132. C. Fink. Lubricants for machinery. July 22.

XIII.—PAINTS, PIGMENTS, VARNISHES, AND RESINS.

Applications.

12,480. J. C. Martin. Improvements in the manufacture of pigments or paints. July 23.

12,895. A. Gutensohn. An improved method and appliances for the production of litharge from metallic lead. July 29.

13,041. T. H. Rees and W. P. Blackham. Improvements in the manufacture of blue or other colouring or bleaching materials for washing purposes. August 1.

13,100. J. Hallett. An improved furniture polish. August 1.

13,429. J. Knowles. Improvements in or relating to laundry blue. August 8.

13,513. M. E. Dejonge. Improvements in anti-fouling and anti-corrosive compounds for ships' bottoms and other purposes. Complete Specification. August 11.

Complete Specifications Accepted.

1890.

12,123. G. Macaulay Cruikshank.—From E. Pietzeker. Preparation of rapidly-drying resinous and other oils or varnishes. August 5.

12,230. T. Christy. Substitute for gutta-percha, rubber, oiled and other transparent tissues. August 12.

15,564. J. P. Bayley.—From J. Bauleh. Improved blacking for leather. August 5.

1891.

1334. W. Grimshaw. Preparation of pigments or colouring compounds. August 19.

8510. H. Pennington. Process of manufacturing lead sulphate from metallic lead. July 29.

9747. H. Beck.—From F. Schaal. Manufacture of hard neutral resins as substitutes for natural resins, such as copal, amber, and the like. July 29.

XIV.—TANNING, LEATHER, GLUE, AND SIZE.

Applications.

12,331. J. Shepherd.—From A. Krizek and R. Eschè, Switzerland. Mineral size. July 21.

13,308. W. Francis, J. A. Carrick, B. Hooper, A. F. Grant, and H. A. Leverett. An improved process of rapid tanning. August 6.

Complete Specifications Accepted.

1890.

13,796. W. J. J. Hawkins. Printers' roller composition. August 5.

14,943. H. Belcher. Treatment of skins and hides for the preparation of leather. July 29.

1891.

7734. A. A. Hunting. Apparatus for treating or preparing leather. August 5.

XV.—AGRICULTURE AND MANURES.

Application.

12,522. E. Brochon. See Class VII.

Complete Specification Accepted.

1890.

14,321. A. Buchanan.—From A. W. Tait. Compounds for protecting vines, potatoes, and other vegetable growths from disease. July 29.

XVI.—SUGARS, STARCHES, GUMS, Etc.

Applications.

11,874. R. Harvey. Improvements in and relating to the manufacture of sugar, and in apparatus therefor or connected therewith. July 13.

11,963. A. R. Bernhard and W. E. Youle. Improvements in the manufacture of gum, similar to gum arabic, and serving as a substitute therefor. July 14.

12,054. H. Klein and G. Dethan. Improvements in apparatus for automatically manufacturing cold syrups of a determined density. Complete Specification. July 15.

12,058. R. F. Cordero. Improvements in apparatus for defecating and evaporating saccharine juices. Complete Specification. July 15.

12,355. O. Mengelbier. An improved apparatus for sucking off the green syrup from sugar masses, and purifying the latter. July 21.

12,518. C. Ferguson. Improvements in the manufacture or refining of sugar. July 23.

12,520. C. Ferguson. Improvements in the manufacture or refining of sugar. July 23.

12,808. R. F. Cordero. Improvements in apparatus for washing sugar. Complete Specification. July 28.

13,069. C. Ferguson. Improvements in or relating to the dissolving of sugar and other substances. August 1.

13,260. T. Drost. Improvements in the process and means for manufacturing crystallised sugar in refineries. August 5.

13,278. J. Cavargna. Improvements in concentrated and solidified gums for cementing paper, leather, fabrics, and other articles. August 6.

COMPLETE SPECIFICATION ACCEPTED.

1891.

12,054. H. Klein and G. Dethan. Apparatus for automatically manufacturing cold syrups of a determined density. August 19.

XVII.—BREWING, WINES, SPIRITS, Etc.

APPLICATIONS.

12,501. J. Walker and H. Higgott. An improved method or composition for cleansing foul casks and other vessels. July 23.

12,506. C. Rach. Process for the preparation of wort from malt or unmalted cereals. Complete Specification. July 23.

12,606. A. Walker. An improved mode of manufacturing yeast. July 24.

12,641. E. Dugdale. Improvements in beverages and their manufacture. July 25.

12,659. V. Denamur. Improvements in apparatus for the manufactnre or brewing of beer. July 25.

12,668. H. Elion. Improvement in the purification of yeast. July 25.

13,047. W. Dawson. Improvements in or relating to distillers' safes, said improvements being also applicable for check sampling the spent wash at outlets of "Patent" stills, and for taking and testing samples of liquids generally at different times or stages of manufacture. Complete Specification. August 1.

13,088. H. E. Newton.—From La Société Anonyme "La Levure," France. Improvements relating to the production and preservation of pure yeast. August 1.

13,353. A. Boake, F. G. A. Roberts, and W. B. Giles. Improvements in the preparation and treatment of worts for brewing and distilling purposes, and in the cultivation of yeast. August 7.

13,684. C. R. C. Tichborne, A. E. Darley, S. Geoghegan, and M. F. Purcell. *See* Class VII.

13,729. O. Perrier. Improvements in distilling and rectifying alcohol or other liquids, and in apparatus employed therein. August 14.

COMPLETE SPECIFICATIONS ACCEPTED.

1890.

17,640. R. H. Leaker and J. H. Howell. Improvements relating to brewers' and distillers' fermenting vessels and yeast receivers. August 5.

1891.

11,183. F. Bollmann. Malting apparatus. August 5.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

APPLICATIONS.

A.—Chemistry of Foods.

12,191. E. Barker. Improvements in or relating to the preparation or treatment of certain waste products to make them suitable for use as food, and in apparatus therefor. July 17.

12,549. J. H. H. Duncan. Improvements in the manufacture or production of butter. July 24.

12,838. A. Goldthorp. An improved process for purifying and clarifying water containing calcareous and metallic inorganic and organic substance or matter. July 29.

13,212. D. Tallerman. Improvements in the preparation of cattle foods. August 5.

13,369. G. C. Dymond.—From T. B. Taylor, United States. New or improved cereal food, and method of manufacturing the same. Complete Specification. August 7.

13,392. G. W. Richards. Improvements in the manufacture or production of articles of food for human consumption. August 7.

13,615. H. Carus-Wilson. An improved process for the treatment of tea. August 12.

B.—Sanitary Chemistry.

12,025. W. H. Munns.—From A. F. Black, United States. Improvements in apparatus for treating sewage. July 15.

12,466. E. E. Scruby. An improved process for treating sewage sludge and the like. July 22.

12,567. S. Phillips and S. F. Smart. Phillips and Smart's disinfecting and ozonising air filter. July 24.

12,947 S. A. Johnson. Improvements in means for purifying smoke and collecting and condensing the products contained therein. July 30.

13,326. W. Wade. Improvements in or connected with means for purifying or filtering sewage. August 6.

13,757. A. Mylius. Method of purifying liquids, more particularly sewage and waste water, and apparatus appertaining thereto. Complete Specification. Augus 14.

13,758. A. Mylius. Method of sterilising liquids, particularly sewage, and apparatus appertaining thereto. Complete Specification. August 14.

C.—Disinfectants.

11,978. A. R. Upward. A system and apparatus for the evolution and diffusion, by electrical energy, of disinfectants, antiseptics, and substances of a like nature. July 15.

12,033. A. J. Eli.—From F. Chavanon, France. A new or improved disinfectant. July 15.

12,247. E. Soy. A new method of using sulphurous acid gas as a disinfectant, and for other medical purposes. July 18.

13,139. T. McMurray. New or improved compounds to be used for disinfecting, deodorising, germicide, sanitary, manuring, and like purposes. August 4.

13,262. H. B. Thornton. Improvements in or appertaining to disinfectants for water-closets and other places or things where water is used. August 5.

COMPLETE SPECIFICATIONS ACCEPTED.

A.—Chemistry of Foods.

1891.

5196. C. B. Lesser. Process for the preparation of condensed milk. August 19.

B.—Sanitary Chemistry

1890.

14,253. A. O. Jones and S. Fox. Treatment of sewage. August 19.

14,858. R. Leigh. *See* Class XVIII.—*C.*

C.—Disinfectants.

1890.

14,858. R. Leigh. Deodorising, disinfecting, and oxidising substances. August 5.

XIX.—PAPER, PASTEBOARD, Etc.

Applications.

12,970. C. Kellner. Improvements in the boiling process for producing cellulose by means of sulphurous acid. Complete Specification. July 31.

12,971. C. Kellner. An improved process and apparatus for preparing the wood in the manufacture of wood fibre. Complete Specification. July 31.

13,225. F. B. Stanley. Improvements in the manufacture of coloured and figured goods of celluloid and like material. August 5.

13,400. W. H. Higgin. Improvements in the treatment and utilisation of esparto liquor and other similar waste liquors and by products. August 8.

Complete Specifications Accepted.

1890.

15,697. A. W. Hayles. Manufacture of paper and paper pulp from home and foreign grown marsh reeds, Danube reeds in particular. August 12.

15,930. C. Kellner. Lining boilers and digesters used in the manufacture of paper pulp and for other similar purposes. August 12.

15,931. C. Kellner. Lining boilers or digesters used in the manufacture of paper pulp and for other similar purposes. August 12.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES, AND EXTRACTS.

Applications.

11,957. W. Majert. Improvements in the manufacture of piperazine or spermine. July 14.

12,729. B. Hasenclöff. Process for the production of a palatable kola nut powder. July 27.

13,613. A. Baur. Improvements in the manufacture of artificial musk. August 12.

Complete Specifications Accepted.

1890.

16,392. E. J. E. Mills. From G. P. Monnier and Cartier. Receiver for the preservation and application of chloride of ethyle. July 22.

17,547. G. de Laire. Manufacture of iso eugenol and of certain of its derivatives and their application to the manufacture of vanilline. August 19.

XXII.—EXPLOSIVES, MATCHES, Etc.

Applications.

12,303. E. W. Anderson. Improvements in machinery for the manufacture of cordite and like explosives. July 20.

12,171. J. Heath and W. Frost. A safety fuse lighter. July 22.

13,038. H. de Mosenthal, A. G. Salamon, and J. J. Hood. Improvements in explosives. July 31.

13,218. J. Heilmann and P. T. Riddett. Improvements in or connected with fuses for mining or other purposes. August 5.

13,507. W. H. A. Kitchen and J. G. A. Kitchen. A new manufacture of explosive. August 10.

13,612. R. Kron. A centrifugal machine for separating acid from nitro-cellulose, or for other like purposes. Complete Specification. August 12.

Complete Specifications Accepted.

1890.

15,483. H. H. Lake.—From H. S. Maxim. Manufacture of explosives and apparatus therefor. August 5.

16,002. J. S. Taylor and S. W. Challen. Processes for producing gunpowder cake. August 12.

16,189. H. H. Lake.—From E. T. G. Thorn, G. R. O. Westendarp, and G. L. C. Pieper. Manufacture of explosives. August 12.

1891.

11,383. C. H. Curtis and G. André. Manufacture of gunpowder. August 12.

XXIII.—ANALYTICAL CHEMISTRY.

Complete Specifications Accepted.

1891.

10,492. J. Laidlaw. Centrifugal apparatus for testing relative volumes of mixtures of liquids of different specific gravities. August 19.

11,717. A. Frayssè. Treatment of samples of crude wool for estimating purposes. August 19.

PATENT UNCLASSIFIABLE.

Application.

13,573. F. Hughes.—From E. V. C. Bichon, France. A new or improved chemical compound. August 11.

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THE JOURNAL

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SESSION 1890–91.

Probable Arrangements.

1891:—

Nov. 2nd (Monday):—
Mr. W. C. Young. "On Volatile Organic Matter in Potable Water and a simple Method of Estimating Volatile and Non-Volatile Matter in Water."
Dr. S. Rideal. "Some Experiments on Solidifying Petroleum."

Dec. 7th:
Mr. Watson Smith. "A Contribution to our Knowledge of the Soluble and Resinoid Constituents of Bituminous Coals."
Dr. Murray Thompson. "The Salt Industry of India."

1892:—
Jan. 4th—Mr. Boverton Redwood. "The Galician Petroleum Industry."

Journal and Patent* Literature.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

PATENTS.

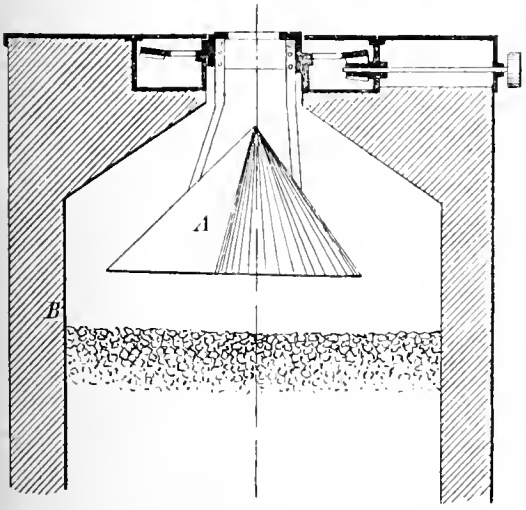
Improvements in Apparatus for Evaporating Liquors containing Salts, and for Separating such Salts when rendered Insoluble by Evaporation of the Liquors. E. G. Lawrance, London. From S. Piek, Szczakowa, Austria. Eng. Pat. 4532, March 22, 1890. 8*d*.

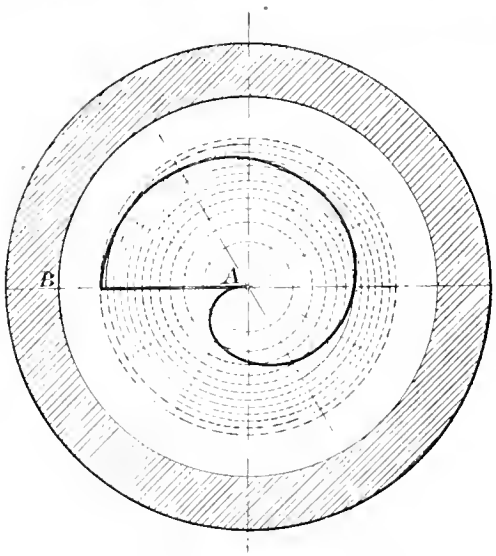
The improvement consists in an easily removable heating chamber of known construction, as applied to the inventor's well-known evaporator (this Journal, 1891, 624). The heating chamber contains a series of small tubes, arranged round a tube of relatively larger diameter; the tubes contain the liquor to be evaporated, which is heated up by means of steam admitted into the chamber. The liquor in the smaller tubes, being acted upon by comparatively greater heating surface, will attain a higher temperature than that in the large tube, and consequently will ascend in the former and descend in the latter, and thus an effective circulation in the liquor to be evaporated will be secured.—H. A.

Improved Method of and Means for Charging Materials into Apparatus such as Cupolas, Blast Furnaces, Lime Kilns, Scrubbers, and Absorption Towers. W. L. Wise, London. From Solvay and Co. Eng. Pat. 10,721, July 10, 1890. 8*d*.

The object of this invention is the placing of materials in the above apparatus in any desired way, thus, for instance, distributing them uniformly, irrespective even of size and density of the particles, all over the section of the apparatus.

The appliance consists of a charging cone, the periphery of whose base is formed by a curve, the shape of which is varied according to the desired purpose. Where uniform charging is desired, the curve is a spiral "such that any two radii forming a constant angle between them shall describe





Improved Charging Cone.

in their rotation two circles, the difference in diameter between which is constant. Each portion of the spiral corresponding to a constant angle at the centre thus generates a constant annular surface." The equation of this spiral is $r = a\sqrt{\theta}$, where r is the radius vector (varying from 0 to the radius of the furnace), a the radius of the section of the furnace, and θ the angle formed between the radius r and the initial radius.

The charge is tipped over the cone, and in falling is distributed all over its periphery; in the same time the cone makes a revolution, and the charge is thus equally sprayed over the surface of the kiln.—H. A.

Improvements in Reducing or Disintegrating Apparatus, more especially intended for Disintegrating Superphosphates and other similar Substances. P. U. Askham and W. Wilson, Sheffield. Eng. Pat. 11,474, July 22, 1890. 8*d*.

For disintegrating superphosphates two or more hollow drums are arranged one above the other, and are capable of being rotated in the same or in opposite directions in close proximity to, but not in actual contact with, reticulated or perforated concave hinged flaps, the inner radius of which corresponds nearly with that of the exterior periphery of the drums. Means are provided for oscillating these flaps in opposite directions. The coarse material to be disintegrated is fed into a hopper at the top of the machine, and falls into the space between the interior of the upper flap and the periphery of the drum, and the flap being made to move towards the revolving drum the material becomes squeezed and abraded. At the same time the lower flap is receding from the other drum, and is receiving into the similar space between it and the drum the material from the upper flap to be further disintegrated. The degree of fineness to which the material can be reduced is regulated by the adjustment of the space between the flaps and drums, and by the size of the reticulations.—E. S.

Improvements in or connected with Rotative Furnaces or Kilns for Treating and Recovering Waste Gases from Raw or partially Raw Materials, used more especially and for Example in the Manufacture of Cement. L. Johnstone, Newcastle-on-Tyne. Eng. Pat. 14,380, September 12, 1890. 8*d*.

See under IX., *page* 771.

* Any of these specifications may be obtained by post, by remitting the cost price, *plus* postage, to Mr. H. Reader Lack, Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C. The amount of postage may be calculated as follows:—

If the price does not exceed 8*d*.	.....		½*d*.
Above 8*d*., and not exceeding 1*s*. 6*d*.	.....		1*d*.
„ 1*s*. 6*d*.,	„	„ 2*s*. 4*d*.	..... 1½*d*.
„ 2*s*. 4*d*.,	„	„ 3*s*. 4*d*.	..... 2*d*.

Improvements in the Production of Cold and Ice, and in Apparatus therefor. E. J. Hardy, New York, U.S.A. Eng. Pat. 18,596, November 18, 1890. 8*d*.

This invention relates to that class of ice machines in which water is evaporated by being subjected to a vacuum, and the vapour brought into contact with sulphuric acid or other absorbing liquid. The improvements embrace the insertion of the pump cylinder to almost its entire length in the acid of the closed absorbing chamber, and causing it to extract air and vapour from that as well as from the freezing chamber, at the same time that a regulated supply of the acid is injected in the form of spray. The acid and vapours are pumped into a receiver, whence the air and vapour escape, whilst the acid is returned to the absorbing chamber. It is claimed that by this arrangement it becomes practicable to use one pump only for the double purpose of maintaining the vacuum and distributing the acid, whilst all working joints are effectually sealed by liquid. A diagram sketch indicates the principle of the arrangement, and there are eight claims.—B.

Improvements in Pressure Filters. J. Oxley and G. Sellars, Wombwell. Eng. Pat. 1717, January 30, 1891. 8*d*.

The invention relates to those filters which receive the water direct from the main, and which in some cases is under considerable pressure.

A lower metal box of a circular form has the lower part projecting and screwed for attachment to the supply pipe, and is provided with a suitable tap for drawing off the filtered water. The upper part of the box has an annular flange, through which pass several vertical bolts which secure in position a glass cylinder standing on the circular flange, and having within its lower end a perforated plate which acts as a lid to the circular box. The lower end of a vertical pipe is screwed into the centre of the circular box, and extends centrally up within the cylinder, to which it conducts the water to be filtered, its upper end being closed by a perforated cap, which can be adjusted by a spindle passing through a stuffing-box on the top cylinder cover, and by which means the various filtering media placed in the glass cylinder are held in the required position and at the necessary compression.—E. S.

Improvements in Evaporating Apparatus. S. M. Lillie, Philadelphia, U.S.A. Eng. Pat. 7187, April 25, 1891. Int. Conv. September 26, 1890. 8*d*.

This patent refers to various arrangements and combinations of the details of parts of evaporating apparatus, the main features of which consist in an evaporating chamber fitted with horizontal heating tubes. These pass at one end through the wall of the chamber into a steam space whilst their other ends are kept within the chamber and are closed except for a small hole in each for the escape of air or steam. The concentrating liquor is allowed to descend from overhead in thin layers over the outer surface of the tubes, where evaporation takes place. The concentrated liquor runs off below and may be returned by means of a pump to the overhead tank for further treatment. The vapour is drawn off by the vacuum pump or, where the apparatus is used in multiple effect the vapour is led into the steam space of the next chamber for heating the tubes and so on. The concentrated liquor is also in that case made to travel from one chamber to the other until the operation is concluded. For details the specification should be consulted, with its four sheets of drawings and 11 claims. —B.

Vacuum Evaporating Apparatus. H. Burgess, Royer's Ford, and C. H. Davis, Washington, U.S.A. Eng. Pat. 7701, May 4, 1891. 8*d*.

This refers essentially to arrangements of parts of evaporating apparatus in which a number of shallow vessels or dishes are superimposed one upon the other within a vacuum chamber, the liquid covering the floor of each vessel in a thin layer and overflowing into the next lower one. Each dish is provided with a double bottom, heated by steam, and an additional steam coil is placed just above the level of the liquid in each, suitable pipes being arranged for the steam and condensed water. There are two sheets of drawings and four claims.—B.

Improvements in Evaporating Apparatus for Concentrating Liquids. W. P. Thompson, Liverpool. From Wirth and Co., Frankfort-on-Maine, Germany. Eng. Pat. 7867, May 7, 1891. 6*d*.

This apparatus consists of a horizontal cylindrical evaporating vessel in which a tubular heating contrivance is kept revolving. The horizontal tubes are fitted with both ends into circular steam chambers with central hollow trunnions, which project through glands in the lower part of the end plates of the evaporatiog vessel, the vessel being partly filled with the concentrating liquid. During each revolution the heating pipes rise above the level of the liquid and dip into it again, thus acting as stirrers, whilst the trunnions serve as inlet and outlet for the steam and condensed water. There is one sheet of drawings and one claim.—B.

Improvements in Evaporating Apparatus for Concentrating Liquids of a Pulpy Nature. W. P. Thompson, Liverpool. From Wirth and Co., Frankfort-on-Maine, Germany. Eng. Pat. 7869, May 7, 1891. 8*d*.

A trough-shaped receptacle for containing the pulpy matter has within it a hollow rotating shaft, which is provided along its entire length in the trough with hollow fan-shaped stirrers arranged in pairs at right angles, and secured to the shaft by screwed bolts. Steam for heating enters through a pipe at one end and traverses the hollow shaft and stirrers, the water of condensation formed in the interior of the stirrers being discharged into the hollow space of the shaft, from which it runs off through a pipe, the whole apparatus being slightly inclined to accelerate its flow. Through the peculiar fan shape of the heating stirrers, the heating surfaces of which lie in the plane of rotation, the caking of the pulpy matter is avoided, the repeated friction between the matter and heating surfaces not permitting any particles to remain adhering to the stirrers.—E. S.

II.—FUEL, GAS, AND LIGHT.

The Causes of Explosions in Manufactories of Brown Coal Briquettes. R. Holtzwart and E. von Meyer. Dingl. Polyt. J. **280**, 185—190 and 237—240.

In spite of numerous efforts to trace the cause of explosions in factories of briquettes made of brown coal and the adoption of sundry precautionary regulations, the frequency of such mishaps has continued, and the present investigation was undertaken to arrive at fuller knowledge and more efficient means of prevention. It may be classified under three heads :—

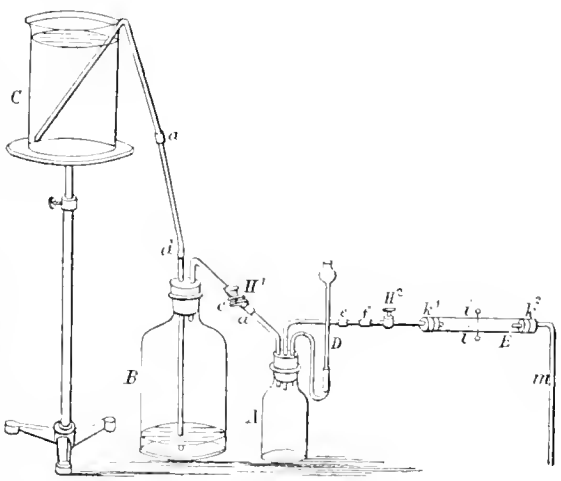
1. *Examination of the gases evolved during the process of manufacture.*—The samples were drawn in the ordinary way and analysed by the usual technical methods such as are described in Winkler's "Technische Gasanalyse." The analyses showed that neither in the drying ovens heated by steam nor in those with direct firing were the gases evolved in the least degree dangerous, the only combustible constituent, carbon monoxide, being present to the extent of 1 per cent. at the most, and generally in much smaller quantity. Moreover, those samples containing even this trifling amount showed a considerable increase in their content of carbon dioxide, whereby their inertness would be much enhanced. The fear of the possibility of danger from this source may be therefore dismissed.

II. *Examination of the gases evolved on heating brown coal.*—It has hitherto been assumed without experimental evidence that brown coal on drying evolves gases which behave in the manner of firedamp and readily give rise to explosions. The authors put this hypothesis to the proof by drawing dry air free from carbon dioxide slowly over brown coal heated to known temperatures and analysing the gases given off. They found that no appreciable amount of carbon monoxide or hydrocarbons such as methane was evolved. With coal *dust*, on the other hand, a considerably larger quantity was given off, 9 grms., when heated to 250°—280° C., yielding 349 cc. of methane and 127 cc. of carbon monoxide, mixed, however, with 920 cc. of carbon dioxide, the presence of which could not fail to diminish any tendency to explosion there might be very appreciably. No relation could be deduced between the composition of the coal and the nature of the gases obtained from it. An experiment upon a sample first heated alone and then with 2 per cent. of pyrites added showed that the addition of the latter, though increasing the rapidity of the oxidation, had no tendency to cause the evolution of combustible gases

III. *The conditions of explosion of brown-coal dust.*—As the foregoing investigations had shown that there was no possibility of the occurrence of an explosion from evolved gases under normal conditions of working, it was evident that the cause must be looked for under conditions other than normal, such as those obtaining when the ignition of a portion of the fuel had actually occurred. Further, as it had been proved that combustible gases were not evolved in appreciable quantity, the conclusion was reached that the explosive material must be coal dust; it being well known that coal dust requires a high temperature for ignition and is ignited more easily when in rapid motion than when at rest.

Experiments were first tried on a considerable scale. A vessel of sheet iron was filled with coal dust and placed over a lighted forge. The bottom of the vessel could be withdrawn and its contents allowed to fall into the forge, thus reproducing to some extent the conditions of explosion mentioned above. The result was, however, negative, a fact which the authors explain by supposing that the source of heat was insufficiently intense to produce that rapid ignition which develops into an explosion.

A second series of experiments was therefore made with the apparatus shown in the Figure.



Apparatus for Testing the Explosion of Coal Dust.

The explosion tube E has a capacity of about 50 cc. and is provided with two platinum wires *i*, *i*, fused in, between which sparks from an induction coil can be passed; the right-angled tube *m* by which it is closed dips into water; the air in the bottle A can be put under pressure (measured by the gauge D) by means of the vessel C, filled with water and communicating with B, which has a capacity of about 3 litres. Communication between B and A and A and E can be made and cut off by means of the screw-clip H_1 and the stopcock H_2. The quantity of dust used for each test is about 0·18 grm. It is projected into the explosion tube by suddenly opening the cock H_2 when the air in A is under pressure. The behaviour of some of the samples tested is given in the following table:—

No. of Sample.	Pressure of Air in Cms. of Mercury.				General Results.
	2.	3.	4.	8.	
	Explosion occurred.				
1	Twice not at all, once very weak.	Once not at all, once weak.	Twice not at all.	Not at all.	Tendency to explode very small.
4	Twice very strong.	Twice very strong.	Twice very strong.	Twice very strong.	Exploded at every trial.
6	Twice not at all, once weak.	Twice fairly strong.	Twice fairly strong.	Twice fairly strong.	Sample possessed considerable explosive tendency: 7 explosions out of 9 trials.

No relation could be traced between the tendency of the samples to explode and their ultimate composition.

The appearance of the explosion differed notably in different cases; when weak its course could be traced; when strong it appeared instantaneous throughout the tube.

The apparatus, though failing to solve many of the matters under consideration, is still of practical value, as by its means the comparison of one sample with another in respect of their explosive tendencies can be readily performed. It is noteworthy that the rapid motion of the coal dust is *essential* for its ignition; mere shaking of the tube even when testing the most explosive sample failed to give any explosion. An experiment with a mixture of 10 per cent. of carbon monoxide and 90 per cent. of air (which is almost explosive on its own account) gave an explosion that was not perceptibly stronger than when air alone was used.

From these results it is plain that the real cause of explosion in factories of brown-coal briquettes is the coal dust, and that the danger from this source only becomes grave under abnormal conditions of working where the ignition of a considerable quantity of the fuel has already taken place

The explosion, however begun, may be considered to take place in two stages: in the first, the expansion of the gaseous products of combustion evolved suddenly by the ignition of the coal dust in itself constitutes an explosion; in the second, the combination of a portion of these products that are imperfectly oxidised (such as carbon monoxide or hydrocarbons) with the oxygen of the air will give a secondary explosive effect.

To this paper Meyer appends the following remarks:—Steam-heated drying ovens are naturally safer than those fired direct. Ventilation is an evil rather than a good, as it supplies any fuel incipiently alight with the necessary air without which it might well become extinct. The elevators

and travelling apparatus of all descriptions being those parts of the plant likely to contain most dust in motion are the most dangerous; consequently the shorter the distance from drying oven to storage room the safer the works.

—B. B.

Explosions of Coal Dust in Artificial Fuel Factories. Dingl. Polyt. J. **280**, 279.

Two accidents due to the explosion of coal dust are described in the *Jahresbericht d. k. preuss. Gewerbräthe für* 1888. At the Reichenwald works an explosion of coal dust took place in the dried coal store room whilst the operations were in full progress, with the result that the front of the drying house was violently blown out and a considerable conflagration occurred in the factory. At Furstenberg on the Oder, where the works are entirely built of stone and iron, a similar explosion occasioned no damage, either to the workmen or to the buildings. The ignition of the coal dust appears to have commenced in the lowest feeding screw belonging to the drying room elevator, and to have spread forwards to the store room and backwards to the two drying houses. Five explosions followed in quick succession in different parts of the works, the detonation being strongest in the store room, and in a few minutes all the chambers containing dry coal dust were on fire.

These accidents afford further proof of the well-known fact that coal dust is itself a dangerous explosive, the presence of which must be guarded against in factories, mines, &c. by thorough ventilation and other protective measures.—S. B. A. A.

Investigation on the Slow Combustion of Gaseous Mixtures. A. Kranse and V. Meyer. Annalen, 1891, **264**, (i) 85—116.

The action of heat on the gradual combustion of gaseous mixtures has been studied with the view of ascertaining whether gaseous mixtures such as ordinary electrolytic gas, when heated to a temperature below the ignition temperature of the mixture, show similar regularities in the relation of the time of heating to the quantity of water formed by the combination of the gases as is observed in the case of hydrogen and chlorine when exposed to light. Very small quantities of air if present with the mixture of hydrogen and oxygen exercise so much influence on the combination of the gases when heated that it was found impossible to work out the above relationship without the gases being in a state of perfect purity. The two gases combine together when heated in a glass tube to 305° C., in presence of mercury, but in absence of mercury they can be heated for days to this temperature without any combination occurring. At 448° C however, they combine slowly, more rapidly at 518° C. Carbon monoxide and oxygen combine in considerable quantities to form carbon dioxide at 448° C. The temperature at which the above two mixtures explode is between 518° C. and 616° C.

The results of experiments made under varying conditions with most carefully purified electrolytic gas fail to show any relationship between the time during which the mixture is heated and the quantity of water formed. With bulbs of as nearly as possible the same size and heated under exactly the same conditions, the percentage composition of the mixture that had entered into combination was found to vary very much—differences of more than 25 per cent. being found in parallel experiments. The cause of the irregularity is traced by the authors to dissimilarities in the surface of the bulbs employed, although they were made as much alike as possible both in size and form, they propose to eliminate this effect in their further experiments on the subject, by etching the inside of the bulbs so that the surface to which the gases are exposed is completely roughened, thereby reducing the proportional effect of the small differences referred to. Full details of the plan adopted for the purification of the electrolytic gas and of the method of experiment employed are given.—C. A. K.

The Resinous (Soluble) Constituents of Coal. P. Liepmann. Zeits. f. Berg. Hütten u. Salinenw. 1891, **36**, 26.

See under III., *page* 753.

The Rate of Explosions in Gases. H. B. Dixon. Lecture, Royal Inst., June 12, 1891.

While Berthelot, associated with Vieille, was measuring the rate of the "explosion-wave" for various mixtures of gases, Mallard and Le Chatelier continued the study of the preliminary phenomena of explosion which precede the formation of the "wave." They showed, by photographing on a revolving cylinder, (1) that when a mixture such as nitric oxide and carbon bisulphide is ignited at the open end of a tube, the flame travels a certain distance (depending on the diameter and length of the tube) at a uniform velocity; (2), that at a certain point in the tube vibrations are set up which alter the character of the flame, and that these vibrations become more intense, the flame swinging backwards and forwards, with oscillations of increasing amplitude; and (3) that the flame either goes out altogether, or that the rest of the gas detonates with extreme velocity. Again, when a mixture of gases was fired near the closed end of the tube, they found the velocity of the flame regularly increased, as far as their instruments were able to record the rapidly increasing pace.

Mixtures of coal-gas with air, and of firedamp with air, show phenomena of the first and second kind. Ignited at the open end of a tube, these mixtures burn at a uniform rate for a certain distance, and then the flame begins to vibrate. The vibrations acquire greater or less velocity according to the nature of the mixture and the conditions of the experiment, but the third *régime* of uniform maximum velocity is not set up. In narrow tubes the explosion soon dies out.

The phenomena studied by Mallard and Le Chatelier have been observed on a large scale in explosions in coal mines. It has been noticed that little damage was caused at the source of an explosion, and for a distance varying from 50 to 80 yards from the origin of the flame, while beyond that distance fall of roof, broken tubs, and blown-out stoppings have testified to the violence exerted by the explosion. Great as the destruction is which an explosion of firedamp and air causes in a mine, it is fortunate that these mixtures do not *detonate*.

Passing on to Berthelot's researches on the *régime* of detonation, the author briefly summarises the results arrived at.

The actual velocities of explosion are compared by Berthelot with the mean velocity of translation of the gaseous products of combustion, supposing these products to contain all the heat that is developed in the reaction. For instance, we know the total heat given out when hydrogen and oxygen combine. If this heat is contained in the steam produced, we can calculate what its temperature must be if we know its heat capacity. And if we know the temperature of the steam, we can calculate the mean velocity with which the molecules must be moving. Now Berthelot supposes that the heat is all contained in the steam produced. He assumes that the heat capacity of steam is the same as the sum of those of its constituents, and he supposes, moreover, that the steam is heated at constant pressure. Making these assumptions, he calculates out the theoretical mean velocity of the products of combustion of various mixtures, and finds a close accordance between these numbers and the explosion rates of the same mixtures. He concludes that the explosive wave is propagated by the impact of the products of combustion of one layer upon the unburnt gases in the next layer, and so on to the end of the tube at the rate of movement of the products of combustion themselves. If his theory is true, it accounts not only for the extreme rapidity of explosion of gaseous mixtures, and gives us the means of calculating the maximum velocity obtainable with any mixture of gases, but it also affords us information on the specific heats of gases at very high temperatures, and it explains the phenomena of detonation, whether of gases or of solid or liquid explosives.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

The Formation of Petroleum and Solid Paraffin. R. Zaloziecki. Dingl. Polyt. J. 280, 69—72, 85—89, and 133—136.

This article consists of a lengthy physical and chemical argument in favour of the modern view that petroleum and paraffin owe their origin to animal sources: that they are formed from animal remains in a manner strictly analogous to that of the formation of ordinary coal from wood and other vegetable débris. For geological as well as chemical reasons, the author holds that Mendeléeff's theory of their igneous origin is untenable, pointing out that the hydrocarbons could not have been formed by the action of water percolating through clefts in the gradually solidifying crust until it reached the molten metallic carbides, as these clefts could only occur where complete solidification had taken place, and between this point and the metallic stratum a considerable space would be taken up by semi-solid slag-like material which would be quite impervious to water. Under the conditions, too, existing beneath the surface of the earth, such polymerisation as is necessary to account for the presence of the different classes of hydrocarbons found in petroleum is scarcely credible.

On the other hand it is to be specially noticed that, with a few unimportant exceptions, all bituminous deposits are found in the sedimentary rocks, and that just as these are constantly changing in composition, so the organic matter present changes, there being a definite relationship between the chemical constitution of the petroleum and the age of the strata in which it is found. It is almost certain that in the most recent alluvial formations no oil is ever found, its latest appearance being in the rocks of the tertiary period, the place where the solid paraffin is almost exclusively met with; thus helping to show that the latter has been formed from the decomposition of the oil, and is not a residue remaining after the oil has been distilled off. To this conclusion the fact also strongly points, that the paraffin is much simpler in constitution, purer, and often of far lighter colour than the crude oil, which could not be the case if it were the original substance.

On examining by the aid of a map the position of the chief oil-bearing localities it will be noticed that the most prolific spots follow fairly accurately the contour lines of the country, so that at one time they formed in all probability a coast line whereon would be concentrated for climatic reasons most of the animal life both of the land and sea. During succeeding generations their dead bodies would accumulate in enormous quantities and be buried in the slowly depositing sand and mud, till owing to the gradual alterations of level the sea no longer reached the same point. This theory is borne out by the fact that oil deposits are usually found in marine sediments, sea-fossils being frequently met with. The first process of the decomposition of the animal remains would consist in the formation of ammonia and nitrogenous bases, the action being aided by the presence of air, moisture, and micro-organisms, at the same time owing to the well-known antiseptic properties of salt, the decomposition would go on slowly, allowing time for more sand and inorganic matter to be deposited. In this way the decomposing matter would be gradually protected from the action of the air and finally the various fatty substances would be found mixed with large amounts of salt, under considerable pressure, and at a somewhat high temperature. From this adipocere, fatty acids would be gradually formed, the glycerol being washed away, and finally the acids would be decomposed by the pressure into hydrocarbons and free carbonic acid gas. That many of these hydrocarbons would be solid at ordinary temperatures, forming the so-called mineral wax, which exists in many places in large quantities, is much easier to imagine, in the light of modern chemical knowledge, than that the fatty acids were at once split up into the simpler liquid hydrocarbons, to be afterwards condensed into the more complex molecular forms of the solid substance.

In this way from animal matter are in all probability formed the vast petroleum deposits, the three substances, adipocere, ozokerite, and petroleum oil being produced in chronological order, just as lignite, brown-coal and coal are formed by the gradual decomposition of vegetable remains.

—F. H. L.

Petroleum Ether. F. Evers. Pharm. Zeit. 1891, 36, 246.

The author has recently examined several samples of petroleum ether which have the specific gravity required by the Pharmacopœa, but which boiled between 32° and 110° C., and which gave a distinct smell of benzaldehyde when treated with nitric acid. These petroleum ethers, technically known as "*hydrocarbon*," are obtained as a by-product in the compression of oil-gas. They contain up to 50 per cent. of benzene and toluene, together with olefines and nauseous sulphur compounds. When shaken with strong sulphuric acid the objectionable smell due to the sulphur compounds is removed and the benzene can be recovered after this treatment by shaking the separated layer of hydrocarbons with lime-water and then distilling with steam. It is recommended that all samples of petroleum ether obtained from such sources as the above should be carefully tested for benzene both by the boiling point and by the nitrobenzene reaction.—C. A. K.

The "Resinous" (Soluble) Constituents of Coal. P. Siepmann. Zeits. f. Berg. Hütten u. Salinenw, 1891, 36, 26.

The coal examined was a Westphalian gas-coal having the following composition:—

C	80·31
H	5·50
O } N }	12·94
S	1·25
	100·00

By treating the coal with different solvents, viz., ether, alcohol, and chloroform, three products differing both in properties and in composition were isolated.

The product extracted by means of ether amounts to 0·3 per cent. and forms a hard, yellow-brown resin, having an aromatic smell. It does not redissolve completely in ether. The portion that is soluble in ether is sticky at the ordinary temperature, at 35° C. it forms a thin liquid and begins to decompose at 100° C. The following analytical results were obtained:—I. of the crude product: and II. of the product purified by redissolving in ether:—

—	I.	II.
C	84·82	78·74
H	10·51	9·64
O	4·67	11·62
	100·00	100·00

The alcoholic extract (obtained after completely exhausting the sample with ether) amounted to 0·25 per cent. It consists of a dark brown resin which when pulverised forms a light brown powder: it has an aromatic smell, melts at 48°—50° C. and begins to decompose at 100° C. An analysis of this product is given below.

The chloroform extract amounted to 0·75 per cent., and consists of a dark brown pitch-like mass, having a smell of coal-tar. It begins to melt at 60° C., melts completely at 85° C., and decomposes at 145° C. The substance extracted by means of ether from two samples of coal was identical, a fact which, in the opinion of the author, may justify one in the opinion that it is an individual and pure body.

The following analytical data are given:—

	Alcohol Extract.	Chloroform Extract.	Coal after Extraction.
C	72·52	78·82	74·00
H	10·05	8·56	4·77
O	17·40	9·97	2·09
N	...	Trace	
S	...	2·65	1·14
	100·00	100·00	10·00

According to Rammelsberg ("Mineralchemie") "a few per cent. of a dark resin can be extracted from cannel coals by means of alcohol, ether, and especially of carbon bisulphide, which resin is the cause of the caking of these coals." The experiments of the author, however, go to show that the caking power of such coals is not due to, although influenced by the presence of these soluble resinous constituents.—C. A. K.

PATENT.

Improvements in the Purification of Coal Tar, and Rendering same a suitable Paint or Coating for Iron and Steel Structures. T. H. Davis, Manor Park, and A. H. Davis, Rock Ferry. Eng. Pat. 10,976, July 15, 1890. 4*d*.

The tar is washed by agitation with a solution of copper or zinc sulphate, and then with clean water. Sulphuretted hydrogen, &c., can by these means be removed.—E. G. C.

IV.—COLOURING MATTERS AND DYES.

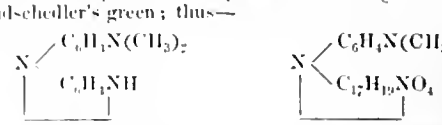
A Violet Colouring Matter from Morphine; the Formula of Pseudomorphine. P. Cazeneuve. Bull. Soc. Chim. 1891, **5**, 857–863.

A violet colouring matter is formed, together with other substances, by boiling for 100 hours in a reflux apparatus a mixture of morphine (7 grms.), *p*-nitrosodimethylaniline hydrochloride (5 grms.), and alcohol (500 cc). The solution gradually assumes a red brown colour, and a quantity of tetramethyldiamidoazobenzene separates in a crystalline state. After filtering from the latter, the alcoholic solution is evaporated to dryness, and the residue boiled with water, a deep purple coloured solution being so obtained. This solution, which contains at least two colouring matters, is evaporated almost to dryness, acidulated with hydrochloric acid, and then rendered alkaline with sodium hydrate, the colouring matters being precipitated and the unchanged morphine remaining in solution. The precipitate is collected on a filter, washed with dilute sodium hydrate, dried, and extracted in the cold with amyl alcohol, which dissolves out a violet colouring matter, and leaves in the residue a blue colouring matter or mixture of colouring matters. The violet colouring matter is obtained in a pure state on evaporating the amyl alcohol. Its platinochloride has the formula $PtCl_4.C_{17}H_{19}NO_3.2\,HCl$, and has the characteristic properties of the platinochlorides of the majority of alkaloids. The colouring matter, of which the free base has the formula—

$$N\begin{matrix}\diagup C_6H_4N(CH_3)_2\\ \diagdown C_{17}H_{17}NO_3\end{matrix}$$

forms an amorphous mass with a bronze like lustre; it is sparingly soluble in water, freely so in alcohol, its alcoholic solution being strongly dichroic; its green coloured solution in concentrated sulphuric acid becomes successively blue and violet on dilution with water; it dyes silk, wool, and gun-cotton, but is not fast to light.

The constitution of the violet colouring matter cannot be expressed on the quinone-anilide type, since codeine, the methyl ether of morphine, gives a similar colouring matter without any separation of methyl alcohol taking place. Nor does the fact of morphine being a tertiary alcohol assist the solution of the problem, as tertiary alcohols in general interact only with great difficulty with *p*-nitrosodimethylaniline. It may, therefore, be assumed that the constitution of the colouring matter in question is analogous to that of Bindschedler's green; thus—



Bindschedler's Green. Morphine Violet.

The constitution of the violet colouring matter cannot, however, be explained until more is known about the constitution of morphine itself, in particular with regard to the position in the molecule of the same of the two atoms of hydrogen which are so readily removed by oxidation. These two hydrogen atoms occupy, no doubt, the position in the molecule to which the two free bonds of the residue—

$$N\begin{matrix}\diagup C_6H_4N(CH_3)_2\\ \diagdown\end{matrix}$$

attach themselves.

Although pseudomorphine could not be detected amongst the products of the reaction of *p*-nitrosodimethylaniline on morphine, it is highly probable that it is formed, according to the equation—

$$2\,C_6H_4\begin{matrix}\diagup N(CH_3)_2\\ \diagdown NO\end{matrix} + 2\,C_{17}H_{19}NO_3 = \begin{matrix}N.C_6H_4.N(CH_3)_2\\ \|\\ N.C_6H_4.N(CH_3)_2\end{matrix} + 2\,C_{17}H_{17}NO_3.H_2O$$

its absence in the final products being due to its combining with the nitrosodimethylaniline or entering into secondary reactions.

Whatever the constitution of the violet colouring matter may be, its formation elucidates the nature of pseudomorphine. For, assuming that pseudomorphine is produced, as Hesse considers, by the dehydrogenation of morphine, the formula of the violet colouring matter would be—

$$N\begin{matrix}\diagup C_6H_4.N(CH_3)_2\\ \diagdown C_{17}H_{17}NO_3.H_2O\end{matrix}$$

Hesse assigning to pseudomorphine the formula—

$$C_{17}H_{19}NO_3.H_2O,$$

instead of $C_{17}H_{19}NO_4$, the formula given to it by Schützenberger.

On heating the violet colouring matter, however, to 130°, no change is produced; the molecule of H_2O is presumably, therefore, in a different state from water of crystallisation. Again, if pseudomorphine have the formula—

$$\begin{matrix}C_{17}H_{18}NO_3\\ |\\ C_{17}H_{18}NO_3\end{matrix}$$

given to it by Polstorff (this Journal, 1886, 616), it should yield with nitrosodimethylaniline either a safranine or a compound of the formula—

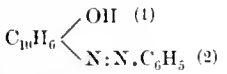
$$N\begin{matrix}\diagup C_6H_4N(CH_3)_2\\ \diagup C_{17}H_{18}NO_3\\ \diagdown C_{17}H_{18}NO_3\end{matrix}$$

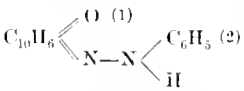
As it yields neither, and as, moreover, one molecule of morphine alone interacts with one molecule of nitrosodimethylaniline, Polstorff's formula is evidently incorrect.

Morphine violet is the first true colouring matter obtained from the natural alkaloids, the Morphine blue of Chastaing and Barillot (Compt. Rend. **105**, 1012) not being a colouring matter properly so-called.—E. B.

Hydrazone Derivatives of β-Naphthoquinone. E. Noelting and E. Grandmougin. Bull. Soc. Chim. 1891, **5**, 863—869.

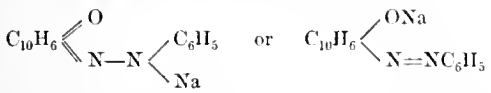
The constitution of the azo-derivatives of β-naphthol and of their isomerides, the hydrazones of β-naphthoquinone, has been much disenssed, the following formulæ being, for instance, variously assigned to the compound produced by the action of phenylhydrazine on β-naphthoquinone :—

I. 

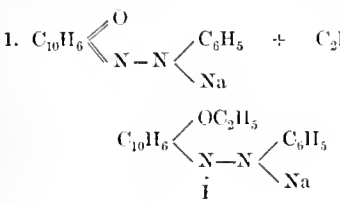
II. 

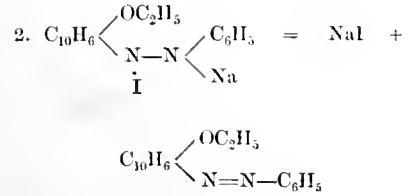
A study of the dyestuff derivatives of the hydrazones of β-naphthoquinone, more particularly of the sulphonic acid derivative of the phenylhydrazone (see following abstract), led the authors to conclude that such bodies were azo-compounds and not true hydrazones. Facts in support of this view are given below.

If the compound of phenylhydrazine with β-naphthoquinone be a hydrazone, it should not react with diazobenzene chloride, whereas, if it be an azo-compound, it should be capable of doing so. To decide this point, β-naphthoquinone-phenylhydrazone was first prepared by the method of Zincke and Bindewald (this Journal, 1885, 395), but with the use of as little acetic acid as possible, namely, 10 times the weight of the β-naphthoquinone; a 50 per cent. yield was obtained, a considerable portion of the phenylhydrazine becoming oxidised, probably into benzene, by the quinone, which is simultaneously reduced to a corresponding extent, to dinaphthoquinol, $\{C_{10}H_5(OH)_2\}_2$, a compound separating in beautiful colourless needles on the acetic acid mother-liquor being diluted with water. Zincke and Bindewald's description of the properties of the chief product of the reaction was confirmed, the authors observing in addition that the compound, like the compound from β-naphthol and diazobenzene, can be sublimed, orange needles with a green surface-lustre being thus obtained; it is insoluble in alkalis in the cold, and but slightly soluble on heating; it dissolves easily, however, in the theoretical quantity of sodium methylate or ethylate, yielding a dark red solution, which remains clear on dilution with water. This alcoholic solution contains the sodium salt of the compound, and, according as it is represented as a hydrazone or an azo-derivative, has either the constitution—



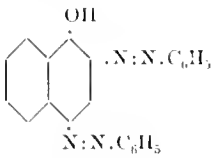
To decide between these formulæ the ethyl ether was prepared and reduced; the reduction products were found to be aniline and β-amido-naphthol ether, without a trace of ethylaniline. This result is in favour of the second formula, though it is just possible that an intra-molecular change is brought about, thus:—

1. 

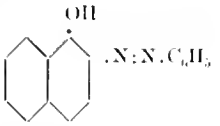
2. 

Phenyldisazo-α-naphthol cannot well be prepared by acting on an alkaline solution of β-phenylazo-α-naphthol, owing to the feeble solubility of the latter. It was, however, readily obtained on adding the necessary amount of diazobenzene chloride to a solution of the β-azo compound in a slight excess of sodium ethylate. After standing 12 hours, the separation of the disazo-compound was complete. It was filtered off and crystallised from a mixture of alcohol and chloroform, and was then obtained in the form of brown needles with a bronzy green reflex. The compound is in every respect identical with the body prepared by Krohn (this Journal, 1889, 116) by the action of 2 mols. of diazobenzene on α-naphthol. (The melting point of Krohn's compound, after recrystallisation, was found to be 193°.) To further prove the identity of the two preparations, the acetyl derivative (melting point 159°—160°) and ethyl ether (melting point 121°) were prepared.

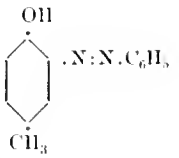
As Krohn (*loc. cit.*) has shown that the formula of phenyldisazo-α-naphthol is—



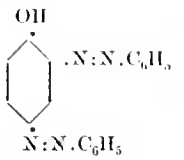
that of the phenylhydrazine compound of β-naphthoquinone must be—



This formula explains the feeble acid character of the compound, other *o*-hydroxyazo-compounds, such as phenyl-azo-*p*-cresol—

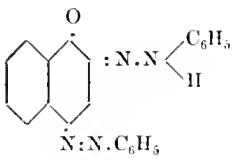


and phenyldisazophenol—



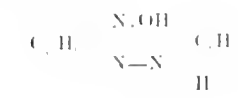
being very sparingly soluble in aqueous alkalis.

If the hydrazone formula—



be assigned to Krohn's disazo-compound, a similar formula must be given to phenyl-azo-*p*-cresol, which is not in conformity with the behaviour of its ethers (this Journal 1890, 1123).

Lastly, if the phenylhydrazine compound of β-naphthoquinone were a hydrazone, it should react with hydroxylamine and yield an oxime—

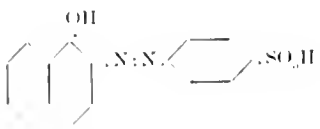


The authors could not, however, obtain such a compound. —E. B.

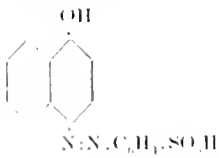
Some o-Hydroxyazo Derivatives of α-Naphthol. E. Noelting and E. Grandmougin. Bull. Soc. Chim. 1891, **5**, 869—873.

Having shown that the phenylhydrazine compound of β-naphthoquinone is an *o*-hydroxyazo derivative of α-naphthol (see preceding abstract), the authors prepared some derivatives of that compound for the purpose of comparison, with respect to their tinctorial properties, with the isomeric *p*-substituted α-naphthol compounds.

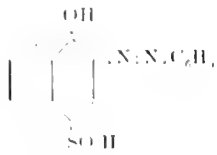
p-Sulphophenylazo-α-naphthol—



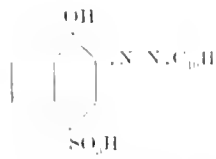
is obtained by suspending β-naphthoquinone (1 molecular proportion) in 10 times its weight of glacial acetic acid and adding a cold, concentrated aqueous solution of sodium *p* phenylhydrazine-sulphonate (1 molecular proportion). After standing for 24 hours, the red precipitate formed, which consists of the sodium salt of the above acid, is filtered off. Its yield is not satisfactory, part of the naphthoquinone remaining in solution in the acetic acid, and part being decomposed as in the preparation of β-phenylazo-α-naphthol (preceding abstract). It dyes wool and silk scarlet from an acid bath. It is isomeric with Orange I.—



which is produced by the action of *p*-diazobenzene sulphonic acid on α-naphthol or of *p*-phenylhydrazine sulphonic acid on α-naphthoquinone. The azo dye—

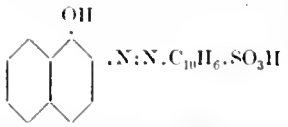


is also a scarlet; the α-naphthylamine compound—



a wine-red; its β-naphthylamine isomeride, a scarlet.

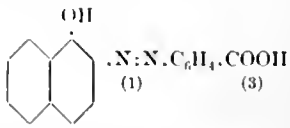
The compound—



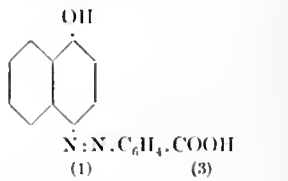
obtained from β-naphthoquinone and 1 : 4-naphthylhydrazine sulphonic acid is a red-purple, whilst the isomeric compound prepared from α-naphthol and 1 : 4-diazonaphthalene sulphonic acid—

is a brown (Fast brown).

In general, the *o*-hydroxyazo derivatives of α-naphthol are reds, the *p*-hydroxyazo derivatives yellow-browns. The same difference appears in the shades yielded by the carboxy derivatives of the two series, the compound—



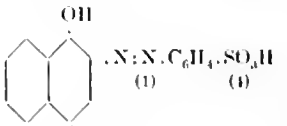
prepared from *m*-phenylhydrazine carboxylic acid and β-naphthoquinone dyeing a bluish-red on wool, silk, and chrome-mordanted cotton, whilst the *p*-isomeride—



dyes brown on the same.—E. B.

The Disazo Derivatives of α-Naphthol: A Transposition. F. Noelting and E. Grandmougin. Bull. Soc. Chim. 1891, **5**, 873—879.

Diazobenzene chloride acts on the phenylhydrazone of β-naphthoquinone yielding phenyldisazo-α-naphthol, a compound which is also produced by the action of diazobenzene chloride on *p*-phenylazo-α-naphthol (*see* preceding abstract: Hydrazone derivative of β-naphthoquinone). The *p*-sulphoxy and *m*-carboxy derivatives of the phenylhydrazone of β-naphthoquinone react similarly with diazobenzene chloride yielding respectively:—



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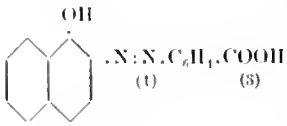
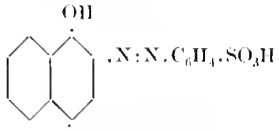


but a curious transposition takes place when *p*-diazobenzene sulphonic and *m*-diazobenzene carboxylic acids act on *p*-phenylazo-α-naphthol, the compounds—



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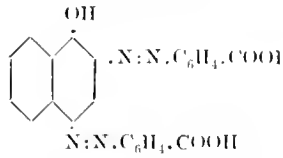
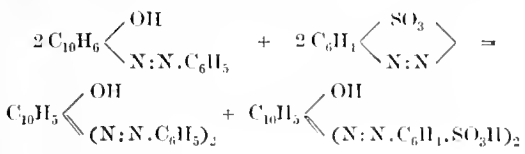
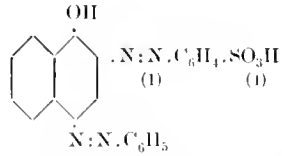


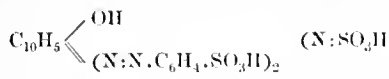
being respectively then produced along with phenyldisazo-α-naphthol, according to the equation—



The compound—

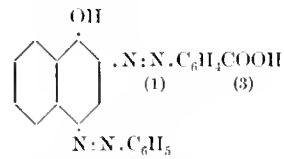


is easily soluble in boiling water, and separates in an amorphous state on cooling. It dyes animal fibres red-brown. Its sulphonic acid derivative, namely—

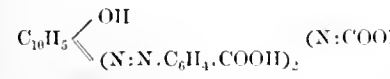


which is obtained, as described above, was separated by filtration from the insoluble phenyldisazo-α-naphthol simultaneously formed. The disulphonic acid is not precipitated by the addition of acids to its alkaline solution, and as it could not therefore be readily obtained pure, an analysis was not made but the dyeing properties of the compound alone investigated, being compared with those of the compound obtained from 2 mols. *p*-diazophenyl-sulphonic acid and α-naphthol; the two preparations were thus found to be identical.

The carboxy compound—



crystallises in fine, brown needles and possesses feeble acid properties; it is soluble in hot aqueous alkalis. Its colouring power is slight, owing to its feeble solubility in water. The corresponding diarboxy compound—



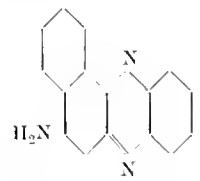
separates after some time from the phenyldisazo-α-naphthol which accompanies it, when the mixture of the two substances is dissolved in chloroform, and alcohol added. It is easily soluble in alcohol, but cannot be crystallised from the same, and dissolves easily in alkalis with a red colour. On heating to 250° it darkens and decomposes at about 264°. A nitrogen determination was made, after precipitating it by acid from its alkaline solution, and the above formula confirmed. It was also prepared by the combination of α-naphthol with 2 mols. of *m*-diazobenzoic acid, and found to have the properties described. On chrome-mordanted cotton it dyes a pale dull red; on silk and wool in an acid bath, red-purple.

The authors notice that, in the preparation of *p*-phenylazo-α-naphthol from diazobenzene chloride and α-naphthol, a notable amount of phenyldisazo-α-naphthol is produced, a corresponding amount of α-naphthol remaining unchanged. This seems to have hitherto escaped observation.

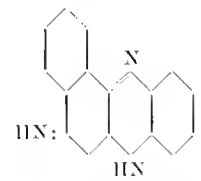
It was thought possible for *o*-phenylazo-α-naphthol to be formed along with the above *p*-compound, but its presence could not be detected.—E. B.

The Relations of Eurhodines to Indulines and Safranines. F. Kehrmann and J. Messinger. Ber. **24**, 584—592.

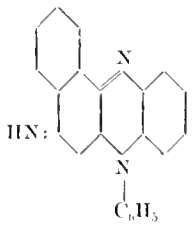
On the two formulæ—



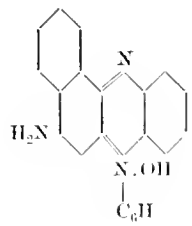
and



proposed for α-amidonaphthophenazine by Fischer and Hepp (this Journal, 1890, 602) and Kehrmann (this Journal, 1890, 934) respectively, the former has been shown to agree better with the properties of the compound in question (this Journal, 1890, 1028). Both, however, appear to be possible, the forms which they represent being desmotropically related. This is proved to be the case by replacing by an alkyl, &c. group the movable hydrogen-atom which produces the tautomerism, stable isomerides of each type being then obtainable. The authors have thus succeeded, by the action of phenyl-*o*-phenylenediamine on hydroxynaphtho-imidoquinone, in synthesising *rosinduline*—



a compound of the second (imidoquinone) type. This was accomplished by heating under pressure a mixture of the bodies named with alcohol and acetic acid, 5 grms. of the imidoquinone yielding 2—3 grms. of rosinduline (this Journal, 1890, 601). To account for the resemblance between rosinduline and the safranines (the bitter taste of the salts of the same, for instance, amongst other points of similarity), it is suggested that the salts of rosinduline are derived from an unstable ammonium-base of the constitution—



Rosindone (this Journal, 1891, 602) was obtained on mixing, at the ordinary temperature, alcoholic solutions of equal molecules of hydroxynaphthoquinone and phenyl-*o*-phenylenediamine and acidulating with a few drops of acetic acid. It is proposed to change the name of this compound to "rosindulone," since the termination "indone" might lead to confusion with the ketoindene derivatives of the same name, the keto derivative of the "simplest" induline, namely, phenindone, being in accordance with this proposed change, named "phenindulone."

Indulones were also prepared from chlorodihydroxyquinone and dihydroxythymoquinone and their physical properties determined.—E. B.

Synthesis of Methyl Indigo from p-Chloracet-toluide and p-Tolylglycocine. H. Eckenroth. Ber. **24**, 693.

When either *p*-chloracet toluide, or *p*-tolylglycocine, is fused with potash (2 parts) in the manner described by Flimm and Heumann in their syntheses of indigo (this Journal, 1890, 281 and 1121), an orange-coloured mass is obtained, from which, on treatment with water and exposure to air, dimethyl-indigo separates. The reaction, in the case of *p*-tolylglycocine, may be expressed by the following equation:—

$$2\,C_6H_4(CH_3)NH.CH_2.COOH = C_6H_4(CH_3)\begin{cases} CO \\ NH \end{cases} C - C \begin{cases} CO \\ NH \end{cases} C_6H_3.CH_3 + 2\,H_2O$$

Dimethyl-indigo is physically indistinguishable from ordinary indigo.

That the product of the above reaction is dimethyl-indigo is proved by its yielding *p*-toluidine on distillation with potash. (See also following abstract.)—E. B.

Non-Formation of an Indigo Derivative from p-Tolylglycocine by Fusion with Alkali. K. Heumann. Ber. **24**, 1346.

The author, in disagreement with H. Eckenroth (preceding abstract), finds that pure *p*-tolylglycocine (made from pure *p* toluidine) does not yield any indigo derivative when fused with potash.—E. B.

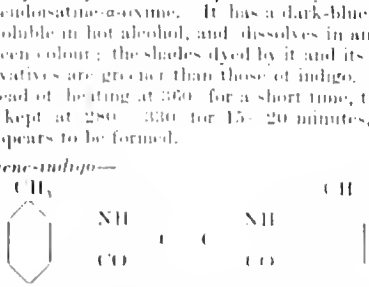
Diethyl- and o-Toluene-Indigo. K. Heumann. Ber. **24**, 977—979.

Diethyl-indigo—

is obtained by fusing ethylphenylglycocine (from chloracetic acid and ethylaniline) with caustic potash in the manner previously described by the author (this Journal, 1890, 1121). It is probably identical with the compound obtained by Baeyer (Ber. **16**, 2201) by reduction of diethylpseudosatinic-*a*-oxime. It has a dark-blue colour, is slightly soluble in hot alcohol, and dissolves in aniline with a blue-green colour; the shades dyed by it and its sulphonic acid derivatives are greener than those of indigo.

If instead of heating at 360° for a short time, the potash melt be kept at 280°—330° for 15—20 minutes, ordinary indigo appears to be formed.

o-Toluene-indigo—



is produced by the action of potash on *o* tolylglycocine at 300°—320°. It crystallises from hot aniline in fine, bronze prisms. The shades it dyes on cotton are a little greener than those of indigo; its disulphonic acid derivative, on the other hand, dyes wool a much redder shade than does indigo extract. The name *o*-toluene-indigo is adopted in order to avoid confusion with the dimethyl-indigo, in which the hydrogen of the imido group is substituted by the methyl group.—E. B.

Adulteration of Cochineal-Red. E. Donath. Chem. Zeit. 1891, **15**, 522.

A sample of cochineal-red of very poor appearance consisted entirely of an eosin lake of lead and alumina mixed with lead sulphate. It was insoluble in ammonia and left 88·5 per cent. of ash. Another sample, only distinguishable with difficulty from pure cochineal when placed side by side with it, consisted entirely of a barium lake of red Corallin. It was to a large extent soluble in ammonia, and on ignition left 74·5 per cent. of ash consisting of barium carbonate mixed with a little sulphate.—S. B. A. A.

The Technical Preparation of Phthalic Acid. H. Lüddens. Chem. Zeit. 1891, **15**, 585.

According to the information to be found in text books, phthalic acid is prepared from naphthalene on the large scale by first converting the latter into the tetrachloro addition product, $C_{10}H_4Cl_4$, which is then oxidised with nitric acid. No details are to be found regarding the manufacture of phthalic acid or of its substitution products by the direct oxidation of naphthalene or of substituted naphthalenes, nor is anything to be found in the literature regarding the employment of oxidising agents other than nitric acid. As regards the direct oxidation of naphthalene, it is generally stated that both it and phthalic acid are completely burned to carbon dioxide and water by chromic acid mixture; that nitric acid acts directly upon naphthalene to produce mononitronaphthalene is, of course, well known. Despite these statements, it is well known to those interested in the preparation of the acid on the large scale, that in its manufacture for the preparation of the cosine and allied colours, by far the larger proportion is not obtained by the oxidation of the tetrachloride of naphthalene with nitric acid, but by the direct oxidation of naphthalene with chromic acid mixture. Sodium chromate is generally employed as the oxidising agent and not the potassium salt or potassium bichromate. According to Friedländer ("Fortschritte der Theerfarben Fabrikation," p. 137) phthalic acid is also prepared by the oxidation of the sulphonic acids of naphthalene and of naphthol either by means of nitric acid or of chromic acid mixture. The author compares the relative values of the old process with that generally employed in the aniline colour works, pointing out the decided advantages of the latter; but even the older method must, in his opinion, be a lucrative one with the present price of phthalic anhydride (7 marks per kilo. = about 3*s.* 6*d.* per lb.) As far as his experience goes, phthalic acid is not manufactured by the direct oxidation of naphthol as stated by Friedländer.—C. A. K.

Phthalic Acid. Fuchs. Chem. Zeit. 1891, **15**, 735.

In reply to the paper by Lüddens on this subject (vide previous abstract) the author expresses his doubt as to whether phthalic acid can be successfully prepared by the direct oxidation of naphthalene with chromic acid, and states that his own experiments on the subject have not yielded favourable results. Reference is made to Hager's patent for getting the acid by treating naphthalene with nitric acid, and to Schützenberger's statement that it can be got by first preparing a solid tetrachloronaphthalene and then oxidising this with dilute nitric acid. In the former process, as is well known, nitronaphthalenes result, and in the latter the yield of phthalic acid is but small, and tri-nitronaphthalene together with other nitrated products are formed, so that neither of them can be regarded as being of any commercial value. Were the yield of the acid by any of the processes in use anything like a theoretical one, the price should be at most 2 marks per kilo. instead of 6—7 marks. One great source of loss is that occurring in the conversion of the acid into the anhydride.—C. A. K.

PATENTS.

Improvements in the Manufacture of Colouring Matters. G. W. von Nawrocki, Berlin, Germany. From P. Böttiger, Lodz, Russia. Eng. Pat. 4415, March 5, 1884. Amended May 2, 1890. (Second Edition.) 6*d*.

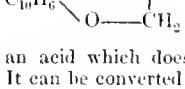
Already abstracted (this Journal, 1891, 131).—T. A. L.

Improvements in the Manufacture and Production of Colouring Matters from Dihydroxybenzoic Acid. J. Y. Johnson, London. From the "Badische Anilin und Soda Fabrik," Ludwigshafen, Germany. Eng. Pat. 12,356, August 7, 1890. (Second Edition.) 6*d*.

Nitroso-derivatives of tertiary aromatic bases, such as dimethylaniline, diethylaniline, methylbenzylaniline, and ethylbenzylaniline are condensed with symmetrical dihydroxybenzoic acid ($C_6H_3CO_2H:OH:OH = 1:3:5$) in an aqueous, alcoholic or acetic acid solution with the formation of dyestuffs. The dihydroxybenzoic acid is obtained by fusing *m*-disulphobenzoic acid with caustic potash (Barth and Lenhofer, Annalen, **159**, 222). About 10 kilos. of dihydroxybenzoic acid are dissolved in 1,000 litres of water, heated to 70° C., and 12 kilos. of nitrosodimethylaniline hydrochloride gradually added. After standing about five hours the new colouring matter separates out as a crystalline precipitate, which is filtered off and washed with cold water. It may be purified by dissolving in dilute soda, filtering and precipitating with an acid. The colouring matters dye wool without a mordant, and the presence of a mordant does not alter the shade, so that these products may be used with mordant colouring matters, such, for instance, as Alizarin blue, giving much more brilliant shades.—T. A. L.

Improvements in and Relating to the Manufacture and Production of New Materials for the Preparation of Dyestuffs. J. Y. Johnson, London. From the "Badische Anilin und Soda Fabrik, Ludwigshafen, Germany. Eng. Pat. 12,386, August 7, 1890. (Second Edition.) 6*d*.

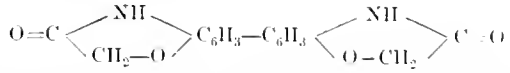
The new substances are amido- and sulpho-derivatives of the naphthylglycollic acids (naphthoxyacetic acid) obtained by condensing α- or β-naphthol or their sulphonic acids with monochloro-acetic acid, nitrating these compounds and reducing the nitro-products thus formed. The amido-derivatives produced are capable of combining with diazo- or tetrazo-compounds to form new dyestuffs. In nitrating β-naphthoxyacetic acid, a better yield is obtained if the ether be employed, and the nitro-compound subsequently saponified. The α-nitro-β-naphthoxyacetic acid melts at 190°—192° C., crystallises in thick pale-yellow needles, slightly soluble in boiling water, more readily soluble in boiling acetic acid or alcohol. The α-amido-β-naphthoxyacetic acid is capable of forming an anhydride of the formula—



by the action of an acid which does not combine with diazo-compounds. It can be converted into the sodium salt of the acid by boiling for a short time with caustic soda solution.—T. A. L.

Improvements in the Manufacture and Production of New Diphenyl Derivatives, and a New Base for use in the Preparation of Dyestuffs. J. Y. Johnson, London. From the "Badische Anilin und Soda Fabrik," Ludwigshafen, Germany. Eng. Pat. 12,550, August 11, 1890. (Second Edition.) 6*d*.

A method for obtaining *p*-diamido-di-*o*-phenoxyacetic acid ($CO_2H.CH_2O)(NH_2).C_6H_3.C_6H_3(NH_2)(OCH_2.CO_2H)$ from *o*-nitrophenoxyacetic acid, an anhydride being formed as an intermediate compound, having probably the following constitution—



This is converted into the amido body by boiling with dilute caustic soda solution and precipitation with salt. On treatment with nitrous acid it yields a tetrazo-compound, which combines with phenols and amines to form colouring matters. The anhydride described is obtained by reducing *o* nitrophenoxyacetic acid with zinc dust and caustic soda, in order to obtain the hydrazo-compound, and this, when added to strong hydrochloric acid, yields the anhydride. It may also be obtained from azo- or azoxyphenoxyacetic acid by reduction with stannous chloride.—T. A. L.

The Manufacture and Production of New Derivatives of Alizarin and its Analogues. B. Willcox, London. From the "Farbenfabriken vorm als F. Bayer and Co.," Elberfeld Germany. Eng. Pat 12,715, August 13, 1890. 6*d*.

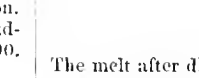
This is an extension of Eng. Pat. 8725 of 1890 (this Journal, 1891, 537). The constitution of the *Alizarin-bordeaux* there described has been investigated, and found to be a tetrahydroxyanthraquinone. If the intermediate product formed in its manufacture, which is its sulphuric ether, be treated with ammonia instead of with caustic soda, a new colouring matter is obtained, giving bluer shades than Alizarin-bordeaux. The intermediate compounds from the various bordeaux from purpurin, flavopurpurin, anthrapurpurin, anthragallol, and also from rufigallic acid, may be treated with ammonia in a similar manner, yielding corresponding colouring matters. The production of *Alizarin-cyanines* is also described. These dyestuffs are obtained by treating the "bordeaux" in a sulphuric acid solution with oxidising agents such as manganese dioxide or arsenic acid. All the substances described may be converted into sulphonic acids by suitable treatment with sulphuric acid, and yield products soluble in water, which dye mordanted wool. (See also this Journal, 1891, 536.)

—T. A. L.

Improvements in the Manufacture of Colouring Matters. W. Majert, Berlin, Germany. Eng. Pat. 13,010, August 19, 1890. 6*d*.

A process for obtaining sulphonated rhodamines by heating together the sulphophthalic acids with *m* amido phenol and its alkylated derivatives or their ethers with or without a condensing agent.

A colouring matter dyeing the same shade as tetramethylrhodamine is produced by heating together 27 kilos. of acid sulphophthalate of soda, $C_6H_3(CO_2H)_2SO_3Na$, 16·5 kilos. of *m*-dimethylamidophenetol, 100 kilos. of 33·3 per cent. hydrochloric acid and 30 kilos. of zinc chloride, in a closed vessel for eight hours to 170°—175° C. The melt is dissolved in water, boiled, and the zinc precipitated with soda. After filtration the colouring matter is precipitated by the addition of acid and salt, and purified by dissolving in water and reprecipitating with salt, after which it is filtered off and dried. It forms a brownish-red colouring matter, easily soluble in water. A similar colouring matter is obtained by heating together 17·4 kilos. of *m*-ethylamidophenol and 26 kilos. of anhydrous sodium sulphophthalate—



The melt after dissolving in water with a little hydrochloric acid is treated in the same way as above.—T. A. L.

Improvements in the Manufacture and Production of Azo Dyes. B. Willcox, London. From the "Farbenfabriken vormals F. Bayer and Co.," Elberfeld, Germany. Eng. Pat. 13,235, August 22, 1890. 6*d*.

One molecular proportion of a tetrazo compound is combined with one molecular proportion of salicylic acid or cresol carboxylic acid and one molecular proportion of α-naphthylamine or α-amido-naphthol-ether. As this compound contains an amido group in the α-naphthylamine residue it can be re-diazotised, and after combination with an amine or phenol, yields valuable fast brown, brown-black, olive green, and black colouring matters, which dye unmordanted cotton.

—T. A. L.

The Manufacture and Production of New Sulpho Acids of Dioxynaphthalene or Amidonaphthol and of Azo Colouring Matters therefrom. B. Willcox, London. From the "Farbenfabriken vormals F. Bayer & Co.," Elberfeld, Germany. Eng. Pat. 13,443, August 26, 1890. 6*d*.

Colouring matters similar to those described in Eng. Pat. 13,665 of 1889 (this Journal, 1890, 854) and in Eng. Pat. 18,517 of 1889 (this Journal, 1890, 1032) are obtained from a new dihydroxynaphthalene disulphonic acid formed by fusing the α naphthol trisulphonic acid described in Ger. Pat. No. K. 7567 of 1890. The acid is a disulphonic acid of (1·1′) dihydroxynaphthalene and combines with diazobenzene to form a colouring matter which dyes wool and silk red from an acid bath. The specification also describes the preparation of a new amidonaphtholmono sulphonic acid by fusing 1 kilo. of α-naphthylamine β-disulphonic acid with 2·5 kilos. of soda containing 75 per cent. of sodium hydrate, adding 10 per cent. of water, and conducting the fusion at a temperature not exceeding 200° C. The new amidonaphthol sulphonic acid separates out in fine white needles on dissolving the melt in a mineral acid. When combined with tetrazodiphenyl it yields blue-black colouring matters. The dihydroxynaphthalene above described may also be obtained from a new amido-naphthol disulphonic acid, produced by fusing with caustic potash at 180—190° C. The naphthylamine trisulphonic acid is formed by nitrating and reducing the naphthalene trisulphonic acid described in Ger. Pat. 38,281. The new amidonaphthol disulphonic acid on treatment with nitrous acid yields a diazo compound, which on boiling with water gives the dihydroxynaphthalene disulphonic acid described above. The specification contains 13 claims.

—T. A. L.

Improvements in the Manufacture of Colouring Matters. H. H. Lake, London. From A. Leonhardt & Co., Mühlheim on the Maine, Germany. Eng. Pat. 13,565, August 28, 1890. 6*d*.

Blue basic colouring matters are obtained by condensing the higher homologues of *m* amidophenols, such as dimethyl- or diethyl *m* amido cresol with *p*-nitroso derivatives of aromatic amines or with dichloro-amidoquinone. The condensation is performed preferably in a spirit solution, and the colouring matter is precipitated by salt and zinc chloride.—T. A. L.

A Process for the Production of Substituted Benzidines (Diamidotriphenyls) and Colours therefrom. J. Dawson and R. Hirsch, Huddersfield. Eng. Pat. 13,710, September 1, 1890. 6*d*.

Phenols in which the hydrogen atom para to the hydroxyl group is substituted, are either incapable of combining with diazo compounds or only do so with difficulty, as in the case of di-*p* dihydroxydiphenyl. If, however, one hydroxyl group be alkylated or if *p*-hydroxydiphenyl be used in the first instance, the combination can be effected. The formation of a base from aniline and *p*-hydroxydiphenyl is described as follows. 10 kilos. of *p*-hydroxydiphenyl (Eng. Pat. 9080 of 1890, this Journal 1891, 538) are dissolved in 200 litres of water and 4·5 kilos. of caustic soda. When cold a diazobenzene solution is run in prepared from 5·5 kilos. of aniline, 20 kilos. of hydrochloric acid, 100 litres of water and 4·1 kilos. of sodium nitrite. The azo compound which forms is filtered off, pressed, dried and alkylated by heating for one hour to 50° C. with 2·5 kilos. of caustic soda, 80 kilos. of spirit, and 7·5 kilos. of methyl bromide. The alkylated compound is filtered off and mixed with a solution of 20 kilos. of tin dichloride in 40 kilos. of hydrochloric acid. When quite white the mother-liquor containing the tin is filtered off, the salt dissolved in as small a quantity of hot water as possible, and after filtering is precipitated by adding sodium sulphate. In place of aniline, *o*-toluidine, *p*-xylidine, α-naphthylamine or *o*-anisidine may be employed, or *p*-hydroxyphenyl-*o*-tolyl or *p*-hydroxyphenyl-α-naphthyl may be substituted for the *p*-hydroxydiphenyl. The sulphates of the bases are much more easily soluble in hot water than benzidine sulphate, their hydrochlorides are nearly insoluble in water in presence of an excess of hydrochloric acid. The bases are almost insoluble in boiling water. By employing sulphonic acids of aniline and its homologues in which the para position is unoccupied, sulphonic acids of the new bases will be obtained, which on combination with unsulphonated phenols or amines yield colouring matters soluble in water. The colouring matters from all these bases are prepared generally according to the methods described in Eng. Pat. 4415 of 1884 (this Journal, 1891, 131) and Eng. Pat. 15,296 of 1885 (this Journal, 1886, 595).—T. A. L.

The Manufacture and Production of New Amido-Azo Compounds and Azo Dyes therefrom. J. Y. Johnson, London. From the "Badische Anilin und Soda Fabrik," Ludwigshafen, Germany. Eng. Pat. 14,416, September 12, 1890. (Second Edition). 6*d*.

The amidonaphthoxyacetic acid and sulphonic acids described in Eng. Pat. 12,386 of 1890 (see above) are, as already mentioned, capable of combining with diazo compounds to form dyestuffs. These dyestuffs can in turn be diazotised and combined with phenols and amines, their sulphonic and carboxylic acids yielding colouring matters, some of which dye wool directly from an acid bath. In practice it is found best to start from the anhydride of the amidonaphthoxyacetic acid and convert this immediately before use into the acid by boiling with caustic soda. After neutralising with hydrochloric acid a solution of a diazo compound is run in, sodium acetate being added if necessary. The amido-azo body forms and partly separates out, and may be filtered off or diazotised in the same solution and combined with a naphthol or its sulphonic acid. The colouring matters so formed dye shades from green to blue-black according to the various constituents chosen for the several combinations.—T. A. L.

The Manufacture and Production of New Substantive Dyestuffs. J. Y. Johnson, London. From the "Badische Anilin und Soda Fabrik," Ludwigshafen, Germany. Eng. Pat. 14,620, September 16, 1890. (Second Edition.) 6*d*.

In Eng. Pat. 12,550 of 1890 (see p. 759), the preparation of a new amido acid, diamidophenoxyacetic acid, is described. This body, on diazotisation gives a tetrazo-compound which combines with phenols and amines, their sulphonic and carboxylic acids to form colouring matters, many of which dye cotton from an alkaline bath, giving shades ranging from yellowish-brown through red and violet to bluish-green. These colours, on treating the dyed fibre with copper sulphate, undergo a change given in the table below, and are then fast to light and alkalis to a very high degree.

Dyestuff obtainable by Combination of one Molecular Proportion of the New Tetrazo Compound with	Colour on Cotton from Alkaline Bath.	Colour after Treatment with Copper Sulphate.
1. Two molecular proportions of 1·4′ naphthol sulphonic acid.	Purple blue	Green
2. Two molecular proportions of 1·1′ benzoylamidonaphthol sulphonic acid.	Green blue	Green
3. Two molecular proportions of 1·1′ dihydroxynaphthalene.	Purple blue	Discoloured
4. Two molecular proportions of 2·3′ dihydroxynaphthalene.	Blue	Greyish green
5. Two molecular proportions of 2·3′ β-naphthylamine-β-sulphonic acid.	Red	Blue
6. Two molecular proportions of β-naphthylamine.	Red	Blue
7. One molecular proportion of salicylic acid and one molecular proportion of chrysoidine.	Yellow brown	Deep dark brown.

—T. A. L.

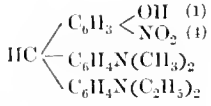
Improvements in the Manufacture and Production of Rosaniline Derivatives. B. Willcox, London. From the "Farbenfabriken vormals F. Bayer & Co.," Elberfeld, Germany. Eng. Pat. 14,621, September 16, 1890. 6*d*.

Leuco-bases of the rosaniline series are obtained by condensing diamidobenzhydrol, its alkylated and certain other derivatives, with aromatic hydrocarbons, phenol, its homologues, nitro-derivatives, sulphonic and carboxylic acids, α- and β-naphthol, the dihydroxynaphthalenes, and amidonaphthols, in presence of concentrated sulphuric acid. The leuco-bases are oxidised in the ordinary manner with lead dioxide. Some examples of the formation of the leuco-bases and dyestuffs are given:—

I. 27 kilos. of tetramethyldiamidobenzhydrol are dissolved in 150 kilos. of sulphuric acid (66° B.), cooled and shaken with 7·8 kilos. of benzene. After the solution has become of a clear brownish colour it is poured into water and the base precipitated by the addition of an alkali.

II. 32·6 kilos. of tetraethyldiamidobenzhydrol are heated with 15 kilos. of benzoic acid and 200 kilos. of concentrated sulphuric acid to 100° C. for two hours. The melt is then poured into ice, made up to 1,000 litres, and the cooled solution oxidised by the addition of 79 kilos. of a 30 per cent. paste of lead dioxide. After filtering, sodium carbonate is added, and the resulting precipitate, after washing, forms a green paste, which dyes wool mordanted with chromium salts green, and is fast to milling.

III. 30 kilos. of dimethyldiethyldiamidobenzhydrol and 14 kilos. of *p*-nitrophenol are mixed, and 200 kilos. of concentrated sulphuric acid added. On stirring, a yellow-brown liquid is obtained which is poured into ice and diluted with water. A yellow nitro-leuco-base of the formula—



is precipitated on the addition of an alkali. It rapidly absorbs oxygen turning yellowish green. The base obtained may be oxidised to a green dye or it may be first reduced and then oxidised or reduced, sulphonated, and oxidised, yielding a blue-green acid colouring matter.—T. A. L.

A Process for the Manufacture of Black Colouring Matters. O. Imray, London. From the Society of Chemical Industry in Basle, Basle, Switzerland. Eng. Pat. 15,120, September 24, 1890. 6*d*.

By combining diazotised α-naphthylamine disulphonic acid with α-naphthylamine an amido-azo-compound is obtained, which can again be diazotised, and this on combination with ethyl-β-naphthylamine yields a colouring matter which dyes wool and silk grey to blue-black. The dyestuff has the formula—

$$(NaSO_3)_2 : C_{10}H_5 . N : N . C_{10}H_6 . N : N . C_{10}H_6NHC_2H_5,$$

and is fast to soap and light. In place of ethyl-β-naphthylamine the methyl derivative may be employed, and instead of α-naphthylamine disulphonic acid, a sulphonic acid of β-naphthylamine, or the disulphonic acids of aniline, toluidine or xylidine may be used.—T. A. L.

The Manufacture and Production of Blue Colouring Matters or Dyestuffs. B. Willcox, London. From the "Farbenfabriken vormals F. Bayer & Co.," Elberfeld, Germany. Eng. Pat. 15,345, September 27, 1890. 4*d*.

The dyestuff "New blue," produced by the action of nitrosodimethyl- or nitrosodiethyl-aniline on β-naphthol yields, when treated with ammonia in an alcoholic solution and subsequently oxidised, a new colouring matter of a more greenish-blue shade and faster to alkalis than New blue. 25 kilos. of "New blue" are mixed with alcohol to form a thin paste, 7 kilos. of a 20 per cent. alcoholic ammonia solution added, agitated, and allowed to stand until the whole of the ammonia has disappeared. A current of air is then passed through the solution until there is no further increase in the depth of the colour. After dilution with water the alcohol is distilled off, acetic or hydrochloric acid added, and the dyestuff salted out with zinc chloride.

—T. A. L.

The Manufacture of Azo Dyestuffs and of Materials for their Production. S. Pitt, Sutton. From L. Casella and Co., Frankfort-on-the-Maine, Germany. Eng. Pat. 15,346, September 27, 1890. 6*d*.

The substances employed for the production of these colouring matters are the diamido-naphthalene α- and β-disulphonic acids. Both combine with diazo and tetrazo compounds, but only the β-acid is capable of being diazotised. The acids are prepared as follow:—The naphthalene disulphonic acids are converted into dinitro compounds, which on reduction yield the corresponding diamido compounds. 256 kilos. of naphthalene are converted into the disulphonic acid by the action of 1,280 kilos. of sulphuric acid. The melt is cooled down and 350 kilos. of a mixture of nitric and sulphuric acids containing 154 kilos. of HNO_3 run in at 20—30°. This forms a mono-nitro acid. Further 350 kilos. of the mixed acids are run in at 120°—140° C. The melt is then diluted with 4,000 litres of brine (20° B). The dinitro-naphthalene-α-disulphonate of soda separates from the hot liquor whilst the β-salt is precipitated from the filtrate by adding salt and allowing the solution to cool. The separated dinitro compounds are then reduced with iron in the ordinary manner. Instead of separating the dinitro compounds the mixture may be reduced with iron and acetic acid, the iron removed with sodium carbonate and the solution saturated with salt, which precipitates the diamidonaphthalene-β-disulphonate of soda. The α-acid is obtained from the filtered solution by adding 200 kilos. of muriatic acid. The diamido-β-disulphonic acid is almost insoluble in hot and cold water. Its sodium salt dissolves in 21 parts of cold water. The potassium salt is very soluble in cold water, the barium salt is soluble with difficulty. The diamido-naphthalene-α-disulphonic acid is easily soluble in hot water and crystallises in long thin needles. Its sodium salt is soluble in 55 parts of cold water and forms long pointed needles. The potassium salt is less soluble than the β-salt.—T. A. L.

The Manufacture and Production of a New Naphthalene Derivative suitable for Use in the Manufacture of Dyestuffs. J. Y. Johnson, London. From the "Badische Anilin und Soda Fabrik," Ludwigshafen, Germany. Eng. Pat. 15,803, October 6, 1890. *6d.*

When sodium *B*-naphthol disulphonic acid (R salt) is fused with twice its weight of caustic soda at 240—280° C. a dihydroxynaphthalene monosulphonic acid is obtained. This compound on further fusion at a higher temperature with more caustic soda yields, not as might have been expected, a trihydroxynaphthalene, but a new dihydroxynaphthalene. The same product can also be obtained by treating the sodium salt of the dihydroxynaphthalene monosulphonic acid with dilute sulphuric acid under pressure. The new dihydroxynaphthalene crystallises from water and melts at 160—161° C. It combines with diazo and tetrazo compounds to form dyestuffs, and a cold dilute aqueous solution gives an intense blue colour with dilute ferric chloride.—T. A. L.

New Process of Separating Ortho-toluol Sulphonic and Para-toluol Sulphonic Acids. M. Lange, Amersfoort, Holland. Eng. Pat. 15,778, October 6, 1890. *4d.*

The process depends upon the discovery that sulphuric acid containing 66 per cent. of H_2SO_4 dissolves *o*-toluene sulphonic acid, whilst *p*-toluene sulphonic acid remains undissolved in a sulphuric acid of that strength.—T. A. L.

Production of a Yellow Colouring Matter or Dye. J. R. Geigy, Basle, Switzerland. Eng. Pat. 16,666, October 20, 1890. *4d.*

By the action of sulphur on tetramethyldiamidothiobenzhydrol in presence of ammonia and ammonium chloride a colouring matter is obtained which dyes cotton mordanted with tannin a pure yellow. 14·3 kilos. of tetramethyldiamidothiobenzhydrol or 13·5 kilos. of tetramethyldiamidiobenzhydrol and 1·6 kilos. of sulphur are heated to about 140° C. in a digester fitted with an inlet and outlet pipe. 120 kilos. of salt and 7 kilos. of ammonium chloride are added, the temperature raised to 175° C. and a current of dry ammonia passed rapidly through the melt for 7—8 hours. The brownish yellow mass formed is treated with a small quantity of cold water. The colouring matter which remains undissolved is dissolved in hot water and precipitated from the filtered solution by the addition of salt.—T. A. L.

The Manufacture and Production of a New Blue Basic Dyestuff. J. Y. Johnson, London. From the "Badische Anilin und Soda Fabrik," Ludwigshafen, Germany. Eng. Pat. 16,868, October 22, 1890. *6d.*

By fusing together nitrosodimethylaniline hydrochloride and *p*-phenylene diamine with or without the addition of benzoic acid, a colouring matter is obtained which dyes cotton mordanted with tannin deep shades of blue, fast to soap and light. The purity of the colour is affected by the temperature employed and the amount of *p*-phenylene diamine used. About 10 kilos. of *p*-phenylene-diamine and 1 kilo. of benzoic acid are heated to 200° C. in an oil-bath, and 6 kilos. of nitrosodimethylaniline hydrochloride and 3 litres of water are gradually added. The temperature is then slowly raised to 130° and maintained for 3—4 hours. When finished the melt is extracted twice with a hot solution of caustic soda containing 5 kilos. of soda lye (35 per cent. NaOH) in 400 litres of water. The colouring matter is thus hasticd and after washing with water is dissolved in a 5 per cent. solution of hydrochloric acid and evaporated to dryness. It forms a bluish-black amorphous powder dissolving in water to a violet, in alcohol to a blue, and in sulphuric acid to a bluish violet solution. The base is insoluble in ether and dissolves in alcohol to a bluish-violet solution.—T. A. L.

V.—TEXTILES: COTTON, WOOL, SILK, Etc.

The Chemical Composition of Asbestos. J. T. Donald. Eng. and Mining J. 1891, 741.

When Canadian asbestos was first placed upon the market it had to compete with the Italian mineral, and attempts were made to decry the Canadian article and to prejudice users by the statement that chemical analysis showed the latter to be inferior to the Italian. From different sources samples of the Italian were procured and an analysis was made of the best, the results of which are shown in the first column of the following table. Column 2 shows the composition of a sample from Broughton, which was taken for analysis because of its marked freedom from foreign matter, the Thetford samples first selected for that purpose having been damaged by fire and smoke.

	Italian.	Broughton.	Templeton.
	Per Cent.	Per Cent.	Per Cent.
Silica	40·30	40·57	40·52
Magnesia	43·37	41·50	42·05
Ferrous oxide	0·87	2·81	1·97
Alumina	2·27	0·90	2·10
Water	13·72	13·55	13·46
	100·53	99·33	100·10

These results show that the chemical composition of the Canadian fibre is in nowise inferior to its European rival.

Up to the present time Canadian asbestos may be said to have been obtained exclusively from the Cambrian rocks of Eastern Canada. Of late, however, indications have not been wanting to show that it is possible that the great belt of Laurentian rocks to the north of the St. Lawrence may yet prove to be a rich source of this mineral. It has long been known that seams of short fibre are to be found in those rocks, but it is only within the last year that any attempts have been made to test these veins, and it is gratifying to be able to state that the results of these attempts are promising. Much of the Laurentian serpentine is different from that of Thetford and Black Lake. It is much lighter in colour, and is remarkably free from disseminated chromic and magnetic iron. The contained asbestos is, like the serpentine, of a lighter colour than that from the Cambrian, and in consequence of the absence of iron there is little or no tendency to discolouration from percolating water. The sample of asbestos from Templeton, of which an analysis is given in the above table, was from the Laurentian rocks, and, so far as its composition is concerned, is practically of equal value with the Cambrian asbestos of Broughton.

VI.—DYEING, CALICO, PRINTING, PAPER STAINING, AND BLEACHING.

Ingrain-Black from Diamine-Black. T. Baldensperger. Bull. de la Soc. Ind. de Rouen, 1891, **18**, 489.

The new Black is obtained from diamine-black by diazotising and then developing it on the fibre. The fibre is first dyed with diamine-black, of which it takes up from 1½ 3 per cent., and is then diazotised at the normal temperature with a solution containing 1 per cent. of sodium nitrite and 4 per cent. of sulphuric acid of 60° B. The development is carried out in the cold, except in the case

of naphthylamine hydrochloride, when a luke-warm bath is required. The resulting colours vary in shade as is shown in the following table. They are all fast to soda and to acid; light reddens them slightly and they are strongly attacked by chlorine :—

Developer.	Resulting Colour.	Loss per Cent. with Soap or Soda.	Loss per Cent. with Acid.
Phenol	Dull blue	15	10—15
Resorcinol	Blackish	Turns greener.	Unchanged
Naphthol	Blue-black	5	Unchanged
β-Naphthol	Blue-violet tinge.	5	Unchanged
Schäffer's naphthol sulphonic acid.	Blue-violet tinge.	10—15	5—10
Piria's naphthol sulphonic acid.	Blue-violet tinge, deeper.	10—15	5—10
Naphthol disulphonic acid (R. salt).	Reddish-blue	10—15	Very little
β-β Naphthylamine sulphonic acid.	Dark blue-black.	10	10
1:5 Naphthylamine sulphonic acid.	Dull violet	5	10
Naphthionic acid	Prune	5	10
Aniline	Violet-blue	10	Slight
α-Naphthylamine	Black-blue	Slightly reddish.	Unchanged
β-Naphthylamine	Dark shade of diamine black.	5	Unchanged
1:3 Phenylene diamine	Black-brown tinge.	10	Turned more blue.
1:3 Toluylene diamine.	Black-blue tinge.	5—10	Turned more blue.
1:4 Phenylene diamine.	Blue-violet tinge.	10	Slight
Aniline black	.. ..	Turned more blue.	Turned green.
Indigo	.. ..	20	Slight

From this list it is evident that the shades obtained with amido-compounds are darker than those got with the corresponding phenols; also that the diamido and dihydroxy-compounds give darker shades than the corresponding mono-substituted bodies (*p*-phenylene diamine is an exception). The best black is that got with 1:3 toluylene diamine, which is considerably better than that with 1:3 phenylene diamine. These two colours are of practical value as are those obtained with the various phenols, with the two naphthylamines and the prune got with naphthionic acid. The blue produced with β-naphthol is good, and by substituting Diamine-black B or Diamine blue-black E, for the ordinary Diamine black, bluer shades result. These ingrain blacks hardly bear comparison with aniline black, but the colour can be intensified by a second diazotising and development, or by giving the whole a basis of aniline black, for which purpose 2 per cent. of aniline suffices.

—C. A. K.

Application of Chromium Fluoride in Wool Dyeing for Alizarin Cyanine G. and R., and Alizarin Bordeaux. Färb. Must. Zeit. 27, 1891; J. Soc. Dyers and Colourists, July 1891.

For the production of clear blue shades in dyeing and of lakes, the colouring matters mentioned require at least 4—6 per cent. of potassium chromate, while for other alizarin colouring matters, 3 per cent. of potassium chromate, with addition of tartar, or sulphuric acid are usually sufficient. The clearest and bluest shades are obtained with Alizarin Bordeaux and Alizarin cyanines, if to the mordanting bath, prepared with chromium fluoride, oxalic acid is added in the proportion of 2 per cent. of the wool or woollen material to be dyed. After the preparatory mordanting, the dyeing is done without the application of acid, or with the addition of 1 per cent. of acetic acid. An application of larger quantities of oxalic acid in the mordanting acts injuriously. The mordanting baths should be preserved, and freshened up for subsequent operations with only one-half or two-thirds of the original amount of chromium fluoride and 2 per cent. of oxalic acid.

It has, moreover, been observed that the application of potassium or sodium bichromate is not to be recommended because in mordanting with them there is fixed on the fibre not only chromium oxide but also chromate of chromium, which latter oxidises the alizarin colouring matters. The shades thus produced are considerably duller. Although this evil may be counteracted by passing the wool, which by the previous mordanting with bichromate of potassium or sodium has assumed a yellow appearance, through a solution of bisulphite, and thus changing the yellow chromate of chromium into the green chromium oxide, it has nevertheless been found advantageous to employ chromium salts, which exclusively precipitate chromium oxide on the fibre. *Chromium fluoride* is therefore to be recommended as the best chromium salt.

Although this salt is apparently more expensive than the bichromates of potash or soda, it has, on the other hand, the advantageous property of fixing exclusively chromium oxide on the wool, and of rendering the application of acids, such as oxalic and tartaric acid (tartar and sulphuric acid), unnecessary, but its chief advantage lies in the circumstance that the wool will attract a considerably greater quantity of chromium oxide from a solution of chromium fluoride than from a solution of bichromate of potash or soda containing the same quantity of chromium.

The results of a series of experiments have shown that if, for instance, a quantity of chromium fluoride amounting to 1 per cent. of the weight of the wool be used as mordant, all the chromium oxide is fixed on the fibre, while a quantity of potassium bichromate, with an equal amount of chromium oxide, used for the same purpose, leaves only one-half of the latter on the fibre.

By employing 2 per cent. of chromium fluoride (without an addition of oxalic acid), 78 per cent. of it is fixed on the fibre, and only 13 per cent. of the chromium oxide contained in the chromium fluoride remains unaltered, while with bichromate of potassium about 50 per cent. cannot be fixed. In using 4 per cent. of chromium fluoride only about 30 per cent. remains in the bath, while about 60 per cent. of the chromium oxide present remains in the potassium chromate bath.

These numbers show the necessity of preserving the chromium baths if the chromium salt contained in them is to be exhausted. But while this is easily possible with the chromium fluoride baths, in which the chromium salt remains present as unchanged chromium fluoride, the chromate of potassium bath, after mordanting, contains not only unaltered chromate of potassium, but also chromate of chromium oxide, which, as stated, has quite a different and, in this case, an injurious effect.

While it has, therefore, hitherto been justly inadvisable to preserve the baths which, after the mordanting, still contain about 50 per cent. of chromate of potassium, which were given up as lost, the preservation of the chromium fluoride bath is not only possible, but is to be highly recommended. The chromium fluoride bath preserved for further use may be brought exactly to the original strength of chromium by means of the table below, or by simply adding to such chromium fluoride baths as were prepared with 4 per cent. of chromium, from one-half to two-thirds of the original chromium fluoride—that is, 2—3 per cent.—which will make the bath as effective as it was before.

This advantage of chromium fluoride is further enhanced by the circumstance that while the wool is strongly attacked and weakened by the chromate of chromium, as formed in the chromate of potassium or sodium baths, this is not the

case with chromium fluoride, because the hydrofluoric acid set free in the baths does not act upon animal fibre. In dark colours, which require much chromium, the advantage of the fibre remaining stronger and considerably softer is of eminent importance.

The best recipe for dyeing is the following:—To dye 100 kilos. of wool, 4 kilos. of chromium fluoride and 2 kilos. of oxalic acid are dissolved in a wooden vat, provided with a leaden boiling pipe; the material is brought into the lukewarm solution and boiled for 1½ to 2 hours, exactly as with potassium chromate. The wool is then allowed to cool, rinsed, and dyed finally in a second wooden vat with leaden boiling pipe, without the application of acid, with the requisite quantity of Alizarin-bordeaux or Alizarin-cyanine.

The baths are preserved, and to the subsequent mordanting baths an addition is made of only one-half to one-third of the chromium fluoride originally employed, together with 2 per cent. of oxalic acid.

It is advisable to use wooden vats for the mordanting as well as for the dyeing, with leaden boiling pipes, which can be more easily handled than copper pipes, and are, besides, less expensive.

With these precautions and conditions Alizarin-Bordeaux produces a reddish and Alizarin-cyanine a greenish blue of great clearness and fullness, less expensive than Alizarin blue. The materials dyed in this manner are very fast to milling, and resist air and light as well as all the other alizarin colours.

Generally chromium fluoride will produce considerably better results with all the alizarin colours and Cloth-reds than potassium or sodium chromate.

With a great number of these colouring matters chromium fluoride has the additional advantage of dyeing in a single bath, except in the case of Alizarin-blue, Gallein, Coruleïn, &c.

The only inconvenience in dyeing with chromium fluoride in a single bath, though it is avoidable, consists in an unevenness of the colours obtained if the necessary precautions are not strictly observed. If they are taken, good results are obtained.

The dyeing of Alizarin-bordeaux and Alizarin-cyanine with chromium fluoride in a single bath is done as follows:—The dye-bath is cooled down to 37° C., and contains for every 100 kilos. of the material to be dyed, the requisite quantity of colouring matter, 4 to 6 per cent. of chromium fluoride and 2 per cent. of oxalic acid; these are dissolved in water, added and well stirred in the bath, after which the material is put in and worked about during 30 minutes; the temperature is then slowly raised to boiling point, the boiling being kept up for 1½ to 2 hours. The longer the time of boiling, the fuller will be the colour.

All the other alizarin colouring matters are dyed in the same manner with chromium fluoride in a single bath, so that every desirable compound shade may be directly produced in a single bath.

In a series of comparative trials 3 kilos. of worsted yarn were separately mordanted with increasing quantities of chromium fluoride and with potassium chromate dissolved each time in 100 litres of water, and the quantity of chromium remaining in the baths after the mordanting was quantitatively determined. The mordanting was done in the usual manner by boiling the wool for an hour and a half with the solution of chromium salt. With potassium chromate oxalic acid was used, but no acid was employed with the chromium fluoride. To ensure an exact comparison, the proportion of chromium fluoride and potassium chromate was such that equal quantities of chromium oxide came into application. Since chromium fluoride contains 42 per cent. and potassium chromate 31 per cent. of chromium oxide, an application of 1 per cent. of chromium salt to 3 kilos. of wool required 30 grms. of chromium fluoride and 25 grms. of potassium chromate.

The following table shows the quantities of chromium oxide which remain in the bath:—

Chromium Fluoride without Acid.

Applied.	In the Bath.	Applied.	In the Bath.
Per Cent.	Per Cent.	Per Cent.	Per Cent.
1	00	6	38
2	13	7	40
3	24	8	45
4	28	9	43
5	40	10	45

Potassium Chromate with Oxalic Acid.

Applied.	In the Bath.	Applied.	In the Bath.
Per Cent.	Per Cent.	Per Cent.	Per Cent.
1	40	6	53
2	47	7	53
3	56	8	58
4	57	9	56
5	56	10	59

The Simultaneous Employment of Vegetable and Coal-Tar Dyes for Producing Fast Colours. V. H. Soxhlet. Chem. Zeit. **15**, 844—845.

The rapid development of the coal-tar dye industry has resulted in the more or less complete displacement of many vegetable colouring substances. For instance, madder and turmeric, which were almost exclusively used a few years ago, are now not employed at all. Of the few vegetable dyeing materials still in use, quercitron, fustic, and logwood must be particularly mentioned. In combination with the so-called "alizarin colours" and other artificial dyes, they are employed for the production of numerous compound shades. For instance, a mixed bath of log-wood and Alizarin yellow dyes woollen materials a splendid black, the material being mordanted in a boiling solution of potassium bichromate and tartar. A most varied series of brown and yellow shades may be similarly obtained on wool by means of fustic in conjunction with Alizarin red, Alizarin orange, Anthracene brown, &c. All these colours are fast towards light and air, and will bear milling. The newer coal-tar dyes, such as dioxin, gambin, &c., can also be advantageously used together with fustic or logwood. Alizarin red is frequently used to brighten the colours produced by log-wood on a potassium bichromate and oxalic acid mordant. If the red be allowed to predominate in the dye-bath, splendid brownish-red shades of considerable fastness are obtained. Logwood and fustic are often employed to finish the blacks produced by aniline colours, chiefly on raw material which cannot be uniformly dyed with aniline colours alone. For this purpose the material is passed straight from the aniline bath into a strong extract of logwood, fresh mordanting not being necessary. Logwood in combination with coal tar dyes is largely used for the production of blue shades on wool and cotton. For instance, logwood and Geigy's Gallamine-blue dye fabrics mordanted with bichromate a bright navy blue of great stability. Certain blue shades on wool may be obtained without separate mordanting, as follows:—a suitable salt, generally ferrous or copper sulphate, is added to the bath, and the precipitated lake is dissolved by means of oxalic acid. Two other aniline dyes, preferably a green and a violet, are then added, and the fabric is dyed in the mixture at a boiling temperature. Various attempts have been made to produce compound colours from vegetable and coal-tar dyes. One of the earliest processes of this character is that of Thomson and Claus of Manchester, by which rather thin alkaline dyewood extracts are mixed with some diazo-compound (diazo-xylene hydrochloride, diazo-toluene sulphonic acid, diazo-benzene

hydrochloride, diazo-benzene nitrate, diazotoluene hydrochloride, &c.). A more recent process is that of Dahl and Co., of Barmen. A fairly concentrated extract of logwood is mixed with a solution of nitrosodimethyl-aniline hydrochloride, and the new colouring body is then salted out. It is said that by means of this product, cotton fabrics may be dyed a deep black, an iron salt being used as mordant.
—H. T. P.

PATENTS.

Improvements in Dyeing Textile Fibres. R. Holliday, Huddersfield. Eng. Pat. 1813, February 3, 1890. (Reprinted Specification.) 4*d*.

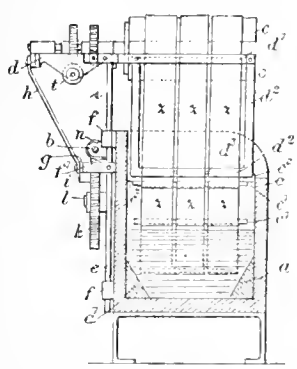
The specification of this invention has been amended, prior to the sealing of the patent, by order of the Comptroller of the Patent Office. The invention relates to the dyeing of wool or other textile fibres by mordanting the same with chrome, iron, alumina, copper, or lead, and dyeing with the nitroso- or dinitroso- derivatives of the following dihydroxynaphthalenes :—$\alpha_1-\alpha_2$, $\alpha_1-\alpha_3$ (Armstrong's), $\beta_1-\beta_2$, $\beta_1-\beta_4$ (Ebert and Merz's), $\alpha_1-\beta_1$, and $\alpha_1-\beta_2$ (Ewer and Pick's), various shades of colour being so obtained.—E. B.

Improvements in Machines for Bleaching, Dyeing, Sizing, and Scouring Yarn in the Hank or Warp, and also for Fabrics. S. Spencer, Whitefield. Eng. Pat. 12,652, August 13, 1890. 8*d*.

The objects of this invention are :—First, simplification of the faller-lifting mechanism described in Eng. Pat. 1954 of 1888 ; second, the provision of means for keeping the yarn ends straight and preventing the hanks, warps, or cloth under treatment from getting entangled ; and third, the production of a machine suitable for dyeing, &c. either hanks, warps, or cloth.

A vat *a* (see Fig. 1) is fitted with a driving-shaft *b*, fallers *c*, and a faller-frame *d*. Two shanks *e* are fixed to

Fig. 1.



Improved Machine for Treating Yarn, &c.

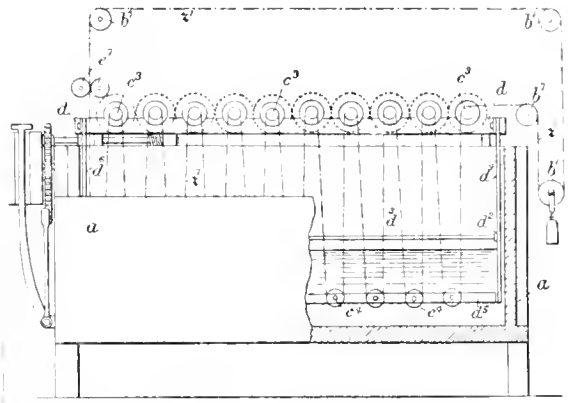
the ends of the faller-frame and arranged to slide in bearings *f*, fastened to the vat. A strong rail *g*, attached to the shanks by means of brackets f^1, and tied to the faller-frame by stay-rods *h*, is moved up and down by two crank-studs *i*, fixed on worm-wheels *k*, and mounted on studs *l*, the raising or lowering of the rail thus producing a corresponding movement of the hanks placed on the fallers.

Rotary motion is imparted to the faller-shafts by means of worm-wheel gearing on a small upper shaft, which is driven from the lower shaft *b*, either by friction gearing, in which case the rotation of the fallers ceases on the faller-frame being raised, or by a chain and wheels, when the rotation of the fallers continues after they have been raised.

The faller-frame is provided at each end with arms d^1 which project across the vat and carry longitudinally a number of rods d^3 placed between the hanks *z* for the purpose of separating them from one another. In the lower ends of the hanks metal rollers c^1 are placed to stretch the same. The ends of these metal rollers, when the faller-frame is lowered, rest on the bevelled sides a^1 of the vat.

When employed for bleaching, &c. warps or cloth, the above-described fallers and metal rods are replaced by rollers c^3 and c^4 (see Fig. 2), supported by a frame d^4, d^5, d^6.

Fig. 2.



Improved Machine for Treating Yarn, &c.

The warp or fabric z^1 to be dyed, &c. is threaded over the rollers and made endless. It is kept in the necessary stretched condition by the guide and tension pulleys b^1. The drawing of the warps, &c. through the machine by the rollers c^4, and not merely by the squeezing-rollers c^3, prevents excessive tension on the same.—E. B.

Improvements in Printers' Roller Composition. W. J. J Hawkins and J. H. Stacey, London. Eng. Pat. 13,796, September 2, 1890. 4*d*.

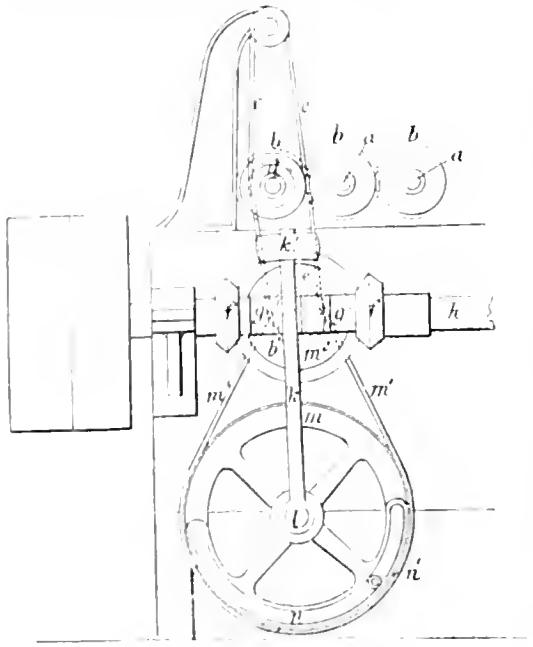
This invention is for a composition which has an affinity for printers' ink, and is free from glycerin, which is a principal ingredient in roller compositions as usually made, but which repels the ink. A composition prepared according to the following formula has been found to answer well in practice :—glue or gelatin, 1 lb. ; water, 12 oz. ; linseed or other suitable oil, 1 lb. 8 oz. ; treacle or sugar, from 1 lb. to 1 lb. 8 oz. ; calcium chloride or potash, $\frac{3}{4}$ oz. ; powdered resin (if required), 2 oz. The glue is first soaked in the water and then melted, and the linseed oil (warmed to a temperature of about 150° F.) is then very gradually added and thoroughly mixed with the melted glue. The sugar or treacle is then added to the mass kept at a suitable temperature, and the calcium chloride then incorporated. If a very tough composition be required the resin (dissolved by heat in a little linseed oil) is to be added. The composition may be made non-absorbent of water by dispensing with the calcium chloride and substituting a similar amount of bismuth carbonate.—B. H.

Improvements in Dyeing, Sizing, and Washing Machines. J. Roberts-haw. Manchester. Eng. Pat. 14,372, September 12, 1890. 6*d*.

An arrangement for giving automatically to hanks in process of dyeing, &c., a certain number of turns in one direction followed by an equal number of turns in an opposite direction. This is accomplished by bringing alternately into and out of gear a double clutch *g* (see Fig.) fitted upon the driving shaft *h* of the dyeing machine previously patented by the present inventor (Eng. Pat. 841, 1888).

The spur-wheels *b b* are actuated by the chain *c*, which gears into the spur-wheel *d* attached to the end faller. This chain receives its motion from a spur-wheel *e* keyed upon a short shaft, to which is attached a bevelled spur-wheel b^1, which gears alternately with each of the two bevel-pinions *f*, the latter being thrown alternately into and out of gear by the clutch on the main shaft. The clutch *g* is automatically actuated by the lever *k* pivoted on a short shaft *l*, upon which revolves a band-wheel *m*, driven by the band m^1

from the wheel m^2 keyed on the short upper shaft. A pin n^1 slides in a long slot n in the band-wheel.



Automatic Revolving Gear.

When the machine is working, the motion of the band-wheel brings the projecting pin n^1 into contact with the side of the lever, which it pushes over along with the clutch, so reversing the motion of the short upper shaft, and consequently that of the fallers. By adjusting the size of the wheels m and m^2 and the length of the slot n, any desired number of revolutions of the wheel m^2 may be made before its motion is reversed.—E. B.

Improvements in and Relating to Apparatus for Printing in Colours. W. P. Thompson, London. From P. Auguste Godchaux, Paris, France. Eng. Pat. 7935, May 8, 1891. 11*d*

Two groups of printing and pressure cylinders, each supplied with a separate inking system, are arranged so as to be simultaneously actuated by the same gearing. According to the course of the paper through the machine there are printed two colours on the same side of the sheet; two colours on one side and three on the other; or, one colour on one side and four on the other. The colours may be printed by either typography, lithography, or copper plate, or by two or more of these methods. Details of the mechanism cannot be intelligibly given apart from the drawings which accompany the original specification.—E. B.

Improvements in Machines for Printing in One or More Colours. C. J. Vacquerie, Paris, France. Eng. Pat. 10,142, June 15, 1891. 6*d*.

The grippers and tapes or other devices employed in connexion with cylinder paper printing machines, for the purpose of seizing the printed paper on the grippers being opened, are replaced by two chains carrying transverse grippers which carry the sheet of paper and hold the same while it is printed, releasing it only after the impression is complete. An arrangement is also claimed for automatically raising the second and following colour distributing rollers so as to permit the passage underneath of the forme from the first or preceding colour, this arrangement effecting a reduction in the length of cylinder lithographic and typographic machines. The mechanism is fully described in the original specification with the aid of drawings.—E. B.

VII.—ACIDS, ALKALIS, AND SALTS.

The Utilisation of Ammonia-Soda Waste. Chem. Zeit. **15**, 821—822.

In 1875 the quantity of seaweed collected on the coast of Jutland was estimated at about 10 million kilos. per annum; the chief sorts are: *Zostera marina, Fucus vesiculosus, F. serratus, Laminaria saccharina and L. digitata.* The first two contain 36·66 per cent. and 23·65 per cent. of ash respectively (reckoned on the dry substance). The ash of each has the following composition:—

—	*Z. marina.*	*F. vesiculosus.*
Potash.....	3·18	2·70
Soda.....	6·57	3·94
Phosphoric acid.....	0·30	0·53
Chlorine.....	6·92	2·61
Sulphuric acid.....	3·14	6·65
Sand and silica	9·63	4·08
Undetermined	6·72	3·14
	36·66	23·65

On account of the heavy tax on salt, an ammonia-soda works at Aalborg endeavoured to use the waste liquor, containing calcium chloride, over again. This could be done by precipitation with sodium sulphate obtained cheaply as Mirabite from Spain, but the "Pearl hardener" thus produced was at that time difficult to sell. Manurial experiments that were carried out with a view to test the efficacy of various artificial manures on the land in the neighbourhood, proved that the best results per unit of cost were obtained from an English superphosphate containing 7—8 per cent. of water-soluble phosphoric acid and 52—55 per cent of gypsum, its efficiency with the soil in Jutland being due to the latter constituent. As this manure was relatively dear, it was decided to prepare a similar material at a cheap rate from the waste of the ammonia-soda works. This was accomplished by the following process. The clear solution of calcium chloride—the lye-product of the ammonia-soda process—is treated with a quantity of seaweed ash capable of precipitating the lime as sulphate; the resulting calcium sulphate is filtered off and the clear solution containing potassium, sodium and magnesium chlorides with small quantities of bromides and iodides treated with bleaching powder to precipitate any iron that may be present, filtered under pressure, and sufficient barium chloride added to precipitate any residual sulphate, "Blanc fixe" being obtained as a by-product. The last traces of lime and magnesia are thrown out by soda solution, and the clear liquid precipitated with lead nitrate added in sufficient quantity to remove the bromides and iodides as the corresponding lead salts; the precipitation is complete when lead chloride begins to come down along with them. After settling for some time the clear liquor from several such operations is decomposed with Chili saltpetre, yielding potassium nitrate and sodium chloride, which is then used over again as the raw material of the ammonia-soda process. In the event of it not being desired to prepare nitre as a by-product the liquor containing both potassium and sodium chloride is saturated with ammonia in the ordinary way, then saturated with sodium chloride, and finally treated with carbon dioxide as usual, the free carbon dioxide and the ammonium carbonate being driven out of the liquid by heat at the end of the operation, and the ammonium chloride decomposed with lime in the customary manner. The waste liquor containing calcium, sodium, and potassium chlorides is then treated with seaweed ash as before, and the resulting solution evaporated until it contains about 22 per cent. of potassium chloride, up to which point sodium chloride is precipitated. On cooling, about 12 per cent. of potassium chloride are deposited and

the mother-liquor can be used afresh in the manufacture of ammonia soda.

The calcium sulphate obtained by this series of operations is divided into two parts, one of which is burnt and then both are mixed with a rich superphosphate prepared from apatite or similar imported material, and sulphuric acid, in such proportions that a *dry* friable product containing 7—8 per cent. of soluble phosphoric acid is obtained.

The seaweed ash can be similarly utilised in conjunction with such materials as Stassfurt salts, provided the magnesia be first precipitated with lime, the last traces being thrown down with soda solution as before. The resulting gypsum, if carefully prepared, can be sold as "Pearl hardener," but in any case will find a use for fixing ammonia in stable manure or as a raw material for selenitic mortars.

The author suggests combining the Leblanc and ammonia-soda processes by precipitating the waste liquor of the latter with salt cake produced by the former, thus obtaining sodium chloride and calcium sulphate. The first can be carbonated in the usual way, and the calcium sulphate used for the purposes suggested above.—B. B.

Experiments in Mashing with Sodium Sulphite and with Acid Calcium Sulphite. J. Heinzelmann. Zeits. f. Spiritusind. 1891, **14**, 95.

See under XVII., *page* 783.

PATENTS.

Improvement in Apparatus for Drying Salt. E. G. Lawrance, London. From S. Piek, Szczakowa, Austria. Eng. Pat. 4695, March 25, 1890. 8*d*.

The apparatus consists of a brick chamber heated by steam, whilst a current of hot air passes through the same. It is provided on both ends with compartments, which are separated from the intermediate part of the chamber, and also from the outer air, by means of doors, which may be worked by a hydraulic ram. The salt is introduced on carriers suspended on rails, or by means of any other contrivance, in one end compartment, and during this operation the intermediate doors are closed to prevent an inrush of cold air into the whole of the apparatus. The outer door is then closed and the intermediate one opened, to admit the salt into the chamber, and this is repeated till the chamber is filled with salt-carriers. These are withdrawn on the far end as fast as the salt dries, using the same precautions as before to prevent the cold air from entering the apparatus.—H. A.

Treatment of Impure or Waste Potassium Salts for the Manufacture therefrom of Soda, Potash, Hydrochloric Acid, Magnesia, Calcium Sulphate, and Sulphur or Sulphuric Acid. W. L. Wise, London. From the "Chemische Fabrik Buckau," Magdeburg, Germany. Eng. Pat. 9198, June 13, 1890. 6*d*.

The Stassfurt waste salts consist of the chlorides and the sulphates of potassium, sodium, and magnesium. It is proposed to work them up by treatment with sulphuric acid, for conversion of the chlorides into sulphates, whereby hydrochloric acid is given off, and may be condensed. The mixed sulphates are dissolved in water and treated with milk of lime; the magnesia is thus precipitated along with gypsum; the separation of the latter is completed in a few days, if the solution be of the proper strength, 20° B. (33° Tw.). The magnesia can be separated owing to its lighter specific gravity from the gypsum by means of washing. The solution of sulphates of soda and potash is now decomposed with barium sulphide (prepared in the usual way from heavy spar); the resulting barium sulphate is available for conversion into more sulphide, whilst the alkaline sulphides are evaporated to say 20 B. (33° Tw.), and treated with strong carbonic acid free from oxygen (as obtained by roasting bicarbonates). Sodium bicarbonate is thereby precipitated, and potassium bicarbonate remains in the solution, from which it is obtained by evaporation. The sulphuretted hydrogen given off in carbonating the solution of alkaline sulphides is available for the manufacture of sulphur or sulphuric acid.

Other means may be employed for the separation of the magnesia, thus by roasting the mixed sulphates with coal until the mass begins to soften. The wear and tear on the furnace will be small, as the magnesia present prevents ready fusion. The resulting mass is then lixiviated, when the magnesia remains, and the alkaline sulphides are dissolved.—H. A.

Improvements in the Production of Acid Sulphates. W. B. Giles, Leyton; F. G. A. Roberts, London; A. Boake, London. Eng. Pat. 11,979, July 31, 1890. 4*d*.

The acid sulphates obtained in the manufacture of hydrochloric, nitric, and acetic acids are capable of combining with much more sulphuric acid, with formation of "pentasulphate of sodium, and which possesses apparently the empirical formula of Na_2O, $5\,SO_3 + 3$ aq." The same compound may be obtained direct from the ordinary chloride, nitrate, or acetate of soda.

The claims are:—"1st. The invention and production of the above mentioned new salt, viz., pentasulphate of sodium from ordinary ($NaHSO_4$) or anhydrous (Na_2O, $2\,SO_3$) bisulphate or less acid sulphates of sodium . . . ."

"2nd. The conversion of the acid sulphates of sodium obtained as bye-products in the manufacture of nitric, acetic or hydrochloric acids (which at the present time have little or no value) into a new and useful product which is a solid dry material capable of being packed and transported in ordinary packages such as iron drums or kegs."—H. A.

Improvement in Apparatus connected with the Manufacture of Sulphate of Ammonia. R. Dempster and J. Dempster, Manchester. Eng. Pat. 12,661, August 13, 1890. 4*d*.

For the purpose of conveying the contents of the saturator to the drainer, a lead or copper pump is fixed within the saturator, with a suction tube of a like material extending to the bottom of the sump. From this suction tube, and preferably below the pump-barrel, a branch tube extends to the drainers. Both tubes are provided with rubber or lead valves which alternately close or open with each stroke of the piston. With a centrifugal pump, of course the valves will not be required.—H. A.

Improvements in the Method of Obtaining Useful Products from Bleaching Powder Dregs and Lime Mud from Paper Works. T. J. Hutchinson, Manchester. Eng. Pat. 13,504, August 28, 1890. 4*d*.

See under XIX., *page* 787.

Improvements in the Treatment of Phosphoric Acid for Facilitating its Storage and Transport. B. E. R. Newlands, London. Eng. Pat. 13,863, September 3, 1890. 6*d*.

See under XVI., *page* 781.

Improvements relating to the Production of Soda and Chlorine. T. Raymand, Moustiers, Belgium. Eng. Pat. 14,483, September 13, 1890. 4*d*.

Sodium chloride and sulphide of iron are heated in the presence of air with the production of chlorine and a residue of sodium sulphate and peroxide of iron. This residue is mixed with charcoal and furnaced, whereby a double sulphide of iron and sodium is formed, from which sodium carbonate is obtained by lixiviation and treatment with carbonic acid, and the sulphide of iron can be used over again.—G. H. B.

Improvement in Preparing and Using Permanganate of Soda. R. Leigh, Bolton. Eng. Pat. 14,858, September 20, 1890. 4*d*.

Crude sodium manganate is treated, preferably in a vertical vessel, with a current of moist air or air and steam, whereby "the manganate absorbs air and sufficient moisture for crystallisation," and sodium permanganate is formed. An alternate way of working consists in exposing thin layers of manganate to the atmosphere and occasionally turning them over, thus exposing fresh surfaces to the action of the same.—H. A.

Improvements in the Manufacture of Caustic Soda with the Recovery of Reagents employed for repeated Use. J. Simpson, Liverpool. Eng. Pat. 18,835, November 21, 1890. 6*d*.

The process comprises a cycle of reactions for the conversion of salt-cake or sodium bisulphate into caustic soda and gypsum, by means of calcium phosphate and hydrochloric acid, which are recovered and used over again. Three alternate methods are described, according to whether sodium sulphate or bisulphate, tri- or bicalcium phosphate are used.

In the first and second method tricalcium phosphate is dissolved in hydrochloric acid of 10 Tw., and the solution decomposed either with salt-cake or with sodium bisulphate. The clear liquor, separated from the calcium sulphate so formed, is boiled down to a pasty consistency whereby weak hydrochloric acid is given off; in subjecting it to a red heat in a muffle furnace, the rest of the hydrochloric acid will be evolved and may be condensed. The molten mass, consisting of sodium phosphate and sodium chloride, is run into water, the solution of the same made up to 60–70 Tw. and allowed to cool, whereupon the less soluble salt will crystallise out. The sodium phosphate is made now into a solution of 26 Tw. and is causticised with lime, sodium hydrate and insoluble calcium phosphate being formed, the latter of which may return to the process.

According to the second alternate method, dicalcium phosphate is used, and in order to regenerate this as such, the causticising operation is divided into two stages, in the first of which the phosphoric acid is kept in excess, and in the second stage the rest of the lime added; the first precipitate consists of dicalcium phosphate, and the second precipitate, containing the excess lime, is available for the succeeding causticising operation.

The gypsum will be found to contain a certain amount of phosphoric acid, and is available as manure, or the phosphoric acid may be recovered by reducing the gypsum with coal into calcium sulphide, which is converted in the usual way into calcium sulphydrate, and then decanted from the insoluble calcium phosphate.—H. A.

An Improvement in Apparatus for Concentrating Sulphuric Acid. F. O. Webb, Manchester. Eng. Pat. 2343, February 9, 1891. 8*d*.

A series of glass vessels are placed on slabs, arranged in steps, in a heating chamber; the vessels are enclosed near their upper edges in iron plates or slabs, corresponding to the bottom. In each of these vessels is placed, at an angle, a loose tapered glass tube, reaching from the spout of the next higher vessel to the bottom of the particular vessel where it is provided on its side with an outlet slit. The fire-gases pass first into combustion chambers on one side of the heating chamber, and pass from thence in the space left round the glass vessels. The weak liquor is fed into the tube of the uppermost vessel, and displaces a certain amount of acid, which will overflow into the tube of the next vessel, &c., thus causing an intimate interchange in the liquor to be evaporated. The concentrated acid is delivered from the last vessel of the series.

The claim is:—"For concentrating sulphuric acid, a series of glass vessels placed on steps in a heating chamber, each of these vessels being made with an overflow spout and having placed in it a glass tube reaching down to its bottom from the spout of the next higher vessel, arranged and operating substantially as herein described."—H. A.

A New Alkaline Magnesium Compound. M. W. Beylikgy, C. J. Everett, and C. A. Collins, New York, U.S.A. Eng. Pat. 5519, March 31, 1891. 6*d*.

The preparation of this compound is effected by making up 100 parts of commercial sodium trisilicate with boiling water into a syrup, and agitating it with 11 parts of a mixture of 3 mol. proportions of magnesium fluosilicate and 1 mol. proportion of hydrated magnesium carbonate, which are suspended in 50 parts of water. The result of the reaction is a compound having the general formula $7(Na_2O,5SiO_2),2(MgO,SiO_2)$. This compound is endowed with the properties of the simple alkaline silicates as regards application in the arts, and it further possesses the insolubility of those silicates when once thoroughly dried.—H. A.

Improvements in Furnaces for Burning Sulphur and the like. C. H. Fish, Manchester, U.S.A. Eng. Pat. 7757, May 5, 1891. 8*d*.

The improved furnace is provided on one end with a feed-door for introducing the sulphur and the requisite air; on the other end, near the outlet for the sulphurous acid fumes, there is a receptacle. The sulphur ashes are gradually pushed forward, and arrive in the receptacle substantially free from sulphur, and may be raked out as often as required.—H. A.

Improvement in Process of Extraction of Carbonic Acid Gas from Bicarbonates. E. Luhmann, Andernach-on-Rhine, Germany. Eng. Pat. 9171, June 1, 1891. 8*d*.

It is known that bicarbonate solutions are decomposed at a boiling heat into monocarbonates and carbonic acid, and that the remaining solution, after cooling, is capable of absorbing fresh quantities of carbonic acid. But the decomposition has in practice hitherto remained incomplete. The inventor finds that the emission and absorption of carbonic acid takes place to its maximum extent when the bulk of the carbonic acid is driven off by boiling under atmospheric pressure and by finishing off the operation under the combined action of steam and pressure.

The apparatus consists of a "boiler," in which the partly decomposed bicarbonate solution from a previous operation is kept at ebullition under pressure; the monocarbonate solution is then forced through a series of cooling pipes and run down a tower packed with coke, where it meets an upward current of carbonic acid from any source. A bicarbonate or protocarbonate solution is formed, which is pumped into a "boiling apparatus," where it is heated and agitated by the steam and carbonic acid given off in the first boiler. More carbonic acid is given off, and passes along with the steam into a condenser, and from thence into a gasholder, whilst the condensed water is mixed with the monocarbonate liquor from the "boiling apparatus," in order to maintain a uniform concentration of the solution, which returns to the boiler (see below, also Eng. Pats. 9646 and 10,158 of 1891).—H. A.

Improvements in and relating to a Process for the Treatment of Phosphorites or other Phosphatic Material. C. Glaser, Baltimore, U.S.A. Eng. Pat. 9348, June 2, 1891. 6*d*.

This invention has for its object the extraction of aluminium phosphate from minerals containing the same. The finely-powdered substance is treated with caustic alkali solution of a suitable strength, whereby all the aluminous portion is dissolved and is separated from the clear solution by treatment with carbonic acid, and the solution of sodium carbonate is recausticised for use over again by treatment with lime. Or the substance is treated with a boiling solution of

sodium carbonate to dissolve out the aluminium phosphate which is afterwards precipitated from the clear solution on cooling. The precipitated aluminium phosphate may be collected in a filter-press and dried at a low temperature without impairing its suitability for direct employment as a manure.—G. H. B.

Improvements in Process for Production of Carbonic Acid. E. Luhmann, Andernach-on-Rhine, Germany. Eng. Pat. 9646, June 6, 1891. 6*d*.

It is proposed to use coke for firing the "boiler" (see above, Eng. Pat. 9171) containing partly decomposed bicarbonate solution and to utilise the combustion gases, after washing and cooling, for the reconversion of the monocarbonate solution into bicarbonate. This is then boiled and decomposed by the steam from the "boiler," whereby the bulk of the carbonic acid is given off and is finally completely decomposed, under pressure, in the "boiler."—H. A.

Improvements in the Production of Carbonic Acid from Bicarbonates of Soda. E. Luhmann, Andernach-on-Rhine, Germany. Eng. Pat. 10,158, June 15, 1891. 8*d*.

The improvements refer mainly to an absorbing tower for the conversion of monocarbonate liquor into bicarbonate, and further, to the construction of a coke furnace which admits of the production of high-strength carbonic acid.

The absorbing tower is provided with a series of horizontal plates or shelves; the cooled sodium carbonate solution from the "boiler" is introduced on the top in form of a spray, and flowing from shelf to shelf, meets a current of carbonic acid which enters from below.

The coke furnace is built after the fashion of "an upright tray furnace and the rear parts of the grate are formed of pipes, the extremities of which enter the boiler at two different parts." The liquor circulating in these is exposed to the full action of the heat, which causes it to give up rapidly its carbonic acid. These pipes serve also to check the introduction of an excess of air, which would weaken the carbonic acid. The coke should not be kept above a dull red heat, to prevent reduction of the carbonic acid into carbon monoxide and formation of "hydrosulphurous gases."—H. A.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

On the Density of Pure Kaolins and Fireclays and its relation to Plasticity. H. Hecht. Thonindustrie Zeit. 1891, **15**, 293.

The destruction of fireclay bricks in the ovens of the porcelain industry results not merely from the high temperatures employed, but much more from the basic substances brought over mechanically by the furnace gases, which consequently eat into the bricks much quicker when they contain free silica than when they consist only of aluminium silicate. The author analysed the exposed surface portion and also the inside portion of a brick which had stood the action of the fire during 10 calcinings of 24 hours each, and found in the glazed portion 4·34 per cent. of alkalis and in the unattacked portion only 0·96 per cent. of alkalis. In order to protect the furnace lining as much as possible from the action of the ashy particles, the bricks should be made of basic materials and the fireclay plaster should be of a kind which sets quickly on firing. The presence of free silica loosens the stone, as quartz expands on heating. On the other hand clay contracts on heating, and in a series of experiments on 14 clays, the maximum contraction was 20 per cent. in linear measurement. The pure plastic clays reached a maximum density at a lower temperature than the pure kaolins, and the latter after repeated calcination in the most intense porcelain fire, showed a porosity of 7 per cent. in volume. The author found that the density of materials consisting of pure clay is a measure of plasticity. The porosity of the 14 clays was determined after heating to the melting point of silver, as the plastic clay was not completely permeable by either petroleum or alcohol. The density varied between 18·40 and 38·86 per cent. by volume.—G. H. B.

The Constitution of "Pink-Colour." L. Petrik. Thonindustrie Zeit. 1891, **15**, 101.

It is well known that a pink colour is produced on porcelain by mere traces of a chromium compound. According to Leykauf, the colouring body employed is chromium stannate. The author has found that a pink colouring body may be produced as well by the aid of alumina or a mixture of alumina and magnesia, as by means of tin oxide. For this purpose the precipitated hydroxides obtained from 90·6 grms. of ammonia alum and 24·6 grms. of magnesium sulphate are mixed by grinding with 0·5 grm. of potassium chromate. The mass is burnt twice, being well washed after the first burning. During the second ignition the red colour appears. The alumina colouring body is made by mixing the alumina from 90·6 grms. of alum with 0·5—1·0 grm. of potassium chromate and igniting twice, as before. In presence of a larger amount of chromium the pink colour is more difficult to obtain; and when the percentage of chromium is very large only a green mass results. An increase in the amount of magnesia favours the formation of the red colour; whilst the substitution of lime, baryta, or strontia for magnesia seems to have a contrary effect. Most likely this is so, because the precipitated alumina is coarser, and because, in all probability, the chromium colour compound only appears pink when very finely divided. The author is of opinion that the pink colours prepared in the manner described above will be more stable towards a reducing flame than those containing tin oxide.—H. T. P.

Blue Sub-Glaze Colour for Porcelain. C. Lauth. Sprechsaal, 1891, **24**, 121.

A number of attempts to prepare a colour resembling Chinese blue have induced the author to study the action of various glazes on cobalt blue. Glazes containing much lime or other alkaline earth impart to the blue a violet tinge, which is most marked with those bases having the least affinity for silicic acid, or which combine with silicic acid only at a high temperature. When zinc oxide is employed the colour assumes a Persian blue shade and loses its transparency. Alkaline glazes affect the beauty of the blue colour more favourably than those containing alkaline earths. Glazes containing much alumina are the most suitable, and the author recommends the following glaze mixtures:—

—	I.	II.
	Per Cent.	Per Cent.
Silica	75·20	75·09
Alumina	12·26	12·24
Alkalis	7·49	8·36
Lime	5·05	4·32

—H. T. P.

Crackled Porcelain. C. Lauth and Datailly. Sprechsaal, 1891, **24**, 321.

Porcelain is described as "crackled" when the glaze is broken up in cracks forming a kind of network. The effect is produced by burning on the glaze at a suitably lower

heat; but if the temperature employed be either too low or too high the glaze is apt to peel off from the surface of the article. The cause of the crackling is in the inequality of the expansion coefficients of the glaze and the backing, and this inequality is best attained by modifying the composition of the glaze. This may be done either by increasing its fusibility by a larger proportion of alkalis or by using more silica or alumina to promote greater infusibility. The latter method is to be preferred, as the backing is thereby attacked to a lesser extent and the glaze has a smaller tendency to peel off. The author has used the following glazes with success on a soft porcelain containing 66 parts of silica, 27 of alumina, and 7 of alkalis, like the soft porcelain of Sevres, requiring a kiln heat of 1,350° C.:—

	Ordinary Glaze.	Crackled Glazes.	
SiO_2	69·48	79·42	69·92
Al_2O_3	14·55	11·80	18·13
Alkalis.....	3·55	5·81	11·95
CaO	13·90	2·88	..

—G. H. B.

Composition of a Colouring Matter for Glass. G. Hattensaur. Chem. Zeit. **15**, 522.

A SUBSTANCE apparently used for imparting a yellow colour to glass had the following composition:—

Moisture.....	1·71
Carbon.....	29·93
Silica.....	10·65
Ferric oxide and alumina.....	1·38
Manganese dioxide.....	37·92
Sodium chloride.....	13·55
Sulphuric acid.....	0·22
Magnesia.....	0·23
Lime, traces of baryta, and loss.....	1·38

It is probably compounded of 15 parts of graphite, 41 parts of pyrolusite, and 14 parts of common salt.—S. B. A. A.

Properties of Clay pressed Wet and Dry. H. Lüdtke. Deutsche Töpf. und Ziegl. Zeit. **22**, 199. (Compare this Journal, 1891, 120.)

THE author, from the examination of 25 samples of various kinds of clay, has deduced that not all can be successfully pressed in the air-dried condition. A certain small percentage of water (4–6 per cent.) retained in the air-dried state is necessary in order to obtain satisfactory results. Up to a certain point the time of pressure can be varied inversely as the pressure is, without impairing the quality of the product. Clays which when pressed wet tend to form blisters should not be pressed dry, as this objectionable tendency is enhanced thereby.

The compressional strength of dry pressed ware is greater than that of material wet pressed, while its porosity is less. The latter difference decreases when the goods are burnt at a high temperature. The consumption of fuel is greater in the case of dry-pressed goods on account of the larger amount of raw material they contain. The small quantity of water in dry pressed ware, before firing, takes almost as long to evaporate as the amount of water used with ware made of wet clay, although this is three or four times as much.—H. B.

PATENTS.

Improvements in or connected with the Firing of Pottery. L. H. Jahn, Hanley. Eng. Pat. 13,155, August 21, 1890. *6d.*

A GUMMY or adhesive solution (gum tragacanth) is applied to the rims and other parts of cups, basins, &c.; and while the preparation is still wet the rims are placed together, one on the top of the other; the result is that during the firing process the articles will adhere firmly together and remain so during the firing, keeping each other in their correct outline, but after firing such articles can be readily separated. This invention is stated to dispense with the use of the rings usually placed on the wares, and to give better results.

—E. G. C.

Transparent Cloisonné Enamel. C. S. Blount, London, V. Ward, Ayot, St. Lawrence, and A. Fisher, London. Eng. Pat. 7885, May 7, 1891. *4d.*

TRANSLUCENT cloisonné enamel or glass is made by fusing between strips of metal placed on a background of metal plaster or other suitable material, which is afterwards removed, leaving the enamel fused together with the metal divisions in one piece, the separation of the background causing the product to be translucent.—B. B.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

Apparatus for Removing Briquettes from their Moulds. W. Michaelis. Thonind. Zeit. **15**, 537, 538.

A FACTOR in the fluctuations observed in the results of the mechanical tests of cement is the possibility of the test-piece suffering injury by removal from the mould. When the moulds are not made in two parts, this is especially likely to occur. The author has devised a simple apparatus for such cases consisting essentially of a metal arm carrying a vertical sliding rod provided at its lower end with a horizontal metal plate of shape similar to that of the briquette. The briquette is ganged in the ordinary way, and while still plastic covered with a piece of tissue paper, a glass plate laid upon it, turned over a piece of tissue paper laid on the other side, brought under the horizontal plate attached to the vertical rod (its position being determined by metal stops), the plate lowered upon its upper surface and secured in this position by a set screw gripping the vertical rod, and the mould raised by hand, leaving the briquette behind. It can then be removed (the paper being stripped off) and set aside to harden.—B. B.

An Improved Method of Preparing Magnesia Cement. Thonind. Zeit. **15**, 365. (Compare this Journal, 1891, 111.)

WHEN cement made from a mixture of magnesia and magnesium chloride is cast in moulds, the magnesia sinks more or less to the bottom, and the mixture is no longer of the required composition. To avoid this difficulty strong solutions of magnesium chloride (*e.g.*, 33° B.) have been used in order that their viscosity might be such that this tendency to segregation should be less. But such mixtures are too rich in magnesium chloride to be of the strength proper for a well-made magnesia cement. In a German Patent of December 15, 1889, O. Prinz has described a process for remedying this inconvenience. The process consists in the addition to the cement of certain substances capable of hindering the subsidence of the magnesia. Such are albumen, size, gum, dextrin, starch, agar-agar, as well as inorganic bodies such as gelatinous silica, alumina, and ferric oxide. These materials are added to the solution of magnesium chloride and the magnesia then stirred in; in the case of starch the solution is heated until a thin paste is formed. When silica is used it is produced *in situ* by the addition of a not too concentrated solution of water-glass. Gelatinous metallic hydrates can be introduced in either of two ways; in the first a salt of the metal is added to the solution of magnesium chloride and precipitated by caustic soda, while in the second the magnesia itself on its subsequent intermixture serves as a precipitant.

The objection to the use of metallic hydrates is that their formation involves the production of a foreign salt, which remains in the finished cement, reducing its strength and stability. This difficulty is overcome by substituting for the hydrates already mentioned magnesium hydrate, which is itself gelatinous, and can moreover be produced by heating crystalline magnesium chloride. The alternative plan therefore suggested by these considerations consists in using magnesium chloride containing magnesium hydrate in place of the pure substance.—B. B.

Carbolineum Avenarius. F. Filsinger. Chem. Zeit. **15**, 544.

The author has compared this material, which is used as a preservative for timber (this Journal, 1891, 465), with seven imitations that are on the market, and finds it to differ from them in all essential respects. The following are the properties and characteristics of the genuine substance:—Colour, red-brown; specific gravity at 17° C., 1·128; viscosity at 17° C. (water = 1), 10·0; ash, 0·03 per cent.; flashing point, 131° C.; firing point, 190° C.; begins to distil at 230° C.; distillate below 270° C., 10·6 per cent.; between 270° C. and 300° C., 12·0 per cent.; phenols, trace; deposits no naphthalene. The residue left on distillation is clear, red-brown, and viscous. It will be seen, therefore, that the name carbolineum has no reference to the presence of carbolic acid, and that the other properties that are characteristic of it are its high specific gravity and viscosity, low volatility, and its freedom from naphthalene.—B. B.

Magnesia Cement. A. v. Berkel. Monit. de la Céramique et de la Verrerie, 1891, **22**, 31.

Fluorspar is digested for some time with sulphuric acid; a solution of kieserite or magnesium sulphate is then added, and as soon as hydrofluoric acid begins to be given off, calcined magnesia is stirred into the mixture. Calcium sulphate and magnesium fluoride are formed, mixed with magnesium sulphate. The cement thus produced sets very hard, and is not in the least affected by water. Articles made of it are pressed and dried by exposure to air, or by heat.—H. T. P.

Cement for Metal. H. Spenlé. Monit. de la Céramique et de la Verrerie, 1891, **22**, 41.

This well-known cement, which is prepared from zinc oxide and zinc chloride and some other material, such as iron slag, powdered glass, &c., may be caused to set more slowly by adding with the zinc chloride, when it is mixed with the other ingredients, some zinc sulphate and powdered limestone. The adhesive power of the cement (for cementing metals) may be increased by the addition of 2 per cent. of ferrous sulphate.—H. T. P.

Imitation Marble. J. G. Maardt. Monit de Céramique et de la Verrerie, 1891, **22**, 90.

The author proposes the following method for producing imitation marble:—10 parts of burnt gypsum and 1 part of alum are mixed together with water, calcined and powdered. 22 parts of this material are compounded with 22 parts of talc, 4 of magnesium chloride, 44 of calcined fireclay, and 1 part of potash alum. The mixture is suitable for moulding into ornaments, and can be polished or painted.
—G. H. B.

PATENTS.

Improvements in the Manufacture of Plastic Compounds for Building and other Purposes, and in Apparatus therefor. R. G. de Vasson and the Société dite "La Subérine," Paris, France. Eng. Pat. 10,962, July 14, 1890. 8*d*.

Coarsely powdered cork is reduced in a machine consisting of a chamber closed at the bottom by a revolving disc provided with sectors made of hard granular material, such as emery, pebbles, or filings, the shaft upon which the disc is keyed also carrying a cross-piece with similar sectors, which is free to slide upon it vertically, working in guides upon the inner surface of the vessel. The ground cork is ejected through an annular passage between the disc and the vessel provided with saw-blades, through which it is forced. The ground cork thus obtained is made into a variety of compositions with such materials as sulphate of lime, sesquioxide of iron and dextrin, or, for damp places, oxychloride of zinc or magnesium, or when it is to be used as an insulator, with india-rubber or gutta-percha. Animal or vegetable fibres may be added to give greater coherence, and such substances as ammonium phosphate and sodium tungstate, to render the product incombustible. Mouldings made from this composition may be glazed or varnished with talc powder, stearin, paraffin or resin.—B. B.

Improvements Relating to the Impregnation of Organic Fibrous and Cellular Matter by means of an Electric Current and Apparatus therefor. G. A. Oucken, Chicago, U.S.A. Eng. Pat. 11,065, July 15, 1890. 8*d*.

The patent relates to a method of impregnating fibrous matter generally, and wood in particular, with alkaline, acid, antiseptic or other solutions, more rapidly than is possible by the usual process. Wood from which veneers are to be cut is commonly treated previously in water or an alkaline solution for 6—36 hours, a time which can, it is claimed, be reduced to one hour by the adoption of the plan patented. This is carried out by running trucks bearing the wood in logs into a long boiler, pumping in the solution with which it is to be treated, raising the temperature from 75°—90° C. by means of steam pipes, and passing a current of electricity between electrodes placed one at each end of the boiler.—B. B.

Improvements in the Manufacture of Artificial Stone. C. George, Berlin, Germany. Eng. Pat. 12,607, August 12, 1890. 6*d*.

Ten parts of silicic acid powdered and freed from impurities are mixed with 90 parts of water and 100 of quicklime, all by weight. 100 parts of the product are mixed with 100 parts of sand and 5 parts of magnesia or fluorspar, and the mass moulded as desired. The articles are allowed to dry for 12—24 hours, and subjected to steam pressure under 10 atmospheres pressure for 48—72 hours, after which they are treated with boiling saturated calcium chloride solution, at a pressure of 10 atmospheres, for 6—12 hours. They may then be dried by air or the circulation of steam. Marble, magnesia, magnesium limestone, &c., may be substituted for the sand. The stones thus formed are said to resemble marble, sandstone, granite, &c. closely, to be fireproof, and to resist the action of the weather as well as natural stones.—B. B.

An Improved Decorative Artificial Stone. A. McLean, Lewisham. Eng. Pat. 13,105, August 20, 1890. 4*d*.

Concrete made of Portland cement and sand is formed into slabs or blocks, upon the face of which clips of marble and small pieces of metal, such as "brass spelter" are set, the whole being afterwards pressed and rubbed down in the usual manner to form a decorative surface. For inloor work, Keene's or Parian cement may be preferably substituted for Portland cement.—B. B.

Improvements in or connected with Rotative Furnaces or Kilns for Treating and Recovering Waste Gases from Raw or Partially Raw Materials, used more especially and for Example in the Manufacture of Cement. L. Johnstone, Newcastle-on-Tyne. Eng. Pat. 14,380, September 12, 1890. 8*d*.

The process of burning carbonate of lime or other carbonate as in the preparation of cement clinker from slurry in the ordinary way, is conducted in a revolving cylinder pre-

ferably inclined towards the combustion end, and arranged so that a considerable mass of the raw material is at the upper or feeding end and evolving carbon dioxide, so that this waste product may be drawn off in a fairly concentrated condition, a result favoured by the introduction of a regulated quantity of steam at the same part of the cylinder. The gas thus obtained may be drawn off, stored, and used for decomposing tank waste or for similar purposes.

At the combustion end of the cylinder are one or two sets of regulators for heating the incoming gas and air previous to the admixture and ignition. The flame is deflected back from the cylinder in a horseshoe shape, and the products of combustion are led to the outside of the regenerator tubes. The fan drawing off the carbon dioxide, or a damper in the case of the burning of such materials as iron slag, which do not evolve this gas, regulates the length of travel of the flame in the kiln.—B. B.

A New Alkaline Magnesium Compound. M. W. Beylikgy, C. J. Everett, and C. A. Collins, New York, U.S.A. Eng. Pat. 5519, March 31, 1891. *6d.*

See under VII., *page* 768.

A Composition of Matter consisting in Casein Cement. C. Wittkowsky, Berlin, Germany. Eng. Pat. 8347, May 15, 1891. *6d.*

One hundred parts of purified or unpurified albuminous matter, such as bullock's blood, are mixed with 8 parts of an earthy hydroxide, such as slaked lime, and 20—35 parts of water-glass. "Firstly, a deposit arises, which, however, again disappears, and a slimy smearable mass results." Wood coated with this preparation and allowed to dry, can be cemented to another piece of wood similarly treated by subjection of the two pieces with their prepared surfaces in contact to heat and pressure, the cement becoming liquid and then hardening under these conditions. The composition may be used for the formation of blocks of artificial wood made from sawdust and similar finely-divided ligneous material.—B. B.

X.—METALLURGY.

The Basic Siemens-Martin Furnace, with Magnesia Lining. Leo. Dingl Polyt. J. **280**, 260—264.

The use of the basic-lined open-hearth furnace has latterly become largely extended in Germany owing to the recognition of the great economical advantages it offers. Among these may be mentioned the possibility of working up the poorest scrap and all varieties of iron in which the percentage of sulphur does not exceed a definite amount. In German works, for instance, excellent results have been obtained from charges containing over 60 per cent. of the poor Luxemburg and Lorraine pig, with over 2 per cent. of phosphorus, and it has been found possible to produce a metal thoroughly well adapted for the tin-plate and wire industries from raw materials of the most doubtful description. The soft varieties of basic steel are distinguished for their welding properties, and of late Darby's and Thielen's processes of direct carburisation have rendered it easy to produce the hardest spring steel. As in the acid process, the facility of ascertaining and controlling the condition of the charge at all stages allows of the constant production of a metal of almost any desired composition, but whilst only pure materials can be advantageously treated by the acid process, the basic-lined furnaces are not only available for inferior material, but they work faster, and are finally the only furnaces in which considerable masses of ore may be worked in with the pig iron with tolerable financial results. The only substances used for forming the basic lining are chrome iron ore, calcined dolomite, and magnesite. The expensiveness and variable quality of chrome iron have led to its gradual disuse, even for the formation of the so-called neutral hearths; of the others, calcined dolomite has the disadvantage that it cannot be stored for any length of time without taking up moisture from the atmosphere and becoming unserviceable; for the same reason, if an open-hearth furnace with dolomitic lining which has been in use for some time be blown out and left cold for a few days, it will be found to be no longer in working order.

Calcined magnesite, on the other hand, is not hygroscopic, and may be stored for any length of time or transported with safety, the slight amount of moisture which is taken up on exposure may be driven off by careful heating, without injury. It is perfectly indifferent to the action of silica, but it must be protected as completely as possible from the action of clay. Its indifference to silica renders it unnecessary to interpose anything between the lining and the siliceous sides of the furnace; in fact it is occasionally used to form an intermediate layer between the sides and a dolomite lining. The corrosive siliceous basic slags have only a transient action on magnesite, and consequently, the repairs necessary after each heat are quickly made, and only small quantities of material are required, whilst in the dolomite hearths about 2 cwt. of dolomite are used in repairs, &c. per ton of produce, and a couple of hours are spent in the work.

The following are some of the most usual dimensions of basic furnaces with magnesian lining:—

The hearth of a 7-ton furnace varies in length from 3·2 to 4·2 metres and 1·9 to 2·3 m. in breadth, with an area of 7 to 8·3 sq. m.; the 8-ton hearth has on the average an area of 9·8 to 10·4 sq. m., the length being about 4·4 m. and the breadth 2·4 m.; an average 10 ton hearth has an area of 9·2 to 12·5 sq. m., with a length of 3·8 to 5·0 m., and a breadth of 2·3 to 2·7 m.; the 12-ton hearth has an area of 14 sq. m., the length being 5·4 m., and the breadth 2·6 m. The best results are obtained from 7-, 8-, 10-, and 12 ton furnaces when the areas of the hearths are 8, 10, 12·5 and 14 sq. m.; the length 4·2, 4·4, 5·0, and 5·4 m., and the breadth 1·9, 2·4, 2·5, and 2·6 m. respectively.

The areas of the cross-sections of the gas and air supply pipes are very variable, there are generally two to four gas pipes and two to five air pipes, and in all the conspicuously successful working furnaces, the cross-sections are equal. Furnaces, on the other hand, in which the sectional areas of the gas and air pipes have a ratio of 22 to 39 or 216 to 385, rarely yielded favourable results.

The air supply pipes are almost invariably placed above the gas ducts, and spread out over the upper part of the furnace the opening being directed towards the hearth. The gas delivery pipes are not disposed symmetrically to the longer axis of the furnace, those lying near the back wall being advanced 15 to 20 cm. towards the centre. The sectional area of the flue into which the waste products of combustion pass is made not to exceed the sum of the sectional areas of the delivery pipes.

The durability of the arch of the furnace is found to increase with its height, and in one of the best-known steel works excellent results have been obtained with dome-shaped arches 2 m. in height. In general, however, the height of the arch above the hearth varies from 1·05 to 1·42 m. The capacity of the heating chambers for air and gas is generally the same; one of the chambers has been made larger than the other in individual cases only. In a well-known Austrian steel works the chambers for the 12-ton furnace had a capacity of 16·4 cbm.

According to experience gained in one large steel works where three 12-ton furnaces had been lined with magnesite alone for many years, a mixture of calcined magnesite and tar being rammed down on the walls, fire-bridges, and hearth; the quantity of magnesite used amounted on the average to 2 per cent. of the weight of steel produced. It generally amounted to 50 to 100 kilos. after each heat, the repairs generally occupying about half an hour.

The hearths formed of magnesite and anhydrous tar have never given rise to any accident and have lasted for 700 and more heats, whilst a new arch of silica bricks was required every 250 to 300 heats, and the surrounding walls had to be renewed every 500 heats. In these furnaces four heats were conveniently worked daily, the duration of each heat, inclusive of repairs, was five hours 10 minutes, of this fully two hours was spent in introducing the charge, which consisted of 18 per cent. of pig iron and 82 per cent. of poor scrap; the average annual production of each furnace is over 11,800 tons. Carburisation of the finished steel with solid carbon has long been practised at these works with good results. When large castings are required it is customary to add ferro-silicon and small quantities of ferro-aluminium to the ladle. In another steel works, where only a 7-ton furnace is used, 960 heats had been worked on the same rammed magnesia hearth up to October 1890. These results are principally due to the fact that the dephosphorisation of the ore is accomplished by the addition of suitable basic materials, and the hearth is accordingly relieved of this duty.

A magnesia hearth may be constructed by either of the methods described below, but in any case the materials must be selected with extreme care, and the work of erection stringently supervised if annoying accidents and breakdowns in the working are to be avoided. The hearth may be formed either by consolidating the magnesia mixed with some binding material either by pressure or by heat, but before the bed of magnesia can be spread on the hearth, a suitable foundation of hard burnt refractory bricks must be prepared; magnesia bricks, though dearer, are preferable for this purpose as they have similar physical properties to the overlying bed. Dinas and silica bricks are disadvantageous on account of their considerable expansion when heated, and subsequent contraction, by which strains are set up in the upper layer, resulting occasionally in rupture. Fireclay bricks are still less serviceable, as clay and magnesia combine at an elevated temperature and form a fusible mass. The materials employed, namely, magnesia bricks, magnesite and the coal-tar used as a cement in the rammed hearths, must be absolutely anhydrous, and are generally used as hot as possible. If any trace of moisture be left it will be converted into steam when the furnace is at work, and as it is prevented from escaping by the compactness of the hearth its tension increases, and may lead to the scaling off and penetration of the hearth. The bricks supporting the hearth must be set with the utmost closeness in mortar mixed with tar, and care must be taken that the smallest hollows on the joints are properly filled up. The tar used for cementing should frit at a high temperature, but must not swell up on coking, the varieties which become inflated on coking impart a certain porosity and tenderness to the hearth which renders it less able to support the weight of the metal and the mechanical impact of the cold charge. The rammed hearth has the greatest powers of resistance when only 25 per cent. of the calcined magnesia is used in a state of fine powder, the remainder being in grains of 2 to 5 mm. diameter or in particles the size of peas and nuts. The amount of tar required is about 8 to 12 per cent. of the weight of the magnesia. In forming the hearth the mixture is introduced into the furnace in thin layers and uniformly and forcibly pressed down with red-hot stamps until it ceases to show the slightest trace of elasticity. The durability of the hearth largely depends upon this operation being properly conducted, and no pains should be spared to make sure that no portion of the hearth, however small, is loose or elastic. The magnesian lining of the sides of the furnace is strengthened against the attrition of the charge by an additional coating for about 20 cm. from the upper part, and any damage arising from this source during the working may be easily repaired by throwing on the injured part floured and sieved magnesite which has been moderately damped a few hours before use. It is found best to have two large charging doors to the furnace and one small working door in between so as to prevent undue cooling.

The fritted magnesian hearth is far more durable than the rammed hearth. The best results are obtained by mixing finely-powdered calcined magnesite with 5 per cent. of powdered clean basic slag. A magnesia brick foundation is here also essential, but instead of the tar-mortar the mixture of powdered magnesite and slag is used as the cementing material. The interstices between the bricks must be filled with great care, but this is rendered easy by occasionally tapping the upper layer of bricks, the powder collecting and leaving any vacant places open to observation. On this foundation the mixture is placed in a layer not more than 10 mm. deep, carefully levelled and fritted, a second and a third layer are then similarly fixed; the latter is, however, smoothed with shovels when soft and drawn out towards the tap-hole; the furnace is then ready for use. For the preparation of a fritted hearth the gas from four generators is required for 42—48 hours, but the cost is less than that of a rammed hearth, as less labour and material are expended; its durability is also very much greater, less material is required for repairs, and it is stated that the heats are finished in less time.—S. B. A. A.

On Pure Platinum and some of its Alloys. W. C. Heraus. Chem. Zeit. Rep. 1891, **15**, 170.

By a method which is left undescribed, the author has succeeded in preparing considerable quantities of platinum which does not contain more than 0·01 per cent. of other metals. Platinum of this degree of purity, being too soft for many purposes, was alloyed with varying quantities of pure iridium, and an alloy of pure platinum with 1 to 2 per cent. of pure iridium is recommended for great durability. The pure iridium used in these experiments had a specific gravity of 22·35, and was extremely hard, being equal in this respect to blue-tempered steel. It was completely indifferent towards nearly all chemical reagents, and only fusible in small quantities in the strongest heat of the oxyhydrogen flame. The author also prepared alloys of pure platinum and rhodium. For the purposes of industrial chemistry the author prepares a compound sheet of platinum and gold, in which the contact surfaces of the two metals are alloyed together so as to form a perfect union. Crucibles made in this way can be substituted for the gold crucibles hitherto used in laboratories.

—G. H. B.

Thomas Slags. J. Stoeklasa. Chem. Zeit. 1891, **15**, 543, 544, and 563—569.

See under XV., *page* 780.

The Manufacture of "Alumina Carbon" (used in the Preparation of Aluminium and Aluminium Chloride). E. Wolfbauer. Chem. Zeit. 1891, **15**, 846—847.

See under XI., *page* 776.

Allotropic Transformations of Metals. H. le Chatelier. Bull. Soc. Chim. 1891, **5**, 840—843.

It has been suggested that the variability in physical properties of metals is due to their existence in an infinite number of slightly-different isomeric states. The results of experiments, however, on the specific heats of metals (Compt. Rend. **103**, 1122) point to the existence of only a very limited number of allotropic changes. Determinations, again, of the effects of heating metals, show that metals undergo sharply-defined changes at temperatures which vary with the nature of the impurities contained in them (Compt. Rend. **103**, 743 and 1135).

The author considers the determination of the electrical conductivity of metals and alloys at various temperatures to be the most satisfactory method of showing the production of allotropic modifications of the same, and finds that molecular transformations take place abruptly in the case of crystalline metals or alloys, and progressively in that of amorphous metals or alloys. A fractured surface of a metal, in a great many cases, shows which of these conditions the metal is in; thus, brass containing 40 per cent. of zinc is readily seen to be crystalline, whereas brass containing 60 per cent. of zinc is amorphous.

The extreme variability in physical properties of metals does not, therefore, depend on the chemical characters alone of the same, but also depends on their internal structure, that is, the form and size of the crystals or grains of metal in juxtaposition, and on the mode of distribution of the impurities.—E. B.

Desulphurising Molten Cast Iron. Chem. Zeits. für Berg. und Hüttenwesen, 39, 1891, 206.

When commercial ferrous sulphide (FeS), containing about 36 per cent. of sulphur, is melted together with ferro-manganese, the sulphur separates as a slag in the form of manganous sulphide, leaving the iron free. This reaction is utilised in a process introduced by the Hoerde Steel Works Company in Westphalia, for obtaining pig iron for the basic Bessemer process free from sulphur: experiments having shown that fluid sulphurous metal from the blast furnace might, by the addition of highly heated melted ferro-manganese, be purified to as low as 0·01 per cent. of sulphur. The resulting manganese-sulphide slag contains 20 per cent. and above of sulphur, and about 50 per cent. of manganese; and when subjected to a reducing fusion with lime as a flux, ferro-manganese is recovered and can be applied for desulphurising further quantities of metal. In order to carry out the operation successfully it is necessary to keep the bath liquid for a sufficient time, either by its own or externally applied heat, so that the slag may separate completely. The most convenient apparatus for the purpose is a Bessemer converter, made up with tuyeres in the bottom, and the operation should be repeated several times before pouring, in order to obtain a large volume of slag, which can then be easily removed, and to promote its separation by the stirring action caused by each new addition of metal.

The results of 15 trials at Hoerde, made in August and September 1890, showed that the sulphur in metal from the blast furnace, ranging between 0·27 per cent. and 1·20 per cent., was reduced to between 0·034 per cent. and 0·056 per cent. in the purified metal for the converter, the charges being from 10 to 14 tons each. The sulphur in the finished steel was 0·018 per cent. from a metal originally containing 0·352 per cent., and 0·025 per cent. from that with 1·20 per cent. The effect of spiegeleisen and ferro-manganese as ordinarily used for recarburising blown metal is somewhat similar, but is less advantageous, as being likely to unduly increase the carbon or manganese on the finished steel.

PATENTS.

Improvements in making Iron of any Quality, Pig Iron, Wrought Iron, Cast Steel, and Rough Steel. A. Dauber, Bochum, Germany. Eng. Pat. 9123, June 12, 1890. 8*d*.

The blast furnace is built with horizontal sets of tuyeres at different heights corresponding to the zones of preparation, of reduction, of carbonisation, of melting, and of maturation. No solid fuel is introduced with the burden except when lighting up, and then as the furnace gets into working order this fuel is replaced by gaseous fuel—"carbon in the gaseous state," superheated air and steam and finely powdered coal, all of which are introduced through compound tuyeres in proportions depending upon the zone into which they are injected, and on the condition of the furnace material at that zone. A set of tuyeres is placed round the hearth or "zone of maturation," through which the desired mixture of gases is blown so that the carbon may be reduced to yield any kind of iron or steel from "spiegeleisen with a high percentage of carbon down to mottled iron containing but traces of carbon."—A. W.

A Hardening Preparation to Harden Iron all through. H. A. van Vught, London. Eng. Pat. 10,940, July 14, 1890. 6*d*.

Ox hoofs and leather are soaked in French rot oil, and are then burnt, pulverised and mixed with sea salt and potash. The following proportions are used:—

30 per cent. of hoofs, 30 per cent. of leather, 30 per cent. of sea salt, 10 per cent. of potash.

This product is said to harden iron all through.—H. K. T.

Improvements Relating to the Manufacture of Steel. H. H. Lake, London. From La Société V. Sagramoso and Co., Milan, Italy. Eng. Pat. 11,877, July 29, 1890. 6*d*.

Extra hard steels containing chromium, tungsten, &c. are produced according to this invention from Bessemer or open-hearth metal, by adding to the molten steel in which the necessary degree of decarburisation has been attained, 2 to 3 per cent. of silicon spiegel and 0·05 to 0·15 per cent. of aluminium in the form of a rich alloy. This addition serves to deoxidise the metal and allows the ferro-chromium, tungsten, copper, manganese, or the like which may be added subsequently, to be completely incorporated with the metal. The proportions of ferro-chromium, &c. added are the same as those usual in the manufacture of similar steels in crucibles.—S. B. A. A.

Improvements in the Manufacture of Nickel. L. Mond, Northwich. Eng. Pat. 12,626, August 12, 1890. 6*d*.

This patent is based on the discovery that metallic nickel under certain conditions combines with carbon monoxide to form the gaseous product $Ni(CO)_4$ from which the metal can be easily separated. The action takes place in the presence of all other bodies, provided the nickel is in a finely-divided metallic state. Oxide of nickel obtained from the ores is reduced to the metallic state by heating it with hydrogen to about 350° C., or with carbon monoxide to 500°. The finely-divided metal so obtained is allowed to cool and at a low temperature—preferably 50° C.—a current of carbon monoxide is passed over it. This gas may be either pure or mixed with some other gases, such as hydrogen and nitrogen, as in producer-gas, but neither oxygen nor the halogens may be present. The carbon monoxide combines with the nickel and carries it off as a gas, which on being passed into tubes or chambers suitably heated, becomes decomposed with the reproduction of metallic nickel and carbon monoxide. The best temperature for this operation is between 180° and 250° C., because below this limit the nickel is not completely deposited and above it the metal becomes contaminated with carbon owing to its power of absorbing this element from carbon monoxide with the formation of carbon dioxide.

The gases can be used over again with advantage, since confining them to the one apparatus obviates any ill effects from the poisonous nature of the "nickel carbon oxide," and moreover any of this compound escaping decomposition in one operation would be saved in the next. The preliminary treatment of the ore is a simple roasting if the nickel is combined with arsenic and sulphur. If it is present as silicate or arsenate, &c. the ore is converted into a speise or matte which is then roasted to oxide.

Other means can be adopted for decomposing the nickel carbon oxide gas, such as mixing with it a hot inert gas or by passing it through hot liquids. It is not necessary that it be decomposed immediately, since it may, by means of a refrigerating apparatus, be condensed to a liquid and bottled. Or it may be absorbed in benzene, petroleum, tar-oils, &c., from which solution, as well as from the condensed liquid, nickel can at any time be separated by heating to the necessary temperature. In this way the metal is obtained free from all impurities, which are left behind, and is even separated from cobalt. After a time the nickel becomes less energetic in its action with carbon monoxide. It is only necessary then to reheat it for a little while to 350° in a current of the gas and to cool it down again, when its energy becomes restored.

The patentee uses an apparatus designed by himself and previously patented (this Journal, 1888, 833). It consists of two cylinders fixed one inside the other with an annular space between them and which turn round together. By projections and a helix the solid substance is made to travel along this annular space from one end of the cylinders to

the other while the gases pass in the opposite direction. A number of such cylinders are connected together in series, so that by the aid of transporting screws and elevators the solid materials as well as the gases can be passed from one to another in succession. In one series the reduction and revivifying is carried on while in another the formation of the metallic gaseous compound takes place. The gases are previously heated to the desired temperature in preference to applying outside heat to the cylinders. The nickel is deposited in tubes suitably heated, of which two sets are employed so as to enable the working to be continuous. The inner surfaces of these tubes are coated with graphite or loam to prevent the metal adhering, or there are introduced thin metallic sheets, bent so as to fit, inside the tubes, on which the nickel is deposited and from which it can be easily removed. "The nickel is thus obtained in coherent bright metallic masses of great purity quite ready for the market."—A. W.

Improvements in or connected with Apparatus for Making Steel. G. Rodger, Sheffield. Eng. Pat. 12,912, August 18, 1890. 6*d*.

In the open-hearth process the author divides the bed of the furnace into two or more parts by partitions built across it, and provides each part with a separate tap-hole so that separate baths of metal of varying qualities may be prepared in the one furnace.—A. W.

A New Product or Compound for Preventing the Formation of Pores in Molten Metals, and the Manufacture of the same. F. Burger, Hamburg, and R. Mannheimer, Berlin, Germany. Eng. Pat. 13,856, September 3, 1890. 4*d*.

This product, which is called "anti-porous," consists of a mixture of 100 parts of pure zinc, 2 of lead, and 2 of wax, and is prepared by melting the constituents together. When added to molten metal (gold or silver) it is said to prevent access of air and the consequent formation of pores by forming a layer on the top of the metal. The quantity used is 1 part of the mixture per 100 parts of silver or $\frac{1}{2}$ part per 100 parts of gold. The anti-porous compound is volatilised to such an extent that no injury is done either to the colour or nature of the metal.—H. K. T.

Certain New or Improved Metallic Alloys. F. W. Martino, Sheffield, and F. R. Martino, Birmingham. Eng. Pat. 14,768, September 18, 1890. 6*d*.

These are alloys for the manufacture of boring and cutting tools having a hardness equal to that of tempered steel, with the further advantage of not losing their hardness when heated by friction. The following alloy is suitable for the manufacture of boring tools such as drills, milling-cutters, rhymers, and the like:—

Pig iron	17·25
Ferro-manganese	3·00
Chromium	1·50
Tungsten	5·25
Aluminium	1·25
Nickel	0·50
Copper	0·75
Bar iron	70·50
	100·00

The following alloy is suitable for the manufacture of nail-cutting blades, cutting blades for machines, cutting-out tools, and the like:—

Pig iron	17·25
Ferro-manganese	4·50
Chromium	2·00
Tungsten	7·50
Aluminium	2·00
Nickel	0·75
Copper	1·00
Bar iron (Swedish)	65·00
	100·00

In making these alloys the pig-iron, ferro-manganese, chromium, and tungsten are melted together in graphite crucibles under stick charcoal and calcined borax, the tungsten and pig iron being preferably melted first. The alloy so produced is then remelted in clay crucibles together with the bar iron; and the nickel, copper, and aluminium are then added. The metal is this time covered with stick charcoal only. The above alloys are cast in sand moulds.—H. K. T.

A Process for the Recovery of the Tin and the Iron from Waste Pieces or Clippings of Tinned Sheet or other Iron or Steel. C. L. C. Bertou, Paris, France. Eng. Pat. 15,174, September 25, 1890. 6*d*.

A claim is here made for treating waste tin-plate with hydrochloric acid and a solution of potassium chlorate or sodium nitrate, under conditions alleged to be particularly favourable to the dissolution of the tin alone. The materials are used in the proportions indicated by the equations—

$$4\,Sn + 14\,HCl + NaNO_3 = 4\,(SnCl_2, HCl) + 3\,H_2O + NaCl + NH_4Cl$$

$$3\,Sn + 9\,HCl + KClO_3 = 3\,(SnCl_2, HCl) + KCl + 3\,H_2O$$

with the exception that hydrochloric acid is added in slight excess.

The nitrate or chlorate required for dissolving the tin from a ton of scrap is first dissolved in about 110 to 220 gallons of water, the hydrochloric acid added, the solution heated to a temperature between 30° and 50° C., according to the concentration of the liquids, and a first batch of waste introduced. It is essential not to heat the liquids at first above the temperatures given, and not to use an excess of reagents. When the first batch of waste is completely stripped, the residual iron is removed, more waste introduced and treated at a higher temperature. The metallic tin is separated from the liquors either by electrolysis or preferably by fractional precipitation with sodium or calcium carbonate, the oxide of tin being precipitated before any iron, zinc, lead, or copper in solution.—S. B. A. A.

Improvements in Machinery for Centrifugally Treating Particles of Metallic or Mineral-bearing Substances of different Degrees of Specific Gravity. O. B. Peck, Chicago, U.S.A. Eng. Pat. 673, January 13, 1891. 8*d*.

The object of this invention is to provide machinery in which the speed of the revolving vessel receiving the substance to be acted upon may be gradually decreased from a high to a diminished rate of rotation from the commencement to the end of the operation. This is effected by the use of tapered pulleys, spur wheels, and other contrivances acting upon the governor of the engine, the whole being automatically regulated, the result being that the heavier and more valuable particles of the material have been permitted to gradually accumulate in the receiving vessel instead of being thrown off and lost, as would be the case were the vessel rotated at one uniform rate of speed. For details of construction the two drawings accompanying the specification must be consulted. (See also Eng. Pats. 15,343, 15,348, and 15,349 of 1890; this Journal, 1891, 552—553.)—E. S.

Improvements in Mills or Machines for Grinding or Amalgamating Gold, Silver, and other Ores or Hard Substances. G. Fraser, Auckland, New Zealand. Eng. Pat. 2037, February 4, 1891. 8*d*.

This invention consists of an amalgamating pan in which the upper outer edge of the muller carries a removable shoe or ring on which a series of rollers are so mounted that they can revolve and grind against the muller, against one another, and against a wearing ring interposed between the muller and the lower sides of the mill bottom. The mill bottom slants outwards and downwards and at the lowest point communicates with a syphon pipe through which mercury is charged and amalgam withdrawn. Round the central axis above the level of the muller there is an arrangement consisting of an inner vertical frame and an outer frame in

the shape of an inverted cone, between which the overflow water rises and is conducted away. On commencing work the mill is half filled with water, mercury introduced, the muller raised about two inches from the bottom, rotated about 60 to 80 times per minute, and the ore previously crushed so as to pass through a half-inch mesh fed in. The centrifugal force of the revolving muller sets the rollers in motion and gives rise to an efficient grinding action: it further causes a separation of the gangue which passes upwards towards the centre of the mill and into the overflow, from the heavier particles which are driven to the periphery and there amalgamated.—S. B. A. A.

Improved Process and Apparatus for Alloying Metals. W. A. Baldwin, New York, U.S.A. Eng. Pat. 4695, March 16, 1891. 8*d*.

The apparatus consists of a furnace of the reverberatory type, on one side of the bed of which is a charging door, and on the other an aperture connected with a hopper. Through the former, molten metal, such as steel, is either run in from a cupola furnace by means of an inclined trough, or is ladled in, while through the latter is introduced the mixture of ores, &c. of the metal to be alloyed with the steel. In producing aluminium steel this mixture consists of clay, salt, and charcoal. The slag is run off through a hole in the side wall and the alloy is tapped by means of another hole under this one leading from near the centre of the furnace bed. These long holes or pipes are provided with doors on the outside of the furnace. There is also built in the roof, immediately over the bed, a small stack or up-take with a damper which is used for the purpose of drawing off the objectionable fumes when necessary.—A. W.

Improvements in the Treatment of Steel. W. B. Middleton, Lancaster, U.S.A. Eng. Pat. 4793, March 17, 1891. 4*d*.

This invention consists in impregnating Bessemer or other varieties of steel with silica, silicate of soda, or other silicates. The steel is preferably dipped into a bath of a saturated solution of silicate of soda containing as little soda as possible, heated and rolled or hammered. It is claimed that this treatment not only prevents the steel from deteriorating in quality during the reheating, but also effects a considerable improvement, low-grade Bessemer steel, for example, being converted by the operation into tool steel. The process may be applied with great advantage to scrap or waste steel.—S. B. A. A.

Improvements in the Art of Soldering Aluminium. F. J. Page and H. A. Anderson, Waterbury, U.S.A. Eng. Pat. 8881, May 26, 1891. 4*d*.

The inventors claim that surfaces of aluminium may be successfully soldered to each other, and to other metallic surfaces, by using silver chloride as a flux in conjunction with ordinary solder.

The pieces of metal, one or both of which are aluminium, are placed in the relative position required in the joint, finely powdered fused silver chloride spread along the line of junction, and solder melted on with a blowpipe or other device. The joints are thus easily and rapidly obtained, and become hard and perfectly sound on setting, and neither crack, flake, or check.—S. B. A. A.

Improved Apparatus for Use in the Manufacture of Lead Fibre. A. Torkington, Rotherham. From *N. K. Morris, Denver, Colorado, U.S.A.* Eng. Pat. 9143, July 4, 1891. 6*d*.

This is an improvement on the apparatus described in Eng. Pat. 15,904, of 1890. Lead issues from a vessel in which it is melted, through a pipe, the end of which is closed by a plug. This plug does not fit accurately owing to small grooves being filed in the edge of the aperture. The lead issues through these grooves and falls into water. The grooves are easily cleaned by removing the plug.—H. K. T.

XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

Determination of Rhodium, Mercury, and Gold by Electrolysis. E. F. Smith. J. Anal. and Appl. Chem. 1891, **5**, 200—201.

See under XXIII., *page* 798.

The Manufacture of "Alumina-Carbon" (Used in the Preparation of Aluminium and Aluminium Chloride). E. Wolfbauer. Chem. Zeit. 1891, **15**, 846—847.

The author recommends the following process for the preparation of the intimate mixture of carbon and alumina used in the manufacture of aluminium and aluminium chloride. Aluminium sulphate is dissolved in one-third of its weight of water, and the solution is mixed at 100° C. with finely-powdered wood charcoal (in quantity equal to one-third of the weight of the sulphate). The mixture is stirred until it forms a thick paste, which is dried at 70° C., and subsequently ignited to a cherry-red heat in a retort, air being excluded. The sulphurous acid which is given off is passed by means of pipes into heaps of moist clay, kaolin, bauxite, or other aluminous material, where it is absorbed. After some weeks or months the aluminium sulphate formed may be extracted by means of water and used for the preparation of further quantities of "alumina-carbon." If the "alumina-carbon" be intended for the manufacture of aluminium by electrical means, it is well to add more carbon and to mould the mixture into rods prior to ignition. The rods possess a considerable electrical resistance, which may be regulated to a nicety by varying the percentage of carbon and the dimensions of the rods.—H. T. P.

PATENTS.

Process for Effecting Electrolytic Deposit with Aluminium. S. Wohle, London. Eng. Pat. 9257, June 14, 1890. 4*d*.

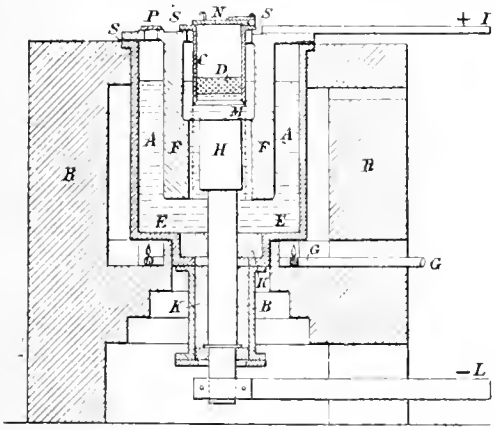
Two solutions are prepared. Solution A.—2 kilos. of ammonia alum in 10 kilos. of water. Solution B.—2 kilos. of pearlash, 8 or 10 grms. of ammonium carbonate, 10 kilos. of water. The solutions are mixed and the precipitate which forms washed. The precipitate is then boiled for half an hour with a second solution of alum to which has been added potassium cyanide (4 kilos. of alum, 2 kilos. of potassium cyanide, and 10 kilos. of water). 20 kilos. of water and 2 kilos. of potassium cyanide are next added, and the whole boiled for a quarter of an hour longer. The filtered solution is electrolysed—preferably at 80° to 120° F. —with aluminium anodes. If the deposit be dull the article should be dipped into caustic soda. The bath sometimes works better when allowed to stand some days before filtering, and when some aluminium scrap has been placed in it during the boiling processes.

Improvements in the Manufacture or Production of Zinc from Oxidised Ores of Zinc. T. Parker and A. E. Robinson, Wolverhampton. Eng. Pat. 12,432, August 8, 1890. 4*d*.

This is a process for the utilisation of the heat of the electric arc for the reduction of zinc ores. The ore, if a sulphide or carbonate, is first roasted and is then mixed with sufficient carbon in the form of charcoal, coke, pitch, or tar to effect its reduction and give a proper electrical conduction. When pitch or tar is used the mixture is submitted to a preliminary coking before being placed in the electric furnace. The furnace is similar to that described in Eng. Pat. 17,060 of 1889, and consists of a rectangular chamber in which the reduction is effected, the zinc vapours and carbonic oxide passing off by a pipe at the bottom or side of the furnace.—H. K. T.

Improvements in the Manufacture of Sodium and Potassium. H. Y. Castner, London. Eng. Pat. 13,356, August 25, 1890. 8*d*.

Fused caustic soda or potash at as low a temperature as possible is decomposed by an electric current. When the temperature is high the power of the bath to absorb both the metal and oxygen becomes very great, and practically no decomposition takes place. The material therefore should not be heated to a temperature higher than 20° above its melting point, and at the same time facilities should be given for the rapid separation of the liberated metal from the bath. The apparatus consists of an iron vessel A, mounted in brickwork R, in which the caustic soda is melted by heat supplied by means of the gas burner G. The vessel is provided by one or more base pipes or extensions B, adapted to receive the negative electrode H



Apparatus for the Production of Sodium and Potassium.

which is made of metal, the space K being filled with molten caustic, which becomes set and seals H in position. Above this electrode is suspended a tubular iron receptacle C, provided with a lid N and with a cylindrical piece of iron wire gauze M attached to its lower end. This gauze surrounds H and rests between it and F, the positive electrode. P is an opening for the escape of gas and for the insertion of a thermometer, and S is an asbestos or other insulating medium. The current is supplied through I and L.

The size of the electrodes and their distance apart should be in proportion to the quantity of current. If they be larger than necessary the elements will be subjected to a greater chance of being absorbed by the bath and recombining with a consequent waste of electrical energy. On the other hand, if they are too small the resistance will increase and the bath become overheated just at that part where an elevated temperature is most objectionable. When the decomposition takes place the liberated metal rises and floats on the surface of the caustic in C, whence it is removed by a finely-perforated spoon which allows the caustic to drain through while retaining the metal. Fresh caustic is added to the bath from time to time so that the process may be worked continuously.—A. W.

A New or Improved Solution or Composition for Charging Electric Batteries. A. Clark, Leeds. Eng. Pat. 3799, March 3, 1891. 4*d*.

For a battery, say of 10 volts, the inventor uses sulphuric acid 1 part to 6 of water, potassium bichromate "powdered to saturation," 10 per cent., ferrous sulphate, 10 per cent., sodium chloride varying from 25 to 50 per cent. and upwards, to which is added chromic acid or copper sulphate, in the proportion of from 5 to 15 per cent. according to strength of current required. By increasing or decreasing the quantity or proportion of the ingredients the power or efficiency of the battery can be regulated.—E. T.

XII.—FATS, OILS, AND SOAP MANUFACTURE.

On the Acidity of various Fats and Lubricants. R. Kissling. Chem. Zeit. **15**, 789.

The results of determinations of free fatty acid in 52 different commercial samples of oils and fats are given in terms of the equivalent percentage of monohydrated sulphuric acid. 20 samples of pure mineral oils contained traces not exceeding 0·015 per cent. As the quantities in the other samples varied considerably they are given below.

	Free Fatty Acid Calc. as H_2SO_4.
Mineral oils mixed with fats:—	
Russian spindle oil	0·035
Valvoline cylinder oil	0·060
Do. do.	0·100
Filtered American cylinder oil	0·058
Do. do.	0·084
Do. do.	0·095
Do. do.	0·315
Vegetable oils:—	
Olive oil (fresh)	1·500
Do. (old)	1·305
Raw colza oil	0·178
Do.	0·200
Do.	0·530
Refined colza oil	0·525
Linseed oil	0·710
Cotton-seed oil	1·070
Refined rosin oil	0·210
Animal fats:—	
Tallow	1·062
Do.	0·255
Do.	0·220
Do.	0·150
Do.	0·552
Do.	0·180
Bone oil	0·145
Neats-foot oil:—	
Pure white	0·940
White	1·915
Extra	1·950
Prime	3·630
No. 1	5·780
Prime lard oil	0·820
Do.	1·430
Extra	2·940
No. 1	4·000

—G. H. B.

A New Method for the Valuation of Lubricating Oils. J. Lew. Dingl. Polyt. J. 1891, **280**, 16—19 and 40—44.

One of the most important tests generally employed for determining the lubricating quality of oils is the viscosity test, for which several apparatus (notably that by Engler) have been introduced during the last few years. The author points out that although some viscosimeters give satisfactory results in regard to the relative viscosity of a material, they do not determine the absolute lubricating capacity. For this latter a determination of the internal frictional resistance becomes necessary. The internal friction of the lubricating material itself and the external friction of the liquid with solid bodies are the physical properties which influence the frictional resistance of solid bodies with their lubricants. According to the author, not sufficient attention has hitherto been paid to the fact that the internal and external frictional resistances are different and vary in different oils and at different temperatures. He deduces formulæ and describes a method by which these coefficients may be determined and used with great advantage in the valuation of oils for their lubricating properties. The author further gives tables showing the coefficients of internal friction of different oils at ordinary temperatures, and the changes which oils undergo in regard to these factors with varying temperatures. The

method of calculating, the formulæ, the apparatus for determining the internal friction, &c. cannot be adequately understood without the reproduction of the entire paper.

—K. E. M.

On the Quality of various Lards. C. Engler and G. Rupp. Zeits. f. angew. Chem. 1891, 389—391.

See under XXIII., *pages* 801—803.

Some Experiments on the Changes in Weight which Fatty Oils undergo on Exposure to Air. R. Kissling. Zeits. f. angew. Chem. 1891, 395—398.

Mulder, in his book "Die Chemie der austrocknenden Öle," gives the results from all former literature relating to the above subject. Since the publication of this book the following are the most important discoveries on the matter: O. Kirchner's (Ber. **21**, 101) discovery of some micro-organisms in poppy oil; O. Bach (Chem. Zeit. **13**, 905—906; see also this Journal, 1889, 990) uses the gumming property of oils for testing machine-lubricating oils, by heating the oil with pure oxygen in a sealed tube in an air-bath for 10 hours and noting the amount of oxygen absorbed. Tatlock (Zeits. f. angew. Chem. 1890, 559; this Journal, 1890, 374) finds that some fatty acids, when heated and exposed to air, lose weight, whilst others first gain then lose in weight, and he concludes that volatile oxidation products are formed. Ritsert (Chem. Zeit. **14**, 1509) finds that rancidity in pure lard is not caused by bacteria, since aerobic and anaerobic bacterii die when inoculated in pure fat, the latter preserving its freshness and not showing acidity when protected from light and air; nor is rancidity the effect of ferments, since sterilised fat which had been heated to 140° C. for several hours became rancid in a closed vessel under the influence of air and light. Rancidity is the result of oxidation under the combined influence of air and light; the presence of water is not necessary. K. Hazura has also published some interesting results on drying oils (Zeits. f. angew. Chem. 1888, 312 and 455; this Journal, 1888, 219 and 681; 1890, 807).

With a view to determine definitively whether the absorption of oxygen by drying oils is due to the presence of micro-organisms, the author has studied the oxidation of sterilised boiled linseed oil. The oil, whether sterilised by heating to 120° C. or by treatment with chemicals such as phenol, was found to absorb oxygen from air which had been entirely deprived of carbonic acid and water. The author concludes from this that the absorption of oxygen by drying oils is a purely chemical reaction, in which bacteria or organised ferments have no part.

In order to determine the quantity of oxygen taken up under varying conditions and by different oils, the following experiments were made:—

Equal parts of boiled linseed oil were exposed to the air in different vessels for 10 days:—

Gain in weight	Per Cent.
In a watch glass with 55 sq. cm. oil surface	3·10
In a beaker with 7 sq. cm. oil surface	0·39

The gain in weight would have been quite proportional to the surface area of the oil had the facility for the change of air, being dependent on the shape of the vessels, not been so different.

Crude linseed oil exposed to air and light for 10 days gained 1·05 per cent. in weight.

Crude linseed oil exposed to air and protected from light for 10 days gained 0·87 per cent. in weight.

Tables I., II., and III. show gain (or loss) in weight of different oils, 10 grms. of which, with a surface area of 55 sq. cm., were exposed to the air for 10 and more days at ordinary temperature.

Table I.

		Diff. in Weight of 100 parts in 10 Days.	Diff. in Weight of 100 parts in One Day.
1	Olive oil	± 0·0	....
2	Crude rape oil	+ 0·050	....
3	Refined rape oil	± 0·0	....
4	Refined neat's foot oil	+ 0·065	....
5	Cotton oil	+ 0·515	+ 0·100
6	Crude linseed oil	+ 1·130	+0·190—0·240
7	Boiled linseed oil	+ 3·490	+0·59 —0·44
8	Triolein	± 0·0	....
9	Refined rosin oil	− 0·825	....

All the oils lost in weight when first exposed to air, with exception of No. 9; however, they gained in weight, after one or more days' exposure. No. 11. Table shows how, after a time, the gain in weight becomes proportional to time of exposure until a skin is formed on the surface which interferes with further oxidation.

Table II.

No. of Days.	Gain (+) and Loss (−) in Weight of 100 Parts in One Day. Cotton Oil.	Crude Linseed Oil.	Boiled Linseed Oil.
1	− 0·010	− 0·625	− 0·03
2	+ 0·010	− 0·010	+ 0·30
3	+ 0·015	± 0·000	+ 0·40
4	+ 0·025	+ 0·030	+ 0·37
5	+ 0·030	+ 0·110	+ 0·42 Skin beginning to form.
6	+ 0·040	+ 0·140	+ 0·42
7	+ 0·055	+ 0·170	+ 0·41
8	+ 0·060	+ 0·180	+ 0·39
9	+ 0·080	+ 0·190	+ 0·33
10	+ 0·090	+ 0·200	+ 0·30 Skin complete.
11	+ 0·100	+ 0·210	+ 0·15
12	+ 0·095	+ 0·230	+ 0·05
13	+ 0·095	+ 0·240	+ 0·01
14	....	+ 0·250	+ 0·005
15	....	+ 0·270	....
16	....	+ 0·210	....
17	....	+ 0·220	....
18	....	+ 0·220	....
19	....	+ 0·230	....
20	....	+ 0·270	....
21	....	+ 0·260	....
22	....	+ 0·210	....
23	....	+ 0·210	....
24	....	+ 0·210	....
25	....	+ 0·180	....

TABLE II—*continued.*

No. of Days.	Gain (+) and Loss (−) in Weight of 100 Parts in One Day.		
	Cotton Oil.	Crude Linseed Oil.	Boiled Linseed Oil.
26	....	+ 0·150	....
27	....	+ 0·130	....
28	....	+ 0·090	....
29	....	+ 0·050	....
30	....	+ 0·030	....
31	....	+ 0·035	....
32	....	+ 0·010	....
33	....	± 0·000	....
34	....	± 0·000	....
35	....	+ 0·040	....
36	....	+ 0·020	....
37	....	+ 0·010	....
38	....	+ 0·012 Complete skin.	....
39	....	Skin partly removed	....
40	....	+ 0·090	....
41	....	+ 0·110	....
42	....	+ 0·040 New skin.	....

Formation of skin.

TABLE III.

	Changes in Weight of 100 parts after Exposure to Air for			Remarks.
	2 Days.	22 Days.	42 Days.	
Crude rape oil, fresh	+0·12	+1·08	..	Moderate skin.
Boiled linseed oil	+0·26	+0·97	..	Strong skin.
Refined rape oil	−0·13	+0·57	..	Moderate skin.
Crude rape oil, old	−0·14	+0·55	..	Do.
Refined rape oil, old	−0·10	+0·51	..	Do.
Crude rape oil, very old	−0·02	+0·42	..	Do.
Beef tallow	−0·01	+0·34	..	Do.
Crude linseed oil	..	+0·19	..	Strong skin.
German half ref. neat's foot oil	−0·23	+0·06	..	Moderate skin.
Cotton oil, old	−0·52	−0·43	−0·96	Strong skin.
American ref. neat's foot oil	−0·08	−0·40	−0·27	Moderate skin.
American ref. lard oil	−0·08	−0·56	−1·57	Do.
Olive oil	−0·15	−0·77	..	Slight skin.
German crude neat's foot oil	−0·67	−1·40	−1·66	No skin.
American crude lard oil	−0·21	−1·44	..	Do.
Russian min. machine oil	−0·83	−2·00	..	Do.
Triolein (techn.)	−0·53	−3·34	..	Do.
Refined rosin oil	−6·00	−17·20	..	Very strong skin.

From the following figures it is evident that when oils are exposed to air at higher temperatures the gain or loss in weight is different from that at ordinary temperature.

Gain or loss of crude linseed oil—

	Per Cent.
After heating to 100° C. for 6 hours	− 0·433
After heating to 100° C. for 12 hours	+ 0·162
After heating to 100° C. for 18 hours	+ 0·096
After further standing for 3 days in large desiccator	+ 0·090
After further standing for 10 days in the air and in darkness	+ 0·865
After further heating to 100° C. for 6 hours	− 0·734
After further standing for 8 days in the air and light	+ 0·836
After further heating to 100° C. for 6 hours	− 0·517
	&c.

This table further proves the volatility of the oxidation products.—K. E. M.

XIII.—PAINTS, PIGMENTS, VARNISHES, RESINS, INDIA-RUBBER, Etc.

Filtration of Shellac Solutions. E. Kressel. Chem. Zeit. Rep. 1891, **15**, 110.

WHEN commercial shellac is dissolved in alcohol several parts per cent. of insoluble bodies (wax, &c.) are left behind, which must be separated from the solution in order to prepare pure spirit-shellac. To effect this separation the turbid solution is placed in cisterns and a small quantity of carbonate of lead added. After standing 10—14 days the insoluble products are precipitated and the clear shellac solution can be drawn off. The precipitate, if made in sufficiently large quantities, can be employed in the manufacture of oil paints.—C. A. K.

PATENTS.

Improvements in or Relating to Varnishes or other Coatings. J. S. Fairfax, London. From F. Crane, New Jersey, U. S. A. Eng. Pat. 12,684, August 13, 1890. 6*d.*

"AN excellent varnish film especially suited for outdoor work exposed to salt water" is composed as follows:—

Amyl acetate, 50 galls.; spirits of turpentine, 25 galls.; methyl alcohol, 25 galls.; pyroxylin, 37½ lb.; shellac, 37½ lb. —E. G. C.

An Improved Elastic Cement for Fixing Cycle and other Tyres. W. Sheppard, Chesterfield, and E. Simpson, Mansfield. Eng. Pat. 13,392, August 26, 1890. 4*d.*

THIS cement consists of tallow 4 parts, resin 4 parts, and glue 1 part.—E. G. C.

A Process for Bleaching Ground Cork. F. Walton, London. Eng. Pat. 14,829, September 19, 1890. 4*d.*

THE ground cork used in the manufacture of linoleum, &c., is, according to this invention, bleached as follows:—A bath is prepared of dilute nitric acid (5 to 10 per cent.) and heated to boiling. Whilst boiling, the ground cork is introduced in successive small quantities and the bath well agitated. The cork, on the expulsion of air from it, sinks in the bath, but after a time rises, whereupon a little cold water is added, which causes the cork to sink again. The boiling is then resumed and continued for half an hour, at the end of which time the bath is allowed to cool, the liquid strained off the mass of cork, and the latter washed with water. The washed cork is next treated with bleaching powder and sulphuric acid "in the same manner as for the bleaching of paper pulp," and, after again straining and washing, is pressed and dried.—E. B.

A New or Improved Method of Cleaning, Treating, or Preparing Kauri Gum for the Market. J. C. Firth, Auckland, New Zealand. Eng. Pat. 17,009, October 24, 1890. Amended April 25, 1891. 4*d*.

THE pieces of Kauri gum are prepared and treated by being submitted, firstly, to the action of bristles of steel or other suitable material, mounted on discs or cylinders, to which a reciprocative, circular, or other motion is imparted, and, secondly, to friction against revolving felt-covered discs.

* The claim is unaffected by the emendation, which consists in adding that the bristles of the abrading tools may be made of "*other suitable material*" besides steel.—E. G. C.

Improvements in the Preservation of Wood and Iron Imbedded or Buried in the Earth. R. A. Chesebrough, New York, U.S.A. Eng. Pat. 6389, April 14, 1891. 4*d*.

THIS inventor dips the wood or iron in melted ozokerite, the coating of which is stated to have been proved, by actual tests and experiments, to be absolutely proof against moisture, alkaline and acid solutions, the attacks of insects and worms, &c.—E. G. C.

XIV.—TANNING, LEATHER, GLUE, AND SIZE.

PATENTS.

Improvements in the Treatment of Skins and Hides for the Preparation of Leather. H. Belcher, Wantage. Eng. Pat. 14,943, September 22, 1890. 4*d*.

THIS invention is for preparing hides and skins for tanning by immersing them in dilute sulphuric acid. The strength of the acid solution used will depend on the character of the hides, but the ordinary proportion is ½ lb. of acid to 35 gallons of water. The inventor states that the dilute acid removes the animal matters and the lime used for unhairing which resist the action of the tanning process.—B. H.

Improvements in Apparatus for Treating or Preparing Leather. A. A. Hunting, Salem, U.S.A. Eng. Pat. 7734, May 5, 1891. 11*d*.

THIS invention relates to a machine by which partially-tanned leather may be stretched without detriment to its strength, and compressed at the same time to make the fibre denser, so that when "split," a side of leather having a substantially uniform thickness and density is obtained, which "plumps" uniformly during the subsequent completion of the tanning process. The specification is unsuited for abstraction and would be unintelligible without the accompanying drawings.—B. H.

An Improved Embossed Composition Fabric. A. M. Clark, London. From The Fantasote Leather Company, Passaic, U.S.A. Eng. Pat. 9769, June 9, 1891. 6*d*.

THE improved fabric consists of four thicknesses, the "foundation" being stout, heavy, and coarsely woven cloth. Upon this foundation cloth is spread a thick layer of gum composition. This gum composition may be any well-known gum compound used for making artificial leather or unvulcanised india rubber, gutta percha, or similar substance, and is spread in quite a considerable thickness while in a plastic state over the cloth. Upon the surface of the gum composition is spread a cloth which is preferably much finer and more closely woven than the foundation-cloth. Upon this second cloth is spread a very thin layer of gum composition which hides the grain of the cloth. The fabric is next embossed by means of a suitable tool and has the appearance of natural leather, is waterproof, and cannot be stretched out of shape.—B. H.

XV.—MANURES, Etc.

Thomas-Slags. Stoklasa. Chem. Zeit. **15**, 543—544, and 563—564.

A GREAT many experiments with Thomas-slags, to ascertain their value as a fertiliser, have been made and recorded, but in the author's opinion they are not of much value, as they have been made with slags of various origin and composition, or different physical structure. The climatic conditions have also greatly varied. To get reliable comparative results, experiments extending over five years with chemically pure preparations have been made by the author.

The chief forms of phosphoric acid (P_2O_5) in concentrated manures are mono-calcium phosphate, free phosphoric acid, di-, tri- and tetra-calcium phosphates. The manuring experiments were carried out according to the modified process of Paul Wagner, and various kinds of soil (humus, clay, lime, sand) were used. Barley was the crop sown. Artificially prepared soils are manured with nitrate of potash, also with the same quantity of phosphoric acid in its various forms. The period of vegetation extended over 55 days. The results given in a table plainly prove that:—

In a humus soil a certain quantity of the phosphoric acid, in the form of a tetra-calcium compound, acts like the same amount of the acid in the mono- or dicalcium phosphate. The more "*Matière noire*" the soil contains, the more valuable the tetra-calcium phosphate becomes.

Experiments made in Bohemia on soils rich in humus have also proved that, in the case of wheat and beet, 1 kilo. of soluble phosphoric acid from a superphosphate has the same effect as 1 kilo. of active phosphoric acid (viz., soluble in citric acid) from a Thomas-slag.

The experiments with Thomas-slags as a manure for clay soils were made both in March and October. Barley was again used. From the results (communicated in two tables) the author draws the following conclusions:—

(*a.*) The action of the Thomas-slags is dependent on the amount of *Matière noire*, which not only retains moisture, but contains both ulmic and humic acids which decompose the tetra-phosphate.

(*b.*) If the soil contain more than 3 per cent. of *Matière noire* of humus soil, Thomas-slags may be advantageously used for summer crops, provided they are ploughed in the month of March. If one wishes to get the same results with the slags as with a superphosphate, it is best to use of its active phosphoric acid, say 75 instead of 50 kilos. per *hectare*. If the soil be poor in *Matière noire* even 100 kilos. must be used.

(*c.*) The autumn manuring with Thomas-slags for winter crops in soils rich in *Matière noire*, is very successful when from 75—100 kilos. of active phosphoric acid are used. The slags must be either ploughed or harrowed in.

(*d.*) In lime or sandy soils which contained less than 0·75 per cent. of *Matière noire*, the author found even 100 kilos. of active acid per hectare to be insufficient.

Very interesting results were obtained with slags which had been treated with sulphuric acid of 1·532 sp. gr. Although the product contained scarcely any soluble phosphoric acid, it still proved superior to the untreated slag, as it raised the produce of beetroots from 40,152 to 50,214 kilos. It was, however, inferior to superphosphate. The author finally suggests that in judging the commercial value of the slags, the analyst should be only guided by the percentage of *active* phosphoric acid, viz., the acid soluble in citric acid solution. To carry out the analysis, 2 grms. of the finely-powdered sample are treated with 200 cc. of solution of citric acid (1:2) for two hours, with constant stirring on the water-bath. The filtrate is then made alkaline with excess of ammonia and precipitated with magnesia mixture.—L. de K.

PATENT.

Improvements in Reducing or Disintegrating Apparatus more especially intended for Disintegrating Superphosphates and other Similar Substances. P. U. Askham and W. Wilson, Sheffield. Eng. Pat. 11,474, July 22, 1890. 8*d*.

See under I., *page* 749.

XVI.—SUGAR, STARCH, GUM, Etc.

Determination of Ash in the Products of the Sugar Manufacture. E. Donath and G. Hattensaur. Chem. Zeit. 1891, **15**, 520.

The authors have attempted to determine the ash in raw sugar, molasses, &c. directly by mixing the sample with a weighed quantity of powdered pumice, ignited alumina, magnesia, or copper oxide previous to combustion, but without satisfactory results. Better results are obtained by first carbonising the sample, then heating it at the lowest possible temperature in a mixture of air and oxygen and finally in pure oxygen. The ignition is best conducted in a platinum crucible with a small shallow platinum dish with perforated bottom fitting inside, and covered by a perforated lid. The perforated dish serves to distribute the entering gas which would otherwise act more energetically upon the substance in the centre of the dish.—S. B. A. A.

The Manufacture of Rice Starch. J. Berger. Chem. Zeit. 1891, **15**, 843—844.

In the present paper, which forms an addendum to a previous communication (this Journal, 1891, 152—154), the author enters more fully into the improvements he has suggested in the manufacture of rice starch. The great importance of the preliminary softening of the rice with a solution of caustic soda is again pointed out. The precise action of the soda has been misunderstood by most rice starch manufacturers. Many of them have been satisfied to look upon the process as a merely mechanical one; whereas in reality the action is purely chemical. The soda dissolves the albuminous substances which cement the starch-cells together and thus renders them amenable to the after-processes. It is advisable that the solution of the rice-proteins, *i.e.*, the softening process, be carried out as quickly as possible in order to prevent fermentation, which is especially liable to occur in warm weather. The method at present most commonly employed is not at all adapted to serve this end. The rice and soda-lye are allowed to stand in contact for considerable periods of time, the mixture being in some cases occasionally stirred. This stirring is practically useless. In order to get the best results the soda solution should be made to circulate through the rice; and it would need but little alteration of existing plant to effect this desirable object.

There is at present very little chance of some better and cheaper reagent than soda being found. Lime, baryta, and strontia certainly exert a slight solvent action on the albuminoids of rice; but in practice large amounts of these bodies are required to effect a useful softening of the rice; and it is afterwards necessary to remove that portion of the base precipitated as carbonate from the starch by means of an acid. Finally, baryta and strontia are dear, and above all, poisonous. Potash and soda are about equal in their solvent action on the proteins of rice, but ammonia is distinctly less effective. Still, if *softening* of the rice be the only object sought for, ammonia might possibly be used with advantage. Ammonia dissolves comparatively little protein, but it may be employed in much more concentrated solution than soda without damaging the starch, so that a rapid softening of the rice may be obtained. From the waste liquor the ammonia may be readily recovered by distillation and used over again. At the same time the proteins held in solution by the ammonia in the waste liquor will be precipitated when the latter is distilled. When soda is used the addition of acid is required to precipitate the albuminoids. In practice, however, the separation of the proteins from the starch must be made the primary consideration; and in this direction soda is much superior to all other substances. Of course, even soda does not dissolve the whole of the albuminoids contained in rice, and it is doubtful whether a reagent to do this will ever be discovered. But it is of interest to know that the greater part of the protein remaining after treatment with soda may be rendered soluble by fermentation. The author is of opinion that a method involving this fact might be of value.—H. T. P.

PATENTS.

Improvements in Saccharate of Lime. W. R. Hutton, Partick. Eng. Pat. 10,449, July 5, 1890. 4*d*.

The saccharine body is dissolved in water, an excess of slaked lime added, and the mixture boiled. The proportions recommended are 100 parts by weight of sugar to 15 parts by weight of lime. The claims are:—"1. The manufacture of saccharate of lime, as a liquid or a solid, of fixed chemical composition. 2. The manufacture of saccharate of lime of fixed chemical composition, being a new commercial compound.—A. J. K.

Improvements in the Treatment of Molasses or Syrup for the Purpose of Improving its Flavour. J. Duncan, Selby. Eng. Pat. 11,473, July 22, 1890. 4*d*.

In the treatment of molasses or syrup by sulphate of alumina or sulphuric acid, the weaker acids, such as acetic and hydrochloric acids, which have been replaced from their combinations by sulphuric acid, are still left in solution in the syrup, and impart to it a disagreeable taste. They may be removed as follows:—The acid mixture, diluted to 17° B., is evaporated in vacuo or in an open pan to 29° to 30° B., being exposed, in the latter case, during evaporation to a current of air, carbonic acid, or some other gas, which is forced through the syrup by a Korting's or other injector. The vapour given off in this operation contains acetic acid and other volatile impurities. The syrup is now neutralised, filtered and refined in the usual way.—A. J. K.

Improvements in the Treatment of Phosphoric Acid for Facilitating its Storage and Transport. B. E. R. Newlands, London. Eng. Pat. 13,863, September 3, 1890. 6*d*.

Phosphoric acid, in a more or less pure condition, is now largely employed in the manufacture and refining of sugar, but the forms in which it comes on the market are open to objection. When in solution it is difficult to pack for shipment, and in the form of superphosphate it is mixed with a very large proportion of calcium sulphate, which is very objectionable to add to sugar solutions. The inventor avoids these difficulties by incorporating syrupy phosphoric acid with kieselguhr or infusorial earth, which absorbs more than twice its weight of phosphoric acid of sp. gr. 1·750, with the production of a powder which is perfectly dry to the touch and can be packed in wooden casks or iron drums. As the kieselguhr consists only of silica, its addition to sugar solutions is free from objection.—G. H. B.

Process for the Defecation of Sugar-Cane Juice. H. H. Leigh, London. From W. V. Fry, Lambayeque, Peru. Eng. Pat. 581, January 12, 1891. 11*d*.

The juice is defecated with a decoction of the leaves, twigs or other of the smaller growths of the *Eucalyptus*. For this purpose 35 lb. of the eucalyptus growths are boiled with 50 gallons of water for three hours or until the liquor

measures 15° Cartier when hot, or from 9° to 10° when cold. (Degrees Cartier × 1·0666 = degrees Baumé.) After straining, the liquor is ready for use, and is used in the proportion of 1½—2 gallons to 500 gallons of sugar juice. After boiling for about 10 or 12 minutes the juice may be filtered by any of the usual methods. The defecant is non-poisonous, and in tropical countries is cheaply and easily obtained.—A. J. K.

XVII.—BREWING, WINES, SPIRITS, Etc.

The Analysis and Judging of Cognac. "Chemiker Verein" in Hamburg. Chem. Zeit. **15**, 463.

Before the February meeting of the society, Langfurth read a paper on "The Analysis and Judging of Cognac." The analysis of cognac is simple enough, and approaches to that of wine. It includes the determination of the specific gravity, alcohol, extract, free acid, fusel oil, nature of colouring matter, and cane and invert sugars. But when it is required to form an opinion from the analytical results as to the genuineness of a sample of cognac, a great difficulty is encountered in the fact that the definition of "cognac" is so exceedingly vague. At the present day cognac is no longer the pure distillate from wines grown in the Charente and Charente Inférieure districts, but consists of "raw cognac" distilled from wine, no matter of what origin, mixed with more or less grain-spirit. Raw cognac, *i.e.*, pure wine distillate, costs from 25—30 marks per litre, and is only employed in the preparation of the finer varieties of commercial cognac. The colour of fine cognac is produced by storing the spirit in casks of oak or ash. The cheaper kinds are coloured with caramel or an extract of raisins or plums. Old white wine is also sometimes added, the process termed "adoucissage" being used chiefly in order to remove the hard flavour which new cognac sometimes possesses, and which would otherwise only disappear after years of storage. The alcohol percentage of finished cognac steadily diminishes during cask storage, so that old cognacs contain less alcohol than new. In fact, according to Fresenius, a certain well-known French firm sends out cognac containing only 25—30 per cent. of alcohol by weight. It is evident, therefore, that analysis is practically useless for detecting an adulteration of cognac, *i.e.*, excessive dilution with other spirit. As regards artificial cognac prepared from potato spirit, caramel, water, and essence of cognac, the matter is different. Such mixtures may be recognised by testing for certain constituents of genuine cognac, such as aldehyde, furfurol, amyl alcohol, &c. These bodies never occur in artificial cognac. Nevertheless it is quite possible that in course of time the manufacturers of such spirit will learn to add these substances artificially, but for the present the author considers the process of value.

Before the March meeting of the "Chemiker Verein," Wagner described various methods for the estimation of tannins in wines, and states that in his opinion Lowenthal's process is the most suitable.—H. T. P.

Influence of Wines on Peptic Digestion. L. Hugounenq. Bull. Soc. Chim. 1891, **5**, 849—855.

The author has investigated the influence on peptic fermentation of the various substances present in wines. The experiments were made by placing in a flask 5 grms. of fibrine, 0·05 to 0·1 grm. of pepsin, 0·05 to 0·15 grm. of hydrochloric acid, and 50 cc. of the solution or infusion under examination, and keeping at a temperature of 38°—40° until a sample on being tested with acid gave no precipitate, a comparative test, in which 50 cc. of distilled water replaced the 50 cc. of the solution, being simultaneously made. The conclusions arrived at are as follows:—

1. All kinds of wine, without exception, hinder the action of the pepsic ferment, those which contain most alcohol, cream of tartar, and colouring matter being most injurious in this respect.

2. The natural colouring matters contained in wine act in conjunction with the alcohol and cream of tartar in hindering or preventing pepsic action.

3. The acidity of natural wines does not in general assist pepsic action.

4. Of the coal-tar dyes employed for artificially colouring wine, Methylene blue, Azoflavine, Spirit induline, and, above all, Magenta, oppose the action of the pepsic ferment, as also do the vegetable colouring matters derived from black mallow, elderberries, and "maki."

5. The treatment of wines with plaster of Paris (plâtrage) causes the removal of a substance which hinders pepsic digestion *in vitro*, digestion being more rapid in the presence of "vins plâtrés" than in that of wines not so treated.

—E. B.

The Analysis of Top-Yeast in Breweries and in Distilleries by Hansen's Method. A. Jörgensen. Zeit. f. d. ges. Brauw. 1891; **14**, 45.

A long series of trials under varying conditions have shown that Hansen's system of testing yeast applies to top yeast as well as to bottom yeast. Also the experience of the author goes to show that one is able to isolate a product characterised by special purity both as regards smell and taste by making a careful and systematic choice of the most suitable top yeast. It is always dangerous to employ mixtures of different top yeasts both in breweries and in distilleries. All top yeast shows a tendency to form more numerous and stronger spores than is the case with cultured bottom yeast, and in all cases there is at least one temperature more favourable to the growth of the crude top yeast than to the corresponding cultured product. Since a considerable number of cultured top-yeasts develop spores on blocks of gypsum at 25° C. in about the same time that the crude products do, a temperature of 15° C. is recommended for their culture, when they develop considerably more slowly than the crude top-yeasts. In cases where there is a difference of only half a day or a few hours in the time of development, a temperature of 12° C. is chosen, when the difference in the time of development becomes more marked, thus allowing the analysis to be made with ease and safety. The spores of the crude top yeast, when young, are clear and homogeneous, with an indistinct wall; those of the cultured top-yeast are less clear and homogeneous, larger, and have, as a rule, a well-defined wall. These differences are chiefly of value when it is not found possible to separate the products by means of the differences of temperature as described above.—C. A. K.

Testing the Keeping Power of Beer. H. van Laer. Station Scientifique de Brasserie, 1890, 72.

The author has examined 15 samples of beer from different countries with a view of testing their keeping qualities. The results arrived at are as follows:—(1.) That the behaviour of the beer at the brewing temperature (25° C.) gives a good indication of its keeping power, due regard being paid to the thickening of the sample. (2.) It is necessary to examine average samples of a cask either by filling several glasses with the beer or by taking the same quantity of liquid from the top, middle, and bottom of the cask. (3.) In taking the samples care must be observed not to allow the liquid to come into contact with the air.—C. A. K.

Method of Detection of Sugared Wine in Natural White Wines. Sochaczewski. L'Union Pharm. 1891, **32**, 209.

The method is based on the assumption that wines made from sugar contain larger quantities of colouring and fermentative matters than the natural wines. 20 cc. of the sample are treated with 1·5 to 2 grms. of sodium bicarbonate. The alkaline reaction causes a change of colour, but the solution remains clear in the case of a pure natural wine. With a sugared wine there is no decided change at first, but after several hours the solution becomes cloudy and discoloured, and gradually a very voluminous precipitate forms.—G. H. B.

Experiments in Mashing with Sodium Sulphite and with Acid Calcium Sulphite. G. Heinzelmann. Zeits. f. Spiritusind. 1891, **14**, 95.

According to Brauer (Chem. Zeit. Rep. 1890, **14**, 368), when sodium sulphite is made use of as an antiseptic in mashing, a very marked smell of sulphurous acid is noticeable towards the end of the mash, and the worms of the fermenting vats are in the course of time attacked by the fumes evolved. These observations are not substantiated by the author, who noticed, however, a distinct smell of sulphuretted hydrogen when using sodium sulphite. Parallel experiments made in four distilleries with and without sodium sulphite showed in almost all cases a better fermentation, and consequently better yield, when the antiseptic was used. Acid calcium sulphite behaved similarly to sodium sulphite. The resulting alcohol was free from sulphurous acid and from sulphuretted hydrogen, nor was any smell of the latter noticeable during fermentation. Details of a number of experiments are tabulated. The antiseptic was not found to decrease the acidity of the fermentation in all cases, notably when potatoes were used; the cause of this lies in the large proportion of acid contained in the sweet mash from such products. With mashes of this nature an antiseptic, even hydrofluoric acid, is of little value.—C. A. K.

On the Capacity of Antiseptics to hasten Alcoholic Fermentation. E. Biernacki. Arch. f. Physiol. 1891, **49**, 112.

The results of this research point to the conclusion that all antiseptic substances possess the property, under certain conditions, especially in small quantities, of assisting and hastening the alcoholic fermentation, and this property is the more decided in the stronger antiseptics. The action is more marked in the organic than in the inorganic substances. The antiseptic power of organic bodies seems to be proportional to their richness in carbon, and inversely proportional to the number of hydroxyls (OH) in its constitution. Combination between the substances increases the antiseptic power, and this effect is most marked in combination between organic and inorganic antiseptic substances.—G. H. B.

On the Action of Finings. C. G. Matthews and F. E. Lott. Trans. Inst. Brewing, 1891, **4**, 201—216.

Finings were made with solutions containing equivalent quantities of sulphurous, acetic or tartaric acid; sulphurous acid "cut" the isinglass quickest and the resulting finings kept best; there was little difference between the acetic and tartaric acid finings except that the former kept slightly better. The quantities giving the best finings were found to be $2\frac{1}{4}$ lb. of Russian isinglass cut with 7 galls. of 0·72 per cent. sulphurous acid, and made up to 36 galls.; finings thus made were used in most of the experiments here described.

Lactic acid cuts isinglass better than acetic acid, so when sour beer is used, lactic acidity is most effective.

Isinglass appears to exist in finings in true solution, as when diluted it is not precipitated and will then pass through filtering paper.

When finings are made slightly alkaline, precipitation occurs, the precipitate sometimes rises in the solution, but after a time contracts and sinks, owing to increase of density produced on contraction.

The density of isinglass is about 1·3, rolled samples are slightly denser.

The actual cause of the precipitation of finings in practice appears to be the presence of suspended matter. Cooler grounds, beer grounds, yeast, clay, powdered glass, &c. when suspended in water will each cause the precipitation of finings. The grey drainings of brewers' grains, or a perfectly bright beer, will not take finings, solutions containing bacteria will not "fine" easily, and even if the bacteria are carried down they will most probably work their way out again.

With regard to bodies actually in solution, it was found that alcohol promotes the action of finings, sugar and dextrin have no effect, caramel causes the precipitation of finings and at the same time is itself partly precipitated.

Hop gallo-tannin is only present in beer in minute traces, and its effect on finings may be neglected, except perhaps in the case of "dry hopping." Water containing hop resin in suspension took finings readily. Hop oil diffused through water had no effect on finings, but if other matter be present which will precipitate finings the hop oil will be cleared out if the globules are not very small. Carbonic acid hastens the action of finings. The fining action was assisted by the presence of 0·4 per cent. of acetic acid and retarded by 0·2 per cent. of lactic acid.

Finings added to beer cooled below 40° F. separated in a bulky form and left the beer turbid. If finings have been heated they will not fine beers.

The conditions that are favourable to fining are, dry hopping, presence of suspended matter in beer, especially with hop resin attached to it, alcohol, carbonic acid at low pressure, normal acidity, soluble hop derivatives, and a rising temperature.

The unfavourable conditions are, unusual fineness without brilliancy, flatness, greyness, presence of bacteria, abnormal secondary fermentation, excessive acidity, excessive quantity of suspended yeast.

The authors consider that finings are best made with tartaric acid and a little sulphurous acid subsequently added, or with sulphurous acid alone, and the best isinglass; and that 1 pint containing $\frac{1}{5}$ oz. isinglass should fine a barrel of beer.—A. L. S.

PATENTS.

Improvements in or relating to Distilling Apparatus for Spirits and the like. W. P. Thompson, Caracas, Venezuela. Eng. Pat. 10,436, July 5, 1890. 11*d*.

The objects of the apparatus are to economise fuel, to distil two distinct spirits at one and the same time, and to produce a pure spirit of high proof.

Fig. 2 shows an improved furnace setting for the retort, especially useful when the fuel is "cane or wood trash." The cavities A^1 are to retain ashes which may have been carried into the flues A^2.

Fig. 1 is an elevation, partly in section, of the entire apparatus. A is the retort, *a* the still head, B the rectifier, D the "vapour still," which is heated by the coil D^7 and fed from the tank E by the pipes E^1 and E^2. The rectifier communicates by a pipe G with a condenser H, situated in a water-tank F. The condenser is connected with a similar condenser J in a tank J^1. K is a third condenser placed in a tank K^1, which is in communication with the vapour still by a pipe K^2 which passes through the tank F. Cooling water is supplied to the tank K^1 by a pipe K^4, and overflows through the small holes K^5 into the dish K^6; thence into the tank J^1, and from this into the tank F, and thence to waste by the pipe F^1.

The vapours issuing from the condensers J and K are conducted by the pipes L and M through the wash heater P to the special condensers N and N^1 and the cooling worms Q^1 and Q^2; these are placed in a cold water tank Q. Each condenser consists of an outer vessel *n*, having within it a similarly shaped vessel n^1 (Fig. 3). The vapour enters at n^2, passes between the two vessels, through the holes n^3 into the interior of the inner vessel, and thence by the outlet n^4 to the worms Q^1 and Q^2 (Fig. 1). When the apparatus is to be employed for carrying on two simultaneous distillations, the retort is charged with fermented wash, the rectifier with low wines and the vapour still with spirit which is to be rectified. At the commencement the water tanks J^1 and K^1 should be supplied with some water, but the full supply should not be turned on until the distillation has commenced. When the liquor in the retort commences to boil the vapours are condensed in the worm D^1 or the tube G until the spirit in the vapour still is raised to a sufficiently high temperature, when it commences to boil, and the more volatile vapours pass through the condenser K to the condenser N^1 and worm Q^2, where they are condensed. The more volatile vapours from the retort then pass through the rectifier B and the condensers H and J to the condenser N

Fig. 1.

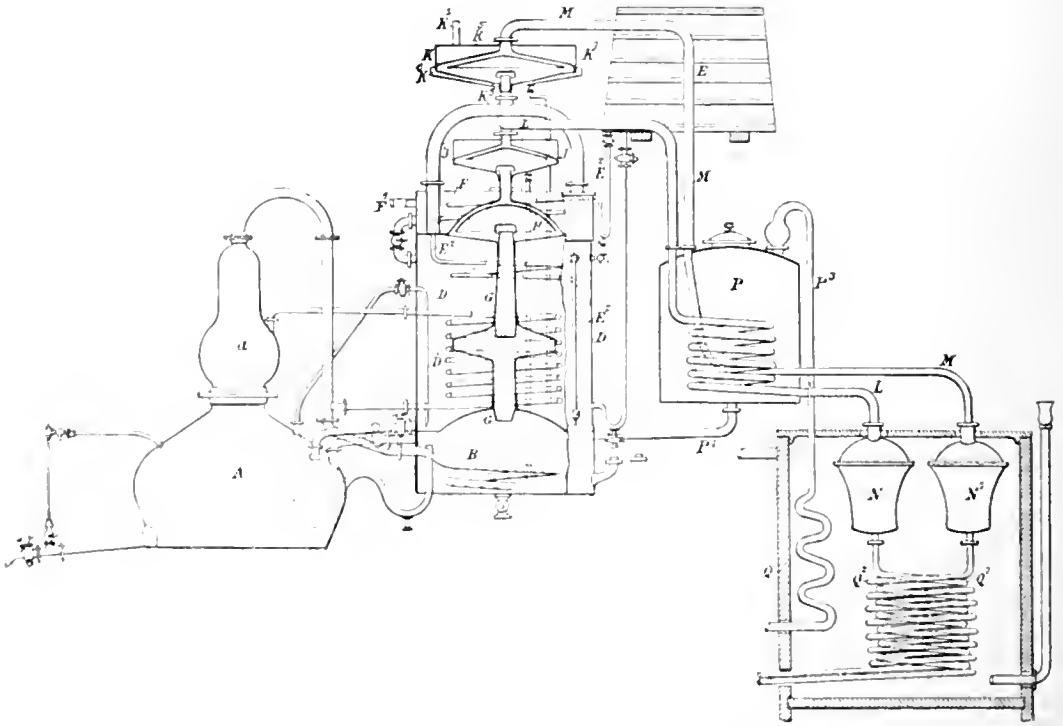


Fig. 2.

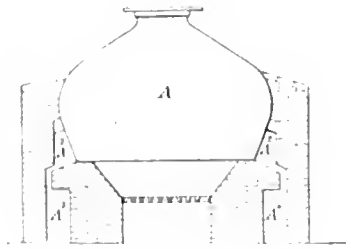
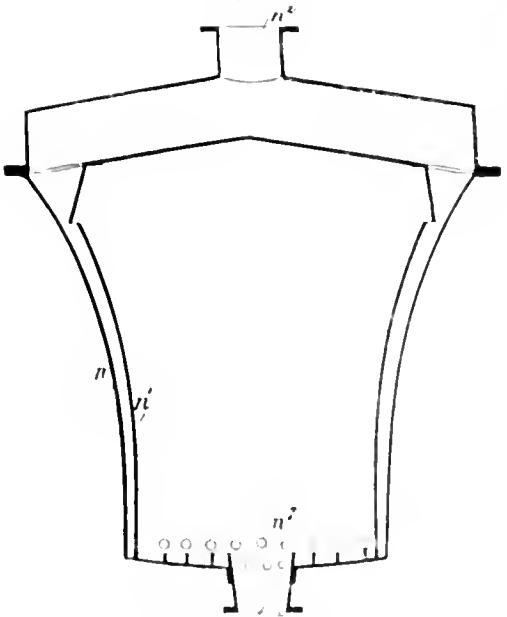


Fig. 3.



and coil Q1, where they are condensed. To make the operation continuous the retort is kept supplied from the wash heater P by the pipe P1, and the vapour still from the tank E by the pipe E2. When the vapour still only is employed the retort and rectifier is charged with water.

If the retort be charged with spirit, the strength of the spirit should be reduced to at least 15 Cartier (15° Cartier = 1·066 = 15·99 Baumé). The apparatus may also be used to produce one spirit.—A. L. S.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

(A.)—CHEMISTRY OF FOODS.

Honey Testing. E. Dieterich. Helfenbergen Annalen, 1890, 50.

See under XXIII., *page* 799.

The Present Commercial Importance of Saccharine and the Attitude of the Beetroot Industry with Reference to the Exemption of this Substance from Taxation. F. v. Thumen. Chem. Zeit. 1891, **15**, 634—635.

This is a reply to certain remarks made on the above subject by v. Lippmann and Maercker at the meeting of the "Central Agricultural Association" of the province of Saxony, held at Halle on the 19th December 1890, and which were published in the February number of the Journal of the Association.

Fahlberg's saccharine being "300 times as sweet as sugar," it seems at first plausible to suppose that each kilogramme of the former would replace 300 kilos. of the latter on the market. This, however, is not possible since the quantity of sweetening material used by mankind has practically no limit. Even if it were the case, the European sugar industry with its factories which number considerably over 1,000, could

receive but little injury from a product of which the whole world's supply emanates from a single factory. Von Lippmann has asserted that the quantity of saccharine manufactured is equivalent to 240,000 ctrs.; whilst Maercker places it at 600,000 ctrs., and both are of opinion that the German sugar manufacture is injured to this extent. These numbers are quite fallacious and exaggerated, and the fact that the greater portion of the saccharine manufactured in Germany is exported is not taken into account. von. Lippmann and Maercker then refer to the noxious effects of saccharine on the human system, citing the investigations of Stutzer and Stift; the experiments of the latter were, however, only made in the laboratory and not on living organisms. They also quote the article published by Worms of Paris. Kornauth has recently made an extended series of experiments with pigs, dogs, and ducks, very large quantities of "saccharinum purum" being administered, and he comes to the conclusion that the substance has neither a noxious effect on the system nor decreases the digestibility of the food in the least; he finds also that the aversion which, according to Stift, animals have towards saccharine is by no means general and only occurs in individual cases, being probably analogous to the aversion which many persons have towards certain foods. Numerous experiments with human beings extending in some cases over several months have led to the same result. The conclusions drawn from the investigations of Leyden, Gerhardt, Rüger, Polatschek, Jessen, Zerner, and Petschek also agree in the main with the last-mentioned.

Saccharine is not a food material, and has never been put forward as such. Maercker objects to the use of a poisonous compound such as phosphorus trichloride in the manufacture of saccharine, this being forbidden by the food laws. His remarks seem however to be directed to the general public, who are unaware that the phosphorus trichloride is subsequently removed.

The statement made by the experts on the commission of the last edition of the German Pharmacopœia which has been interpreted by those interested in the sugar industry to signify the exclusion of saccharine from the dispensary, is in reality as follows:—"*That saccharine is a substance of such wide application that it does not belong to the dispensary.*"

Lippmann and Maercker's concluding motion that every food material containing saccharine shall be marked as such, the omission being regarded as an infringement of the food laws, does not meet the case, for if saccharine were found to be noxious to health, its sale would then come under the penal laws, and not under the food laws at all.—A. R. L.

(*B.*)—SANITARY CHEMISTRY.

On the Purification of Sewage. T. König. Chem. Zeit. **15**, 541—543.

The author in a lengthy reply to his critics first of all treats of the action of lime on sewage. It has been argued that lime, without any addition of alum, is capable of purifying the water. Now, it all depends on the nature of the sewage. If it contain substances which are capable of yielding copious insoluble precipitates, for instance, carbonic or phosphoric acid, fatty matters, sugar, dextrin, or salts of heavy metals, &c., an addition of alum may be superfluous.

It has been proposed to determine the amount of lime to be used by a laboratory experiment, but the author does not believe in this, because the same precautions and care can never be taken when operating on the large scale. The question whether lime used in excess is injurious or not is answered by the author in the affirmative. Lime, being a powerful alkali, has a solvent action on nitrogenous organic matter, as has been proved by many hundreds of water analyses. It is true that water treated with excess of lime had for a while lost its bacteria, which fact was taken by bacteriologists as an excellent sign; but no sooner had the alkalinity disappeared than the bacteria at once made their appearance. Another drawback to the use of excess of lime is the nasty scum which forms on the surface of the water, when exposed to the action of atmospheric carbonic acid.

The author next treats of the purification of sewage by the action of oxygen. The plan recommended is to expose the water as a fine spray to the action of the air. It has been observed that such water has not immediately lost any of its injurious organic matter, but the object of the process is to charge the water with sufficient oxygen, for then bacteria will perform their purifying mission more completely, as the author has observed that in well-drained and aërated soil the micro-organisms perform their functions more completely than in ill-drained and confined soil.

This fact seems to be somewhat ignored by the modern bacteriologists. The bacteria themselves are probably harmless enough, and would never make their appearance if the water were not charged with organic matter. The question is, whether they ought not to be encouraged instead of being destroyed by chemical means. This idea has been, in principle, proposed by Muller and East, who desired to destroy the organic matter by a kind of rapid fermentation. This ingenious plan would, however, require a great number of very large reservoirs, which, in most places, cannot very well be fitted up.—L. de K.

On the Purification of Sewage. H. Schreib. Chem. Zeit. **15**, 669—670.

The author objects to some statements made by König (see preceding abstract), and, having experimented on sewages of widely different origin, concludes that excess of lime diminishes the amount of soluble organic matter. He also holds that experiments may be safely made on the small scale, although as a rule a smaller amount in proportion of the purifying agent need be added when performing on the large scale.

The author, who has witnessed an experiment with König's aërating process (see preceding abstract), had no reason to be particularly pleased with it. In the town of Praeg, chimney gas is used with good success for the purification of the sewage. From this it would seem that abundant supply of oxygen is not so necessary after all.—L. de K.

The Purification of Rivers. O. Loew. Arch. f. Hygiene, 1891, **12**, 261.

To the various means which contribute to the natural purification of rivers, the growth of algæ should be added, for these plants are capable of assimilating many substances which are the products of decomposing organic matter. Indol, skatol, phenylpropionic acid, paraeresol, phenol, and other aromatic products, together with amido-fatty acids, the pure fatty acids and ammonia, carbonic acid, sulphuretted hydrogen, and methyl-mercaptan are instances of bodies which can afford nourishment to plants of the mushroom tribe, and they may also be taken as affording support to algæ, whose assimilating powers are shown to be similar to mushrooms in the case of glycocine, leucine, asparaginic acid, creatine, and betaïne.—G. H. B.

(*C.*)—DISINFECTANTS.

The Disinfecting and Antiseptic Action of Guaiacol. P. Marfori. Annal. di Chimica, 1891, **13**, 3.

A large number of experiments go to show that the antiseptic and disinfecting powers of guaiacol are greater than those of many other commonly employed aromatic substances. A 2 per cent. solution of guaiacol is as powerful as a 5 per cent. phenol solution in the case of the mildew bacillus; a 0·5—1·0 per cent. guaiacol solution destroys the tuberculosis bacillus in 2 hours, whilst a 0·1—0·2 per cent. solution only produces local infection when injected into rabbits. Other bacteria are killed by a 4—5 per cent. solution in 20—30 minutes.—C. A. K.

XIX.—PAPER, PASTEBOARD, Etc.

Soda Wood Pulp. Paper Zeit.; through Chem. Trade J. **9**, 107.

The results were obtained by E. Hennefeld in a Swedish pulp works. The principal kinds of timber used correspond to the *Pinus Sylvestris* and *Pinus Abies excelsa*. Trees having a diameter of about 6 inches are now being cut down. The Kiefer (*Pinus Sylvestris*) when felled, is sorted into three different sizes, viz., 15—25 cm., 25—35 cm., and 35 cm. diameter and over. After barking these poles, they are cut up into pieces 12 mm. × 12 mm. × 4 mm. thick, and in this condition used for pulp boiling.

The pulp boilers are capable of holding 8½ cbm. of chopped and cleaned wood, *i.e.*, 245 cb. ft. of piled logs, and to this 6,000 litres of caustic soda-lye containing caustic soda equivalent to 75 kilos. of Na_2O per cbm. of wood. The pulp boilers revolve, and their contents are heated by direct steam. The pressure employed is 125 lb. above that of the atmosphere, and the length of time the pressure is applied varies with the age and variety of the wood.

Thus for timber of 35 cm. diameter and above, the pressure is maintained for 2 hours. Timber of 35 to 25 cm. diameter, the pressure is maintained for 1½ hours. Timber of 25 to 15 cm. diameter the pressure is maintained for 1 hour.

This done, the steam pressure in the pulp boiler is blown off, and the latter emptied. Each boiler full of wood yields 1,240 kilos. (24·35 cwt.) of air-dried pulp or 145·9 kilos. per cbm. of wood (35·28 cb. ft.).

From these figures, according to the Chemical Trade Journal, the following numbers may be deduced:—

60 per cent. caustic required per ton of pulp, 14·75 cwt.
Air-dried pulp per boiler, 24·35 cwt.
Cubic feet of wood per ton of pulp, 245.

The Constitution of the Ligno-celluloses. C. F. Cross and E. J. Bevan. Chem. News, **64**, 1891, 63.

I.—*Recent Investigations of Soluble Products of Wood Boiling (Bisulphite Cellulose Process).*

Through the kindness of Prof. Tollens, the authors received a copy of the "Inaugural Dissertation" (Gottingen, 1891), of J. B. Lindsey, embodying the results of an extended investigation of the products of the now widely-known "bisulphite" process of treating wood for converting it into a paper-maker's pulp (cellulose). The object of the latter, working under the guidance of Tollens, was to throw light on the constitution of the substance of fir-wood. The main subject of his inquiry was the constitution of the lignone, or *non-cellulose* constituent of the wood substance (lignocellulose).

This was converted by the process of digestion (at 108° C. Mitscherlich process) into a soluble derivative, probably, as Lindsey premises, with the minimum of change, and the first part of the work is therefore devoted to the investigation of the waste liquors of this process, holding in solution 9—10 per cent. of "total solids." Of these the inorganic constituents are mainly calcium sulphate and sulphite. In the organic constituents the author found small quantities of pentaglucoses, probably xylose, and of galactose or galactan, traces of vanillin, and some quantity of mannose. But by far the larger proportion, say 90—95 per cent., the author finds to be made up of the amorphous or gummy solid which characterises the residue of evaporation. This compound was isolated in a variety of forms, showing a satisfactory uniformity in empirical composition. Of these we may cite the following, omitting the details of the preliminary purification:—

(a) Precipitated by alcohol	$C_{12}H_{18}O_{11}SO$
(b) Gums precipitated as lead compounds	$C_{12}H_{18}O_{11}SO$
	$2(C_{12}H_{18}O_{11}SO)3H_2O$
(c) Precipitated by HCl	$C_{12}H_{18}O_{11}SO$
(d) Precipitated by Br	$C_{12}H_{16}O_{11}Br_2SO$

These bodies may be regarded as derived from the compound $C_{24}H_{24}(CH_3)_2O_{12}$, which is therefore well established, subject to the conditions premised, as *the empirical formula for the lignone constituent of fir-wood.*

The insoluble product of the manufacturing process, *i.e.*, sulphite cellulose, was found to be partially converted into dextrose by treatment with concentrated sulphuric acid. By the action of strong nitric acid this cellulose, and also the original wood, was converted into an oxycellulose, having the empirical composition:—

C	43·41
H	6·19
O	50·40

Therefore similar in composition, as it was found to be in its properties, with that obtained by the authors from cotton (Chem. Soc. Jour. 1883).

Such is a brief outline of Lindsey's results, and upon them the authors offer one or two comments.

The empirical formula deduced by themselves for the lignone constituent of jute, from the study of its chlorination products (Chem. Soc. Jour. 1889, 213), was $C_{76}H_{90}O_{35}$, which differs but little from Lindsey's formula (*supra*) for the non cellulose of fir-wood; for—

$$3 \times C_{26}H_{30}O_{12} = C_{78}H_{90}O_{36}.$$

The proportion of methyl groups in the above formula was determined by the hydriodic acid method; they are therefore present as O.CH_3 groups. In their paper on the "Constitution of the Jute Fibre Substance" (*loc. cit.*), the authors noted the formation of acetic acid by the solution of the fibre in sulphuric acid, and deduced from the observation that the CH_3 groups were in union with CO groups. But conclusions may be true, and would appear to be justified by the study of the products of destructive distillation, of which both CH_3.CO and OCH_3 groups are prominently characteristic. The authors also obtained methyl chloride by the destructive distillation of the chlorinated derivative of the lignone of jute.

Lindsey does not appear to have attempted to diagnose the mode of union of the S atom in the molecule of the derivative of the lignone. It is important, however, to have established the fact of its presence in combination; and it will no doubt prove to have an important bearing on the theory of this process of cellulose isolation. The authors are engaged, on the other hand, in studying the derivative obtained in the sulphurous acid (Pictet) process of resolving pine-wood, which is of an obviously simpler character, and appears to yield a derivative more closely related to the original lignone than that investigated by Lindsey and Tollens.

Lastly it is noted that Lindsey and Tollens retain the term *lignin* for the non cellulose constituent of the lignocellulose; seeing that the characteristics of the body are those of a ketone, we have suggested the substitution of the term *lignone*, which we think preferable.

II.—*Oxidation of Ligno-Celluloses by Chromic Acid.*

In their earlier contributions to the chemistry of cellulose (Chem. News, **42**, 77; Chem. Soc. Jour. **38**, 666), the authors noticed that the cellulose isolated by the chlorination method was not homogeneous, containing a form of cellulose easily hydrolysed by acids and alkalis to soluble derivatives; further, that by suppressing or limiting as far as possible the conditions tending to hydrolysis in the process of separating the cellulose, the proportion obtainable, *i.e.*, percentage yield on the raw fibre, could be considerably increased.

Thus, by preventing the rise of temperature in chlorination, and digesting subsequently in aqueous sulphurous acid at 0°, the yield was increased to 80—82 per cent. from the 74—76 per cent. obtainable without these precautions.

These observations led the authors to the conclusion, which we give in the words of our first paper (1880), that "as the cellulose is not homogeneous, and the percentage yield varies with the several methods by which the intercellular substances may be removed, they had reason for believing them to contain a body allied to cellulose. The

facts are explained by the hypothesis that the intercellular substance consists of a complicated quinone which is intimately associated with a carbohydrate . . . . more closely allied to cellulose than to glucose."

This view the authors are now in a position to confirm and develop from results which they had recently obtained by graduated oxidations of the ligno-celluloses with chromic acid. Of these they take the opportunity of giving a brief preliminary notice.

Chromic acid, in cold dilute aqueous solution, is not deoxidised to Cr_2O_3 by the jute fibre substance; there appears, on the other hand, to be a direct combination and a considerable quantity of the oxide appears to be fixed, probably, in part at least, in the form of the oxides intermediate between Cr_3O and Cr_2O_3.

The addition of a mineral acid determines the deoxidation, and the fibre is converted into a greenish product, brittle and yet soft to the touch, and of high lustre. Of this product the authors obtained from 85—90 per cent. of the weight of the raw fibre; in this case a jute of medium quality, yielding about 74 per cent. cellulose by the ordinary chlorination method. On ignition it gave an ash containing Cr_2O_3, equal to from 2—2·5 per cent. of its weight. The organic portion they found to be an *oxycellulose*. The carbon percentage they determined in various specimens; it varies between 43 and 44. It is largely soluble in alkalis, the solution reducing Fehling's solution copiously on boiling.

Pine-wood they found gives similar results, *i.e.*, a high percentage of a product of low carbon percentage, soluble for the most part in cold alkaline solutions, and agreeing in this as in other respects with the well-characterised group of oxycelluloses.

The soluble products of the chromic acid oxidation they isolated and found to be brown gummy bodies giving chlorine substitution products with characteristic colour reactions.

By this particular oxidation, therefore, the authors appeared to convert into cellulose (*i.e.*, a derivative of cellulose) a body which, under the treatment hitherto adopted for separating the cellulose, is *hydrolysed* into soluble products. They had on many occasions pointed out that the yellow chlorinated derivative obtained from the fibre contained a *quinone-chloride* associated with a body which gave a copious yield of furfurol by acid hydrolysis, and probably, therefore, a *pentaglucose*.

It is therefore probable that this pentaglucose exists in the fibre in the form of a cellulose (E. Schulze, Ber. **24**, 2277). There are many grounds for regarding lignification as a process of modification of cellulose by deoxidation and dehydration, and the action of dilute chromic acid in presence of a hydrolysing acid would appear to confirm this view, while giving the nearest approach which the authors have yet made to the retracing of the process backwards through its several stages.

PATENTS.

An Improved Method of Treating Peat Fibre for the Manufacture of Paper Wrappers, Millboards and the like. J. A. London, Newcastle-on-Tyne. Eng. Pat. 7816, June 30, 1890. 4*d*.

Peat fibre is taken direct to the breaking engine and is there mixed with the other material, such as rope, bagging, waste jute, and waste papers. To the mixture rosin size, containing a large excess of alkali, is added, and the temperature raised to 150° F.—E. J. B.

New Process of Sizing Paper. A. Mitscherlich, Freiburg, Germany. Eng. Pat. 11,372, July 21, 1890. 4*d*.

On adding sulphite liquors in which wood has been boiled to a solution of gelatine, the latter is precipitated in a "highly cementitious and adhesive condition." The precipitate is dissolved in slightly alkaline water, and is reprecipitated in the pulp by the addition of alum. (Compare this Journal, 1883, 541.)—E. J. B.

Improvements in the Manufacture of Pearl Hardening. J. Beveridge, Gravesend. Eng. Pat. 12,400, August 8, 1890. 6*d*.

Pearl hardening or crystallised calcium sulphate is prepared by the double decomposition of solutions of sodium sulphate and calcium bisulphite. The resulting solution of sodium bisulphite is sold as such, or it may be applied to a variety of uses in paper mills.—E. J. B

Improvements in the Method of Obtaining Useful Products from Bleaching Powder Dregs and Lime Mud from Paper Works. T. J. Hutchinson, Manchester. Eng. Pat. 13,504, August 28, 1890. 4*d*.

Instead of repeatedly washing with water the waste residues from the production of bleach liquor or caustic soda liquor, the inventor treats these residues at once with a solution of sodium carbonate, so as to utilise any lime present in the residues for the production of caustic soda. The treated residue is collected in a filter press, dried and calcined for the reproduction of caustic lime.—G. H. B.

Improvements in Photographic Sensitised Films or Cards. H. Kuhn, Springfield, U.S.A. Eng. Pat. 6921, April 22, 1891. 6*d*.

The inventor renders cardboard waterproof by dipping it in a "*solution of insoluble soap.*" After being covered with celluloid varnish it is coated with a mixture of barium sulphate and gelatine. When this is dry the boards are passed between polishing rollers and are then coated with an emulsion prepared by mixing together alcohol, ether, pyroxylin, chloride of strontium, an aniline colour, and nitrate of silver.—E. J. B.

Improvements in the Manufacture of Pearl Hardening. J. Beveridge, Gravesend. Eng. Pat. 7797, May 6, 1891. 4*d*.

Instead of the sulphate of soda specified in Eng. Pat. 12,400 of 1890 (see above) the inventor uses a solution of sulphate of magnesia for the purpose of decomposing a solution of bisulphite of calcium.—E. J. B.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES AND EXTRACTS.

Hypoiodous Acid. A. Schwicker. Chem. Zeit. 1891, **15**, 630.

See under XXIII., *page* 805.

The Spontaneous Inflammability of Carbon Disulphide. M. Pöpel. Chem. Zeit. **15**, 822—823.

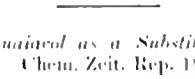
The causes governing the spontaneous ignition of carbon disulphide are obscure, and the following case may be useful as serving to elucidate one of them. On account of the volatility of carbon disulphide great difficulty is experienced in working with it, it being impracticable to prevent its escape through the cocks, manholes, &c., of the extraction apparatus in which it is used even at trifling pressures such as 9·1 of an atmosphere. The air which finds its way into the apparatus each time it is opened also carries away a considerable amount. While experimenting, in order to diminish the loss thus caused, the author attached a tube to the end of the exit pipe dipping into oil to the depth of about 10 cm., and found that absorption was fairly complete, and that though the amount of carbon disulphide vapour carried off when the temperature of the cooling

water was only 10—12° C., yet when it rose 8—10° C. the loss amounted to several litres in a few hours. On account of the addition of the absorption vessel the pressure in the apparatus rose to about one-eighth of an atmosphere, and the boiling of the liquid in the still was consequently affected. While a workman was removing the pipe and the oil vessel was lowered to give him more room for that purpose, it was observed that the pipe became hot at the bend, and an explosion followed which set fire to the oil saturated with carbon disulphide. The author attributes this occurrence to the mixture of vapour and air in the pipe being raised to its ignition point by friction. A direct experiment, consisting in allowing a little carbon disulphide to evaporate in a copper oven, showed that ignition would take place at 98—99° C. Copper has apparently some specific action inducing the combination, as on coating the sides of the oven with clay no such effect was produced. Iron steam-pipes at a temperature of 135—145° C. (= 3—4 atmospheres) will ignite a mixture of carbon disulphide and air; all steam-pipes should therefore be lagged where such a mixture is likely to come into contact with them. The more air is present the higher the temperature of ignition and the more violent the explosion.

In conclusion, the author recommends the adoption of as low pressures as are possible without the use of a partial vacuum, recourse to which is forbidden by the risk that would be incurred by the explosion of a mixture of carbon disulphide vapour and air during compression in the pump cylinder. Where plenty of cold water for condensation is available the loss is small, but in any case the plant should be under careful and intelligent control.—B. B.

On Benzoyl-Guaiacol as a Substitute for Creosote. F. Walzer. Chem. Zeit. Rep. 1891, **15**, 165.

Creosote is one of the most useful medicines in lung diseases, but it has a disagreeable taste and not unfrequently gives rise to inflammation of the mucous membrane of the stomach. The author attributes the evil effects to the cresolic substances present and the good effects to the guaiacol. But as guaiacol also possesses an objectionable taste and smell, the author proposes the use of Bongartz's "Benzosol" (benzoyl-guaiacol)—



This substance can be obtained free from injurious impurities, as well as from taste and smell. It becomes decomposed in the stomach into guaiacol and benzoic acid, and, according to the hospital experience of the author, its use as a substitute for creosote has a favourable effect on digestion and has a strengthening influence on the patient.—C. H. B.

The Properties of Diethylendiamine (Piperazine). A. Ladenburg. Ber. **24**, 2400—2402.

The quantity of piperazine furnished as a commercial product being now such that exact observations and experiments are rendered more easy than formerly, the author has availed himself of opportunities thus occurring.

Nitroso piperazine, $C_4H_8N_2(NO)_2$, is easily prepared by treating a solution of piperazine hydrochloride containing some free hydrochloric acid, with nitrate of soda, and warming the mixture for a short time. A crystalline body thus separates out, which is once or twice recrystallised from water. A solution of phenol in concentrated sulphuric acid (Liebermann's reagent) is coloured strongly by this nitroso-compound, and becomes, after a few minutes, deep blue. Melting point 158°. It is with difficulty soluble in cold water and ether, easily in hot water and hot dilute alcohol.

s-Dimethylpiperazine, $C_4H_8N_2(CH_3)_2$.—An aqueous solution of piperazine is warmed with an excess of methyl-potassium sulphate for several hours in connexion with an inverted condenser until the alkaline and nitroso reactions have disappeared. Supersaturation with soda follows, and distillation so long as the base distils over. The latter is then evaporated down with hydrochloric acid, and the residue recrystallised from alcohol.

The Base itself is easily separated from the hydrochloride by means of alkalis, is easily volatile, and possesses a penetrating odour, similar to that of methylamine.

New Compounds of the Camphor Group and a New Terpene. O. Wallach. Annalen, 1891, **263**, 129—156.

This paper is a continuation of the author's researches on Fenchol, the geometrical isomeride of camphor, for which it is now proposed to substitute the name Fenchon, on account of its ketonic nature. (This Journal, 1890, 1147.)

Fenchon, $C_{10}H_{16}O$.—To prepare this body, the portion of fennel oil of boiling point 190°—195° C. is treated with nitric acid (concentrated), when the anethol and other impurities are oxidised, whilst the fenchon is left unchanged. The product of the reaction is poured into water, the separated oil washed with caustic soda, distilled with steam, dried, and finally crystallised at a low temperature. The pure product boils at 192°—193°, and has a specific gravity of 0·9465 at 19° C. (not 0·934 at 23° as given in the abstract mentioned above). On prolonged cooling at a low temperature it solidifies in large crystals, melting at 5—6° C. Its index of refraction is $n_D = 1{\cdot}46306$ at 19° C., corresponding to a molecular refractive power = 44·23, whereas a compound $C_{10}H_{16}O$ without ethylene bonds requires 44·11. It is dextro-rotatory $[\alpha]_D = +71{\cdot}97$. Bromine forms an unstable crystalline addition-product with fenchon in the cold; on warming, both bromine and iodine yield substitution products. Fenchon is dissolved unchanged by cold hydrochloric or sulphuric acid, nitric acid only attacks it on prolonged heating, and then but slowly, organic acids and hydrocyanic acid being among the products of decomposition. It is oxidised by potassium permanganate, when dimethylmalonic, acetic, and oxalic acids are formed. Fenchon and camphor have a similar physiological action. The former does not react with either phenylhydrazine or with acid sulphites of the alkalis, but yields a crystalline oxime with hydroxylamine (*vide* previous abstract). The melting point of this body varies with the method of heating from 150—165° C., owing to its losing water and forming an anhydride, $C_{10}H_{15}N$, which is most readily got by warming the oxime with sulphuric acid (dilute). This anhydride boils at 217—218° C., is dextro-rotatory, and appears to be an unsaturated body, combining readily with bromine and with the halogen hydracids. When treated with sodium amalgam in alcoholic solution it yields a base, $C_{10}H_{19}N(C_{10}H_{17}NH_2)$, which boils between 250° and 260° C. Like the anhydride or nitrile, it appears to be an unsaturated body, forming a hydrochloride, $C_{10}H_{19}N.2HCl$. Fenchon reacts similarly to camphor with ammonium formate to form the formyl compound of a base, *fenchylamine*, from which the free base, $C_{10}H_{17}NH_2$, is readily isolated. This latter is a liquid having a smell resembling both that of piperidine and of bornylamine. It boils at 195° C., and has a specific gravity of 0·9095. Of the salts, the hydrochloride and sulphate are readily soluble in water. The base is a primary one, and acetyl, benzoyl, and alkyl substitution products have been prepared from it. It is lævo rotatory, $[\alpha]_D = -21{\cdot}63°$. With nitrous acid a peculiar neutral oil is formed, which is under investigation, but neither the corresponding alcohol nor a diazo-compound results. The alcohol, *Fenchyl-alcohol*, $C_{10}H_{17}OH$, the analogue of borneol, is obtained by reducing fenchon with sodium in alcoholic solution. It forms well-characterised white crystals melting at 40°—41° C. and boiling at 201° C. The vapour has a penetrating smell slightly resembling that of borneol. The alcohol is insoluble in water, soluble in alcohol and ether, but does not form addition products with bromine or with the halogen hydracids as borneol does. It is lævo rotatory, $[\alpha]_D = -10{\cdot}35°$. Treated with strong nitric acid it is readily oxidised to fenchon. Phosphorus pentachloride converts the alcohol into the corresponding chloride, $C_{10}H_{17}Cl$, a liquid boiling between 84° and 86° C.,

which, like bornyl chloride, is converted into a terpene, $C_{10}H_{16}$, when heated with aniline. This body, to which the name *Fenchene* is given, is a liquid boiling at 158°—160° C., readily volatile with steam, and optically inactive. Its refractive index points to the presence of an ethylene bond, as does the case with which it reacts with bromine. It is very stable towards nitric acid; on oxidation with potassium permanganate a monobasic hydroxy acid, $C_{10}H_{18}O_3$, results, the nature of which is being worked out. The paper concludes with theoretical considerations as to the relation which fenehon and its derivatives bear to camphor.—C. A. K.

Terpenes and Ethereal Oils. O. Wallach. Annalen, 1891, **264**, 1—32.

Pinene.—It is generally believed that pinene readily takes up a molecule of bromine to form a liquid dibromide, $C_{10}H_{16}Br_2$, which when treated with alcoholic potash gives off hydrobromic acid and forms cymene. On the other hand Tilden has shown (J. Chem. Soc. 1888, 82) that pinene, like limonene and dipentene, can absorb 2 molecules of bromine. The author has re-investigated the reaction and finds that when 1 molecule of the hydrocarbon is treated with 1 molecule of bromine, absorption occurs very readily, but that some hydrobromic acid is always liberated. The product of the reaction when treated with alcoholic potash yields a complex mixture consisting of camphene, undecomposed pinene hydrobromide, a crystalline pinene dibromide, and perhaps a very small quantity of cymene, which last was not however detected with certainty. The crystalline dibromide, which has the formula $C_{10}H_{16}Br_2$, forms hexagonal colourless crystals melting at 169°—170° C., soluble with great difficulty in cold alcohol, readily soluble in chloroform and in warm acetic ester. The yield obtained is only 7 per cent. Neither camphene nor pinene hydrobromide yield it when treated as above, so that it is to be regarded as a direct product of the action of bromine upon pinene. It is optically inactive and does not form addition products. When heated with aniline, cymene is formed.

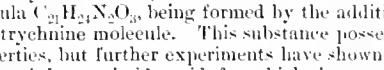
Limonene, when treated with 2 molecules of bromine yields in addition to the crystalline tetrabromide, $C_{10}H_{16}Br_4$, a liquid tetrabromide which is regarded as a physical isomeride of the former. The crystalline, dextro-rotatory tetrabromide when heated with alcoholic potash, is converted into a liquid monobromide, $C_{10}H_{13}Br$, also dextro-rotatory, 3 molecules of hydrobromic acid being most probably split off thus:—$C_{10}H_{16}Br_4 = C_{10}H_{13}Br + 3\,HBr$. This monobromide reacts with hydrobromic acid to form the inactive limonene tetrabromide, viz., dipentene tetrabromide. Aniline reacts differently to alcoholic alkali with limonene tetrabromide, only a small quantity of hydrocarbons resulting amongst which a mono-alkylated benzene, probably propylbenzene and cymene, were detected.

Dipentene.—Dipentene dihydrobromide, $C_{10}H_{16}.2HBr$, treated with bromine, is converted into a crystalline tribromide, $C_{10}H_{17}Br_3$, which forms snow-white plates melting at 110° C. Heated with sodium in alcoholic solution a hydrocarbon, $C_{10}H_{14}$, is formed, isomeric but not identical with cymene. It boils at 183°—184° C. and absorbs bromine very readily to form a well defined crystalline tetrabromide, $C_{10}H_{14}Br_4$, which melts at 154°—155° C., and also a second tetrabromide of the same formula, melting at 103°—104° C. This latter could not be obtained crystalline, but only in an amorphous condition. The study of the action of chlorine on dipentenedihydrochloride has also been begun by the author, a tri- and tetrachloride, $C_{10}H_{17}Cl_3$, and $C_{10}H_{16}Cl_4$, having already been isolated.—C. A. K.

Strychnine. J. Tafel. Annalen, 1891, **264**, 33—84.

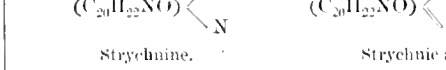
After a review of the attempts that have been made to elucidate the constitution of strychnine, the author gives full details of his own experiments, with the same object in view.

Loebisch and Schoop (Monatsh. Chem. **7**, 83), have shown that strychnine treated with alcoholic soda yields a body to which they gave the name of "*strychnol*," which has been shown by the author (this Journal, 1890, 1061), to have the formula $C_{21}H_{24}N_2O_3$, being formed by the addition of H_2O to the strychnine molecule. This substance possesses phenolic properties, but further experiments have shown that it is not a phenol, but an imido-acid, for which the name "*strychnic acid*" is proposed. The alkaloid itself is to be regarded as the anhydride of this acid, the two bodies standing in the relation of isatic acid to isatine:—



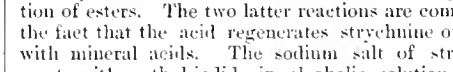
Strychnine. Strychnic acid.

The presence, both of the imido-group and of the carboxyl group in strychnic acid is pointed to by the action of nitrous acid, by the introduction of acid radicles and by the formation of esters. The two latter reactions are complicated by the fact that the acid regenerates strychnine on treatment with mineral acids. The sodium salt of strychnic acid reacts with methyl iodide in alcoholic solution, to form the methiodide of strychnic acid, also a secondary base, which, when treated with mineral acids, behaves similarly to strychnic acid and forms strychnine methiodide, the product obtained by direct treatment of strychnine with methyl-iodide:—



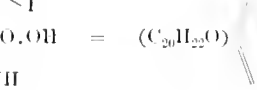
Strychnic acid methiodide. Strychnine methiodide.

When the sodium salt of this methiodide of strychnic acid is treated with an excess of methyliodide in methyl-alcohol solution two methylated bodies result, standing in the relation of a methyl ester to its acid, as was proved by converting the one into the other. These products are:—



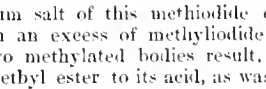
Methylstrychnic acid methiodide. Methylstrychnic acid methiodide methyl ester.

the formation of which points decisively to the presence of the imido group and of the carboxyl group in strychnic acid. The silver salt of the methiodide of strychnic acid loses silver iodide on gentle warming with water and forms methyl strychnine, which is to be regarded as the methyl-betaïn of strychnic acid, an ammonium hydrate having been formed as an intermediate product:—



Methylstrychnine.

The silver salt of the methiodide of methyl strychnic acid reacts similarly to form the corresponding compound in which the hydrogen of the imido-group is replaced by methyl, viz.:—



Dimethylstrychnine.

Methyl strychnine is a secondary amine and forms a nitrosamine; dimethyl strychnine is a tertiary amine and forms a nitroso-compound closely resembling the nitroso-compound of dimethylaniline, with which base it shows

further analogy in reacting both with benzaldehyde and with diazobenzene sulphonic acid to form a green and a yellow colouring matter respectively. These reactions point undoubtedly to the $=N-CH$ group in dimethyl strychnine and consequently the $=N-CO-$ group in strychnine itself, being attached to a benzene ring by one valency. Attempts to decompose the nitroso-dimethyl-strychnine by alkali similarly to nitroso-dimethyl-aniline, with the formation of a substituted methylomine were unsuccessful.

Two other products, produced by the action of baryta-water on strychnine at 130° have been described by Gal and Etard, to which the names of *dihydrostrychnine* and *trihydrostrychnine* have been given respectively. The former of these bodies has the composition $C_{21}H_{24}N_2O_2$, and according to the researches of the author is an isomeride of strychnic acid, containing one molecule of water of crystallisation, which it loses at 135° C. This *isostrychnic acid* is stable towards mineral acids, with which it forms salts, differing essentially in this from strychnic acid. Concentrated hydrochloric acid acts on the iso-acid at 100° C. to form a body reacting similarly to strychnine, which could not however be obtained in a crystalline condition and which has not yet been examined in detail; the acid has similar poisonous properties to strychnine. The iso-acid forms a nitrosamine, and reacts with alcohol and with acetic anhydride to form an ester and acetyl compound respectively, which crystallise with difficulty. Methyliodide forms a methiodide with the sodium salt of the iso-acid and the sodium salt of the former reacts further with methyliodide on similar lines to the corresponding compound of the normal acid to form methyl-iso-strychnic acid methiodide, and its methyl ester. Iso-methyl-strychnine and iso-dimethyl-strychnine have also been prepared from the silver salts of the corresponding iso-compounds; these behave similarly to the normal compounds in their reactions, but differ in their physical properties. The cause of the isomerism requires further investigation.

Full details of the methods of preparation and properties of the substances dealt with in the memoir are given.

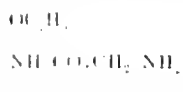
—C. A. K.

Stability of Hydroxylamine. V. Meyer. Annalen, 1891, **264**, 126.

HYDROXYLAMINE is not completely decomposed by boiling with concentrated caustic fixed alkali, as is generally supposed, and hence this reagent does not serve to remove the base completely from solutions when required. It is, however, completely destroyed by treatment with platinic chloride and hydrogen being reduced to ammonia, as previously shown by the author. On the decomposing action of ferric chloride, platinic chloride, &c., Lossen and others have repeatedly written.—C. A. K.

Phenocollum Hydrochloricum, a New Antipyretic. Schoting. Apoth. Zeit. 1891, **6**, 247.

THIS new antipyretic is the hydrochloride of amidoacetparaphenetidine—



and results from the condensation of glycocine and phenetidine. It forms a white microcrystalline powder soluble in about 16 parts of water and crystallising therefrom in cubes. From alcoholic solution it separates in needles which melt at 95° C. Ammonia, caustic potash, and the alkaline carbonates separate the base from an aqueous solution of the hydrochloride in the form of fine needles, which contain 1 molecule of water of crystallisation. Phenetidine and glycocine are regenerated on prolonged boiling with the alkaline hydrates or carbonates. Doses of 0·5—1 grm. of the hydrochloride act most successfully in cases of nervousness or neuralgia, whilst daily doses of 5 grms. have given good results in cases of rheumatism in the joints, when antipyrine, antifebrine, and sodium salicylate were of no avail.—C. A. K.

The Physiological Action of Paraphenetidine. L. Reuter. Pharm. Zeit. 1891, **36**, 185.

PARAPHENETIDINE, which is found as an impurity in phenacetine, is poisonous, and when given for some time in very small doses affects the kidneys, producing *nephritis*. It is therefore very necessary always to test phenacetine for *p*-phenetidine.—C. A. K.

Conversion of Cupreine into Quinine. O. Hesse. Pharm. Zeit. 1891, **36**, 289.

THE author observes that Grimaux and Arnaud, (this Journal, 723—720) who claim the production of quinine from cupreine by the action of methylic chloride on cupreine sodium, have not stated the yield. He therefore thinks it possible that the cupreine experimented upon might have contained quinine as an impurity.

But even if the conversion has really been successful it will simply be a matter of scientific, not practical, interest, as cupreine is, after all, an alkaloid procurable with difficulty.

—L. de K.

A Violet Colouring Matter from Morphine; the Formula of Pseudomorphine. P. Cazeneuve. Bull. Soc. Chim. 1891. **5**, 857—863.

See under IV., *page* 754.

Resopyrine. L. Roux. J. Pharm. Chem. 1891, [5], **23**, 282.

WHEN concentrated solutions of antipyrine and of resorcinol in molecular proportions are mixed together a white precipitate is formed with which a few oily drops are mixed up. On stirring, the oily compound increases in quantity, forming a thick mass which after 1—2 minutes becomes hard. The resulting product is insoluble in water, only slightly soluble in ether, but fairly so in alcohol, from which solution it separates in white crystals which melt readily on heating. *Resopyrine* is the name given to the new compound, the composition of which has not been ascertained. It has no smell but a slightly biting taste; the alcoholic solution is not precipitated by water. It is coloured orange-red by sulphuric acid, red by nitric acid, and blood-red by ferric chloride.—C. A. K.

Preparation of Hypnal or Monochloralantipyrine. Demandre. Répert. de Pharm. 1891, **47**, 107.

FORTY SEVEN grms. of chloral hydrate are dissolved in 50 grms. of water, and a solution of 53 grms. of antipyrine also in 50 grms. of water added. The mixture is well shaken in a separating funnel and allowed to stand when it separates into an aqueous and an oily layer, the former floating on the latter. After standing for one hour the two liquids are run separately into evaporating dishes and there allowed to stand for 24 hours, when the oily layer solidifies to form transparent rhombic crystals. A few crystals also separate from the aqueous solution. The crystals are purified and finally dried between filter paper or over sulphuric acid in an exsiccator.—C. A. K.

Method for Purifying Carbon Bisulphide without Distillation. A. Chenevier. L'Union Pharmac. 1891, **32**, 204.

ONE litre of the carbon bisulphide is treated with 0·5 cc. of bromine and allowed to stand for 3 to 4 hours. The excess of bromine is removed by agitation with caustic potash or copper turnings. Any remaining cloudiness may then be removed by agitation with a little dry calcium chloride with subsequent filtration. The carbon bisulphide treated in this way is colourless, of pleasant smell, and evaporates without residue.—G. H. B.

Bromoform. G. Beringer. Amer. J. Pharm. 1891, **63**, 80.

The author was unable to obtain satisfactory results with Günther's method for the preparation of bromoform, and has worked out the following modification of Dumas' method. 120 grms. of lime are slaked and placed in a flask attached to a condenser and provided with a dropping funnel. The stopper of the flask carries in addition a tube reaching into the flask and connected at its upper end by means of a piece of rubber tubing to a rubber ball which serves to blow a current of air into the mixture and thus to keep the whole well agitated. 120 grms. of acetone are then added gradually, the mixture warmed gently to 45°—50° C. and then bromine added slowly until the liquid is coloured permanently yellow. When the reaction is completed, lime-water is added to alkaline reaction and the liquid distilled. The first portion of the distillate contains the bromoform, which is separated, washed with water, dried over calcium chloride and distilled. The product of boiling point 143°—148° C. is placed in a freezing mixture and the portion that solidifies at + 6° C. separated as quickly as possible from adhering liquid. The crystals, which may be considered as chemically pure bromoform, have a sp. gr. of 2·900 at 15° C. and boil at 147°—148° C.

According to the author, bromoform used medicinally should boil at 147°—150° C. and should not be coloured either by strong sulphuric acid or by caustic potash. When shaken with water the aqueous solution should not give an acid reaction, nor a precipitate with silver nitrate, nor reduce the latter reagent with the formation of a mirror. The vapours of the sample should not irritate the membrane either of the eyes or of the nose.—C. A. K.

The Present Commercial Importance of Saccharine and the Attitude of the Beetroot Industry with Reference to the Exemption of this Substance from Taxations. F. v. Thümen. Chem. Zeit. 1891, **15**, 634—635.

See under XVIII. *A., pages* 784—785.

PATENTS.

Improvements in the Manufacture of Oxyphthalic Acids (Phenol Dicarbon Acids). J. Y. Johnson. From F. von Heyden, Dresden, Germany. Eng. Pat. 12,993, August 19, 1890. *4d.*

The alkali salts of the alkyl esters of 1 : 3 and 1 : 4 hydroxybenzoic acid are treated in an anhydrous condition with carbon dioxide in an autoclave at a temperature of 140°—180° C., the product of the reaction dissolved in water and the ester of the hydroxydicarboxylic acid precipitated by the addition of a mineral acid. The alkyl group attached to the carboxyl is then removed by hydrochloric acid or other suitable means and the free dicarboxylic acid obtained. In this manner the following acids are formed:—(1.) the β-hydroxy-phthalic acid of Reimer and Tiemann; (2.) the hydroxy-terephthalic acid of Burkhardt and Jacobsen; (3.) the α-phenol-dicarboxylic acid of Ost, from the esters of 1 : 2, 1 : 3, and 1 : 4 hydroxybenzoic acids respectively. The following equation represents the reaction:—

$$C_6H_4\begin{cases}CO.OC_nH_{2n+1}\\O.R\end{cases} + CO_2 = C_6H_3\begin{cases}CO.OC_nH_{2n+1}\\OH\\CO.OR\end{cases}$$

—C. A. K.

Improvements in the Manufacture of "Spermine." W. Majert, Berlin, Germany. Eng. Pat. 15,404, September 29, 1890. *6d.*

"*Spermine*" is the name given by Schreiner to a base, C_2H_5N, found in human and in animal sperm, and which, according to Ladenburg (Ber. **21**, 758), is ethyleneimine—

$$NH\begin{cases}CH_2\\|\\CH_2\end{cases}$$

which in aqueous solution should be easily condensible to piperazine or piperazidine—

$$\begin{matrix}CH_2-NH-CH_2\\|\qquad\qquad|\\CH_2-NH-CH_2\end{matrix}$$

The author finds that the product has this latter formula, and that it is produced by the action of alkalis or of alkaline earths or of mixtures of the two upon the following bodies:—

Dinitroso- Dinitro- Trinitro- Tetranitro- Pentanitro- Hexanitro- Di-chlor- Trichlor- Tetrachlor- Pentachlor- Hexachlor-	Diphenyl-piperazine. Ditolyl-piperazine. Dixylyl-piperazine. Dimesityl-piperazine. Dipseudocumyl-piperazine. Dinaphthyl piperazine.

The dichlor, &c. compounds may be substituted by the corresponding bromo- or iodo-piperazines.

One part by weight of the above is treated with 2 to 4 parts by weight of 25 per cent. caustic soda or potash. From dinitroso-diphenyl-piperazine, one molecule of piperazine and two molecules of nitrosophenol result. The mixture is distilled, when the piperazine passes over with the steam, and is neutralised in the distillate by hydrochloric, phosphoric, or sulphuric acid. Water is employed as the solvent for the alkalis or alkaline earths; when the latter are used it is advisable to work under pressure in closed vessels and at a rather higher temperature. The free base has the smell of sperm, and is very soluble in water, from which it crystallises in glittering four-sided tables. The hydrochloride, which is employed in medicine, forms needles containing water of crystallisation. Very weak, slightly acid solutions of this salt yield a pomegranate-coloured crystalline precipitate with bismuth-potassium iodide, and a yellow precipitate with picric acid. The gold double chloride forms small yellow glittering scales. (Compare this Journal, 1891, 381.)—C. A. K.

A Receiver for the Preservation and Application of Chloride of Ethyle. B. J. B. Mills, London. From Messrs. Auguste Gilliard, Prosper Monnet, and Jean Marie Cartier, Lyons, France. Eng. Pat. 16,392, October 15, 1890. *4d.*

The ethyl chloride is enclosed, immediately after its manufacture, in glass flasks, each containing the quantity usually necessary for an operation—about 10 grms. The flasks are cylindrical and have a slender neck, which is hermetically sealed after filling. The slender neck of the flask is broken off at the most contracted part, which is indicated by a file mark, when required for use, and as the ethyl chloride boils at + 10° C. it vaporises immediately and issues in a fine jet of vapour. A liquid jet can be obtained by laying the flask down or by turning it upside down. By heating the flask more or less by the hand the strength of this liquid jet can be regulated at will. By simply placing the finger over the mouth of the flask the jet of liquid or vapour can be stopped.—C. A. K.

Improved Manufacture of Pepsine. J. Le Roy Webber, Detroit, U.S.A. Eng. Pat. 5981, April 7, 1891. 4*d.*

The mucous membranes from animals' stomachs, especially those of the pig, are digested with acidulated water or with weak hydrochloric acid at 40°–50° C., sufficient sulphurous acid then added to prevent decomposition, and the whole allowed to clarify by standing. The comparatively clear liquid is next drawn off and saturated with sodium sulphate, preferably at about 34° C., which precipitates the pepsine. This is collected, pressed and dried, and forms the crude product from which the pure pepsine is prepared; it is, however, very active itself, and is marketable. The purification is effected by dialysis, the sulphate of sodium and peptone passing into solution, whilst the pepsine remains behind. More than 90 per cent. of the sodium sulphate employed can be thus recovered. The purified pepsine is practically devoid of offensive odour; it is not hygroscopic, and is of superior digestive strength, being quite free from the inactive peptone.—C. A. K.

Improvements in the Manufacture of Ortho-oxyquinoline and Oxyquinoline Derivatives. A. Lembach and L. Schleicher, Biebrich, and C. J. Wolff, Wiesbaden, Germany. Eng. Pat. 7803, May 6, 1891. 4*d.*

Ortho-amido-phenol-para-sulphonic acid, ortho-nitrophenol-para-sulphonic acid, glycerol, and sulphuric acid are boiled together for about 6 hours in a suitable vessel provided with an inverted condenser and the resulting molten mass diluted with water. The whole is then neutralised with caustic soda, and the hydroxyquinoline, which is completely precipitated, separated by filtration and purified by distillation with steam. By boiling this product with sulphuric acid and water for 6 hours and evaporating off the excess of liquid in a vacuum pan, the neutral sulphate, $(C_9H_6NOH)_2.H_2SO_4$, is obtained in the form of sulphur yellow crystals. Or instead of separating the water in a vacuum pan, the liquid can be evaporated on a water-bath, or by means of steam, when a honey-like yellow syrup is obtained which when digested with a mixture of alcohol and ether yields the sulphate as a fine yellow powder melting between 170° and 180° C.

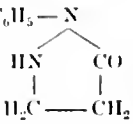
The phenol sulphonate of 1:2 hydroxyquinoline, $C_9H_5(OH)N.C_9H_4(OH)(SO_3OH)$, is prepared by boiling a mixture of molecular proportions of 1:2 hydroxyquinoline and 1:4 phenol sulphonic acid with water for about a whole day in a vessel provided with an inverted condenser. A 50 per cent. solution of the product results, which, when concentrated in a vacuum pan below 100° C., yields a yellow syrup which does not crystallise readily. The phenol sulphonate is very soluble in water. Similar compounds of 1:2 hydroxyquinoline with 1:2 phenol sulphonic acid, with 1:2 and 1:4 cresol sulphonic acid and with sulphosalicylic acid—hydroxyquinoline sulphosalicylate, $C_9H_5(OH)N.C_9H_3(COOH.OH.SO_3OH)$—are obtained on analogous lines to the above phenol sulphonate. Further, other phenols or their derivatives may be employed in the preparation of 1:2 hydroxyquinoline derivatives, and in the preparation of the 1:2 hydroxyquinoline itself the 1:2 nitrophenol 1:4 sulphonic acid may be substituted by nitrobenzene, picric acid, or other suitable oxidising agents. —C. A. K.

Improvements in the Manufacture of Medical Extracts. P. A. Newton, London. From the American Extract Company, New York, U.S.A. Eng. Pat. 8511, May 19, 1891. 6*d.*

The process consists in obtaining medicinal extracts from vegetable substances by means of "petroleum jelly" (vaseline). The jelly is allowed to percolate through a suitable vessel containing the substance to be extracted, the whole being kept at such a temperature that the solvent is perfectly liquid (120° Fah.). Or the vegetable substances may be steeped in the warmed jelly. After extraction the jelly is strained or filtered. Mustard, cloves, coffee, cinnamon, bay leaves, cinchona bark, &c., may be extracted in this manner. The patent further covers the production of a medicinal preparation consisting of the said jelly, having absorbed within it the active principle of a vegetable substance.—C. A. K.

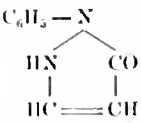
Manufacture of Pyrazolones. O. Imray, London. From C. F. Boehringer Söhne, Waldhof, near Mannheim, Germany. Eng. Pat. 9923, June 26, 1891. 6*d.*

Pyrazol derivatives are produced by the action of β-halogen substituted fatty acids or of their esters on phenylhydrazine, the substances being heated together on the water-bath and the product of the reaction then separated by the addition of water. From β-chloropropionic acid or its ester *phenyl-pyrazine* (*phenylhydropyrazolone*)—



results.

This body forms fine flat needles or plates which melt at 121° C. and are readily soluble in alcohol and in chloroform. When treated with a mild oxidising agent such as mercuric oxide, in benzene or chloroform solution, it is converted into *dehydro-phenyl-pyrazine* which crystallises in fine needles melting at 154° C. This body has the following constitutional formula:—



From this, *dehydro-methyl-phenyl-pyrazine* is obtained by the action of methyl iodide and wood spirit at 100° C., a body which possesses valuable antipyretic properties. It is readily soluble in water and crystallises from chloroform in large crystals which melt at 120° C.—C. A. K.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

Stability of Hydroxylamine. V. Meyer. Annalen, 1891, 264, 126.

See under XX., *page* 790.

PATENTS.

Improvements in the Manufacture of Transparent Flexible Films for Photographic and other Purposes. J. W. Swan, Bromley, and J. Leslie, Belfast. Eng. Pat. 9893, June 26, 1890. 4*d.*

A solution of nitrocellulose or celluloid is distributed by means of a machine or in any other suitable manner, upon or over a surface of paper, linen, cotton, or any other suitable *flexible* material, previously prepared with a surface of gelatine or other substance unaffected by the nitrocellulose or celluloid solution, calendered or polished with tale, &c. After coating, the flexible support must be kept level until the solution sets, when it may be hung up to dry. The film is then stripped from the support. If intended for photographic purposes the film is coated with the sensitive emulsion either before or after stripping.—C. H. B.

Improvements Relating to the Manufacture of Flexible Films for Photographic and other Purposes, and to Apparatus for Use in such Manufacture. B. J. Edwards, London. Eng. Pat. 11,945, July 30, 1890. 8*d*.

The specification describes and illustrates an apparatus for recovering the solvents used in the manufacture of flexible films by passing the coated support through a heated chamber from which the vapours are driven or drawn into a refrigerating and condensing apparatus. The support used is preferably a plate or slab of glass, and after the dried film has been coated with the sensitive emulsion these slabs are passed into a special drying chamber containing horizontal racks placed one above the other and capable of movement in a vertical direction.—C. H. B.

Improvements in Apparatus applicable for Use in Photography. T. B. Sloper, Devizes. Eng. Pat. 12,014, July 31, 1890. 8*d*.

This patent relates to holders made of wire for lifting plates out of developing dishes and holding them during washing, also for keeping prints separate whilst washing. The holders for plates grasp them round opposite corners. In the case of prints, wires or threads are passed across from one end of the wire holder to the other, in order to form a network on which the print rests.—C. H. B.

Improvements in the Manufacture of Photographic Films. J. J. Acworth, London. Eng. Pat. 13,836, September 3, 1890. 4*d*.

A band of American cloth or other suitable material is coated with a strong solution of gelatine or an analogous substance, such as isinglass, containing glycerol or some similar compound in order to make it pliable. When the film of gelatine is dry it is stripped off the support and wound on a roller. The film is then passed through a solution of nitrocellulose or pyroxylin, which makes it waterproof, or nearly waterproof, on both sides. The pyroxylin solution contains from 3 to 6 per cent. of pyroxylin dissolved in a mixture of amyl alcohol and amyl acetate. The film is afterwards dried by passing dry air over the surface, or by placing it in a room kept at a suitable temperature, or by passing it through a specially constructed chamber containing air heated to about 200° F.
—C. H. B.

Improvements in or connected with Photographic Spotting or Re-touching. F. C. D. Beacham, London. Eng. Pat. 2390, February 10, 1891. 6*d*.

A coloured crayon for spotting or re-touching is made by melting together, and heating at a high temperature, white wax, soap, "salts of nitre," pitch, shellac, calcined lampblack, and brown, scarlet, blue, and violet powders in varying proportions according to the colour required.
—C. H. B.

Improvements in Photography. A. J. Boult, London. From J. North, New York, U.S.A. Eng. Pat. 8557, May 19, 1891. 6*d*.

Guaiaretic acid, $C_{20}H_{26}O_4$, when freshly prepared, is soluble in alcohol, ether, carbon bisulphide, chloroform, acetic acid, benzene, &c., but when the free acid, or its salts with metallic or organic bases, or its haloid substitution derivatives and their salts, are exposed to light, they become more or less insoluble in the solvents named. The addition of small quantities of Aniline violet, Magenta, Safranine, and other colouring matters, accelerates the action of the light. Guaiaretic acid is prepared by concentrating to a thin syrup a filtered solution of two parts of guaiacum in 10 parts of alcohol and adding a warm concentrated solution of 1 part of potassium hydroxide. After 24 hours the pulpy mass is pressed through a filtering cloth, and the solid matter washed with alcohol and then with water, and finally crystallised from dilute alcohol.

One hundred parts of the acid, or 120 parts of its silver, zinc, lead, or magnesium salt with or without 3 to 4 per cent. of Aniline violet or other colouring matter, are dissolved in 500 parts of pure benzene. 7½ parts of dry caoutchouc is also dissolved in 500 parts of benzene, and the two solutions are thoroughly mixed and spread in the dark on a well cleaned surface of glass, metal, &c. The dried film is exposed behind a transparent negative or positive to bright sunshine for 10 to 12 minutes, and is developed by means of a mixture of one part of benzene and five parts of turpentine, or some similar liquid. The plate is then dried and etched by some acid according to the nature of the support.

Another method is to mix a neutral aqueous solution of 10 parts of guaiaretic acid (neutralised by any alkali) with 100 parts of a dilute solution of gelatine. A well-cleaned surface is coated with this mixture and dried in a horizontal position at a temperature not exceeding 120° F. The film is then put into a dilute solution of any suitable acid in order to precipitate guaiaretic acid in the film, or into a solution of a metallic salt in order to form a guaiaretate. After thorough washing it may or may not be immersed in a very dilute solution of an aniline dye. After again drying the film is exposed and is then developed with a benzene developer. After drying the gelatine film is hardened by means of alum, chrome alum, tannic acid, &c., and the support is etched through the film by a suitable acid. If the image is etched on glass suitable pigments may be rubbed in and fixed.—C. H. B.

XXII.—EXPLOSIVES, MATCHES, Etc.

The Rate of Explosions in Gases. H. B. Dixon. Lecture Royal Inst., June 12, 1891.

See under II., *page* 752.

Modern Explosives in Relation to Health. Industries, August 21, 1891, 182.

In compliance with the wish of the workpeople a committee was formed in September 1889 of the Durham Coal Owners' Association consisting of representatives of both masters and men, with two of Her Majesty's Inspectors of Mines, to consider the question and report whether the fumes produced by the combustion of *Tonite* and *Roburite* were injurious to health.

The medical report of Drummond and Hume shows that after thorough inquiry and examination, they could find no evidence of acute illness being caused. The general conclusions arrived at by the united experts, chemical and medical, were that (1) the fumes produced by *Tonite* and *Roburite* are not more dangerous than those from gunpowder. (2.) Nitrobenzene is apparently not produced by the combustion of *Roburite*. (3.) The carbon monoxide produced is only present in traces. (4.) An interval of five minutes should be allowed to elapse before the hewers re-enter the scene of firing; and (5) that as a portion of the gases in the fumes came from the fuse the charges should be fired by electricity.

Dynamite. V. Meyer. Annalen, 1891, **264**, 127–129.

According to the researches of Abel, explosive substances are not exploded by the detonation of any other body, but it is only certain detonators which produce an explosive effect in each case. For instance, large quantities of iodide of nitrogen will not explode gun-cotton, and dynamite is not fired by all explosives. Hence it appears that the explosive wave of the detonator must be specially suited to the explosive, and consequently one would expect that each explosive would be its own best detonator. The author observed, however, that in one instance, when he exploded a dynamite cartridge as a lecture experiment and had pushed an ordinary detonator further than usual into the mass

of the dynamite, that although an explosion took place, a considerable portion of the dynamite remained unaffected and was merely scattered about, a result which is quite out of accord with the above theoretical idea. In like manner, the author points out that Abel, on allowing a weight of 22 kilos. to fall through a space of 11·9 m. upon compressed gun-cotton, found that only a comparatively small portion of this material was exploded, whilst the greater portion was scattered about in a finely-divided state. —C. A. K.

PATENTS.

Improvements Relating to Explosive Projectiles or Shells and to Cartridges or Charges for Use therein. J. M. McMahan, New York, U.S.A. Eng. Pat. 9612, June 20, 1890. 1s. 3*d*.

The object of this invention is to enable nitro-glycerin and other high explosives to be fired with safety in shells. For description of the numerous means by which the inventor proposes to effect his purpose, the original specification, with its copious description and numerous drawings, must be consulted.—W. M.

Improvements in the Manufacture of Explosive Projectiles. A. Martin, Birmingham. Eng. Pat. 11,616, July 24, 1890. 6*d*.

The object of the invention is to prevent the blowing out of the fuse and the consequent failure of the shell to burst under the force of the explosion. For this purpose "the base of the shell is formed by closing in or contracting the internally threaded rear end of the shell behind or around an externally threaded ring or bushing after the same has been screwed into the body of the shell. The ring or bushing is thus wholly or partially imprisoned by the contracted end of the shell, the fuse being screwed into a tapped hole passing through both the closed-in base of the shell and the internal ring or through the bushing only, as the case may be."—W. M.

Improvements Relating to the Manufacture of Explosives and to Apparatus therefor. H. H. Lake, London. From H. S. Maxim, Westminster. Eng. Pat. 15,483, September 30, 1890. 6*d*.

The invention proposes to effect great economy in the manufacture of nitrocellulose by dipping the cotton successively in acid baths of increasing degrees of strength. The excess of acid is removed at each operation from the cotton. When the acids in the final bath become too weak to properly complete the nitration, the weakest bath is removed and a fresh bath of highly concentrated acids is added which becomes the final one, and so on systematically. After immersion in the last bath the cotton is left in contact with the adhering acids in closed chambers for some hours. It is then quenched in a large quantity of water and put into a pulping mill which is provided with heating coils, so that the wash water can be heated, and thus the material can be thoroughly washed without having recourse to the usual boiling.—W. M.

Improvements in Matches. J. A. Ventris, Reading. Eng. Pat. 4381, March 11, 1891. 6*d*.

This improvement consists in coating wooden splints with wax, stearin, or any other substance.—W. M.

Improvements in Smokeless Blasting Compounds and Cartridges made therefrom. A. Moschek and A. Brunner, Graz, Austria. Eng. Pat. 5843, April 4, 1891. 6*d*.

The blasting compound consists of a mixture of malt germs or coombs, ammonium nitrate, and potassium chlorate. The malt germs can be either desiccated or undesiccated, or can be used in a dried or in a steeped condition. The nitrate of ammonium and chlorate of potassium can be employed either solid or dissolved, or the materials for producing these salts can be so used as to be converted into the salts in the blasting material. Other indifferent materials can also be added to the mixture for colouring purposes, such as aniline dissolved in alcohol or glycerol. Further, either of the above salts may be omitted from the mixture, which can be prepared either wet, dry, warm or cold. By modifying the proportions of the ingredients any desired degree of explosive force can be attained. The cartridge is cylindrical, with a central boring for the introduction of the match, round which five air channels are arranged, whilst it also contains a recessed air-chamber at the base. A sketch is given. The name "*Dynamoit*" is proposed for the new explosive.—C. A. K.

XXIII.—ANALYTICAL CHEMISTRY.

APPARATUS.

Brunton's Quartering Shovel. Eng. and Mining 1891, 718.

The author has invented a rapid and accurate sampling tool. The tool consists essentially of a flat-bottomed, well-balanced steel shovel 10 in. in width, having vertical sides, and two central partitions 2½ in. apart, thus dividing the shovel into three compartments, the centre one being closed by a curved back, and having a width one-quarter of the whole.

Sampling Shovel.

To use it the shovel is pushed into a pile of finely-crushed ore. As the shovel is raised it is drawn back at the same time with a sharp rotary motion to the right, which throws the ore contained in the outside compartments out from the back end of the shovel into a rejected ore pile. When the necessary throw to accomplish this result has been given, the motion is reversed and the shovel brought rapidly to the left, which action discharges the sample from the central compartment of the shovel upon a pile.

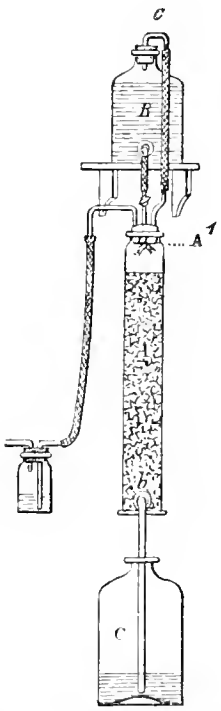
Tests at sampling works and different smelters upon hundreds of lots of ore, many of them in duplicate and triplicate, show that there is no difference between the results obtained by this method and Cornish quartering. Experienced operators attain such great rapidity in this method of quartering that it will doubtless be as applicable to concentrates and all other finely-crushed material as to the final reduction of machine samples. In some recent speed tests it was found that a ton of ore could be cut down to a 100-lb. grinder sample by one man in 15 minutes.

Apparatus for the Constant Generation of Gases. R. J. Ulbricht and O. Foerster. Chem. Zeit. 1891, **15**, 563.

The authors are in the habit of drying feeding cakes, and their ethereal extracts, in a current of carbonic anhydride. As the Kipp's apparatus requires a good deal of attention, and wants often re-charging, they have now constructed an apparatus which will be found to answer better, and can be left for a long time to itself.

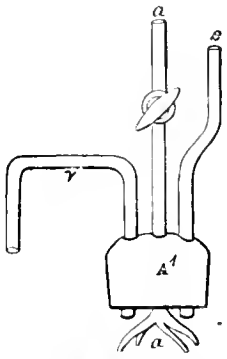
Fig. 1 represents the apparatus. A is a glass cylinder 1 metre in height and 10 cm. in diameter, filled with small

Fig. 1.



lumps of marble. The top of the cylinder is fitted with a trebly-perforated ground glass stopper A^1, and the lower part is connected with the tube *b*. Through the tube *a* (see Fig. 2)

Fig. 2.



A Constant Generator of Gases.

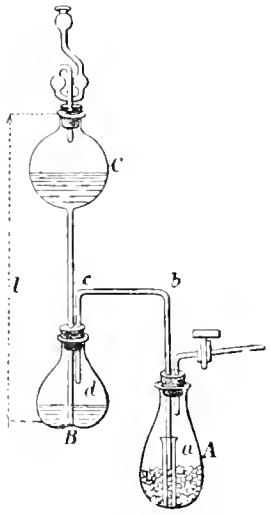
which can be closed by the stop-cock, and the lower part of which is drawn out into four points, hydrochloric acid contained in the reservoir B is allowed to slowly drop on to the marble. Having to traverse such a long distance, the acid is almost completely spent before it reaches the bottom. The solution of the calcium chloride flows through the tube *b* into the flask C, which must contain sufficient fluid to prevent escape of gas. The tube must have a sufficiently large diameter so as never to be filled and consequently not to act as a syphon. The cylinder A is connected with the reservoir B by means of the tube β (Fig. 2), which in turn is connected air-tight with c by means of an india-rubber tube, in order that the pressure of the gas in both tubes shall be the same. The carbonic acid finally escapes through the tube γ (Fig. 2) and is passed through a wash-bottle. If the marble wants replenishing, all the analyst has to do is to remove the stoppers *a* and *c*.

The same apparatus may of course also be used for generating other gases such as hydrogen sulphide.—L. de K.

Continuous Apparatus for the Generation of Chlorine. G. Grünewald. Zeit. Chem. u. Phys. Unterr. 1890, **4**, 84.

The flask A contains the manganese dioxide and is provided

Fig. 1.



Apparatus for Generation of Chlorine.

with a rubber stopper having two holes through one of which the bent tube *a*, *b*, *c*, *d*, passes to the flask B, whilst a tube provided with a stop-cock is inserted in the other. By opening or closing this stop-cock the acid is drawn into or forced back from the flask A, the acid being contained in B and C. The bent tube *a*, *b*, *c*, *d*, must be capable of being moved up and down. To prevent the stopping up of the bent tube it is provided with a number of small holes at the bottom, and is surrounded by a wider tube also containing small holes at the sides as shown in Fig. 2. The dimensions

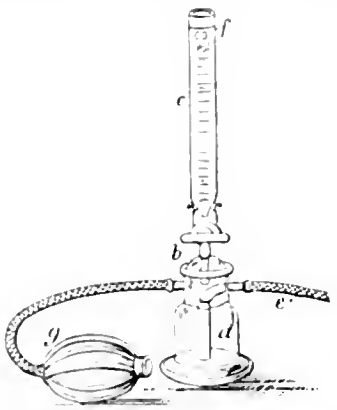
Fig. 2.

recommended are as follows:—Flask A, 300 cc.; flask B, 320 cc.; bulb C, 600 cc.; *a*, *b*, 24 cm.; *b*, *c*, 12 cm.; *c*, *d*, 12 cm.; *l*, 40 cm. For larger forms of apparatus these proportions should be adhered to. The apparatus can also be employed for the continuous generation of other gases that require heat for their production.—C. A. K.

Apparatus for the Rapid Determination of Carbon Dioxide in Furnace Gases. Thonind. Zeit. 1891, **15**, 539—540.

The apparatus, as shown in the Figure, consists of a vessel *a* having a capacity of 100 cc. and provided with an inlet and outlet tube. A graduated tube *c*, divided into cc., and fitted with a stop-cock, is ground into *a* at *b*. The stopper *b* is bored at the side, so that communication between the vessel *a* and its side tubes can be made or closed.

The vessel *a* is filled with the furnace gas to be tested by drawing it in through the tube *c* by means of the rubber ball *g* in the usual way. The graduated tube *c* is filled with caustic soda solution of specific gravity 1·25 to the mark *f*. A blank experiment is first made by filling the vessel *a* with air free from carbon dioxide, closing the openings of the side



Apparatus for Determining Carbonic Dioxide.

tubes by turning the stopper *b* and opening the cock communicating with *c*. The liquid in *c* falls to a certain point, which is made the zero of the instrument. Correction for temperature and pressure is neglected, as the instrument is only intended for rough technical purposes.

In making a determination, the vessel *a* having been filled with the gas to be tested, the soda solution is allowed to flow in until absorption of carbon dioxide is complete and no more can enter. The volume of soda solution used then gives at once the percentage of carbon dioxide in the sample.

Determinations made by this instrument agree well with those made by more accurate apparatus.—B. B.

INORGANIC CHEMISTRY.—QUALITATIVE.

m-Phenylenediamine as a Reagent for Active Oxygen. P. Cazeneuve. Bull. Soc. Chim. 1891, **5**, 855—857.

The author has made some experiments with *m*-phenylenediamine as a reagent for the detection of active oxygen, a use for which it has been recommended by Denigès (Bull. Soc. Chim. 1891, **5**, 293). A 1 per cent. alcoholic solution of the hydrochloride of the base was prepared and mixed with a few drops of ammonium hydrate; such a solution, as Denigès has shown, gives a blue colouration when heated with hydrogen peroxide. The author finds that the active oxygen contained in animal black, resin black, coke, and mineral black (the residue of calcined schists), gives immediately an indigo blue colouration with the reagent; the reaction is less decided when these substances have been washed with hydrochloric acid. Platinum black acts still more powerfully, a milligramme of the same being sufficient to cause the coloration of 10 cc. of the reagent. Ozone gives a very distinct brown colouration, whilst ordinary oxygen, even under a pressure of 100 atmospheres, fails to effect any change.

As *m*-phenylenediamine thus distinguishes between ozone, hydrogen peroxide, and the active oxygen contained in charcoal, &c. (this Journal, 1890, 657), it is superior as a reagent for active oxygen to the methyl derivatives of *p*-phenylenediamine proposed by Wurster (this Journal, 1887, 304), which do not so discriminate.—F. B.

INORGANIC CHEMISTRY.—QUANTITATIVE.

Estimation of Bismuth in Silver Refinery Slags. W. Hampe. Chem. Zeit. 1891, **15**, 410.

At Lautenthal crude silver is refined according to Roessler's method (this Journal, 1889, 286) by treating it in graphite crucibles with powdered quartz and silver sulphate, this process occasioning less loss of silver and purifying it almost completely from bismuth. The slag consists mainly of silicates, and is sold according to the percentage of silver and bismuth. For a complete analysis the slag is evaporated to dryness with nitric acid, taken up with nitric acid and water, filtered, and the residue fused with soda in a platinum crucible, the fused mass treated with nitric acid, the solution evaporated to dryness, &c. For a determination of the bismuth it is sufficient to digest 1 grm. of the finely-powdered slag with 15 cc. of the nitric acid for a considerable time, adding 10 cc. concentrated hydrofluoric acid, and when solution is complete adding a few drops of sulphuric acid and evaporating to dryness. The residue is dissolved in nitric acid, filtered from graphite, neutralised with ammonia, precipitated with ammonium carbonate, boiled, filtered, the precipitate dissolved in nitric acid, sulphuretted hydrogen passed in, the precipitated sulphides redissolved in nitric acid, treated with ammonium carbonate, the precipitated lead and bismuth carbonates dissolved in hydrochloric acid, evaporated almost to dryness, treated with excess of hot water, and the undissolved bismuth oxychloride filtered off, dissolved in nitric acid and reprecipitated with ammonium carbonate. The dry bismuth carbonate is removed as far as possible from the filter paper from which the adhering traces are dissolved off with nitric acid, the solution evaporated to dryness in a weighed porcelain crucible, the bulk of the carbonate added, and the whole ignited to oxide.

The following is an average analysis of a silver slag from the Roessler process:—

SiO_2,	P_2O_5,	SO_3,	S,	FeO,	Al_2O_3,	Bi_2O_3,	PbO,
40·07,	0·61,	0·61,	0·15,	13·47,	0·43,	6·61,	33·50,

Ag_2O,	Cu,	Sb,	CaO,	MgO,	K_2O,	Na_2O.
2·05,	0·45,	0·02,	1·73,	0·25,	0·64,	0·26.

—S. B. A. A.

Estimation of Phosphorus in Pig Iron by the Centrifugal Process. C. Reinhardt. Chem. Zeit. 1891, **15**, 410.

The centrifugal process for estimating phosphorus in iron is now largely adopted in German steel works. Bormann and Von Reis (this Journal, 1890, 111) recently rendered it available for use with high carbon steels by introducing potassium permanganate into the boiling solution of steel. Von Reis has determined the influence on the volume of the separated precipitate of the amount of acid, ammonium nitrate, and molybdate present, and of the dilution, but has overlooked the effect of variations of temperature and of the time of rotation. The bulk of the precipitate is greater when the temperature of precipitation is high, and decreases with continued rotation, and in order to obtain satisfactory results the method of working must be absolutely uniform. The process is conducted by the author as follows:—Two grms. of pig iron (1 to 0·5 grm. if there be over 1 per cent. of phosphorus) are treated in a 500 cc. flask with 60 cc. of nitric acid (sp. gr. = 1·2), heated until solution is complete and the nitrous acid is expelled, a solution of potassium permanganate (10 cc. for grey iron, 20 cc. for white iron, 30 cc. for spiegel and ferro-manganese) added a little at a time, the whole boiled for a few minutes longer and a solution of potassium oxalate added drop by drop until the liquid becomes clear. After boiling for a little while it is cooled, diluted to 250 cc., the silica (when there is much) allowed to subside, and filtered off; 25 cc. of the solution (= 0·2 grm. iron) are pipetted off into a 200 cc. Erlenmeyer flask, which must be previously cleaned by rinsing with 50 cc. of 10 per cent. ammonia, distilled water, 100 cc. of warm hydrochloric acid (1:1) and distilled water successively to prevent adhesion of the precipitate to the sides of the flask,

10 cc. of acid ammonium nitrate solution are added, the whole heated exactly to 70°, 10 cc. of ammonium molybdate solution added, and the mixture briskly agitated for 1 to 2 minutes and allowed to cool. The pear-shaped vessel with graduated stem in which the precipitate is rotated is cleaned first with a strong jet of distilled water, then, if necessary, with dilute ammonia and water, and finally it is half filled with hot hydrochloric acid (1:1), emptied and rinsed with distilled water. The precipitate is poured into this vessel directly, the last portions being washed in with water containing a little ammonium nitrate; the vessel is then closed with the thumb, well shaken and placed in the centrifugal machine. The latter is rotated for two minutes at the rate of 20 revolutions per second, and then violently brought to a full stop, the vessel removed, closed, tapped on the bench until the precipitate has a level surface, and the volume read off. The mean coefficient or value of a division of the calibrated stem of the vessel, must be ascertained by a number of very carefully made comparative gravimetric and centrifugal determinations. A series of analyses given by the author show a difference from 0·005 to 0·026 per cent. of phosphorus in different classes of iron.

The reagents used in the above process are as follows:—(*a.*) *Acid ammonium nitrate*, a clear solution of 400 grms. of ammonium nitrate in 280 cc. of water, to which is added 280 cc. of nitric acid (sp. gr. = 1·4). (*b.*) *Potassium permanganate*, 28 grms. of the crystals are dissolved in 1 litre of water. (*c.*) *Potassium oxalate*, 250 grms. of the neutral salt in 1 litre of water. (*d.*) *Molybdate solution*, 180 grms. of molybdic acid are dissolved in 450 cc. of water and 450 cc. of 20 per cent. ammonia, the solution allowed to stand several days, filtered and 450 cc. of the filtrate added to 1 litre cold nitric acid (sp. gr. = 1·2), heated to 80° or 90° C., let stand for some days and filtered. (*e.*) *Wash-water containing ammonium nitrate*, a clear solution of 750 grms. of ammonium nitrate in 1 litre of water is added to a mixture of 250 cc. of nitric acid (sp. gr. = 1·4) with 3½ litres of water.—S. B. A. A.

Analysis of Phosphates. J. H. Vogel. Chem. Zeit. 1891, **15**, 495—499.

For the estimation of ferric oxide and alumina the author prefers a combination of the methods of Glaser (this Journal, 1890, 111) and Stutzer, as follows:—The lime is precipitated as sulphate according to Glaser's method, and the filtrate is then rendered alkaline with excess of ammonia; this excess of ammonia is *not* expelled by boiling. The precipitated phosphates of iron, alumina, and possibly a little magnesia, are filtered off, and then, without any washing, 30 cc. of nitro-molybdate solution are poured on to the precipitate while still on the filter. The beaker, in which the phosphates were precipitated, and which will still contain a little of this adhering to the sides, is placed under the funnel, and the phosphates become dissolved by the nitric acid of the molybdic acid solution. 20 cc. of the molybdate solution are diluted to 100 cc. with water, and the filter thoroughly washed with it. The phosphoric acid in the solution is precipitated and filtered off, and the filtrate, which now contains the iron, alumina, and magnesia (if present at all) is heated to boiling, and after the ferric oxide and alumina are completely precipitated with ammonia, 10 cc. of concentrated ammonia are added. It sometimes happens that some molybdic acid precipitates with the iron and alumina, but this will be entirely redissolved by excess of ammonia. The magnesia present remains unprecipitated, and the precipitated iron and alumina are therefore pure.

The results obtained by the author are good.

If it be desired to estimate the magnesia also, it is recommended to allow the first ammonia precipitate, consisting of the phosphates of iron, alumina, and magnesia, to stand for 24 hours, instead of filtering it off while still hot. In this case the whole of the magnesia is separated with it, and will be found, together with the ammonium molybdate, in the filtrate, after separating the ferric oxide and alumina.

—J. W. L.

Estimation of Sulphur in Iron and Steel. G. Hattensaur. Chem. Zeit. 1891, **15**, 521.

The accuracy of the results obtained by dissolving the metal to be tested in hydrochloric acid and oxidising the sulphuretted hydrogen evolved has been questioned by Meineke (this Journal, 1888, 645) and others.

A series of analyses of Siemens-Martin metal made by the author by this method, and by dissolving the metal in a solution of sodium copper chloride, yielded, however, very concordant results, as is evident from the following figures:—

—	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.	No. 7.
Solution in hydrochloric acid.	0·022	0·052	0·034	0·008	0·025	0·027	0·011
Solution in sodium cop. perchloride.	0·020	0·063	0·033	0·007	..	0·027	0·012

It may be noted that in one of these samples (No. 6) the whole of the sulphur was evolved on treatment with hydrochloric acid, in spite of the presence of a considerable quantity of copper (0·16 per cent.).—S. B. A. A.

The Employment of Iodic and Bromic Acids in Quantitative Analysis. A. Schwicker. Chem. Zeit. 1891, **15**, 845—846.

The author has independently elaborated a volumetric process similar to that of Feit and Kubierschky (this Journal, 1891, 486) for the estimation of reducing bodies, involving the use of iodic or bromic acid. The author's method differs from that of Feit and Kubierschky in so far that the bromine liberated by the reduction of the bromic acid is not boiled off prior to titration with sodium thiosulphate. Of course, in those cases when the substance being estimated is only completely oxidised at a boiling temperature, or when it is necessary to filter the liquid, only the latter process is permissible. Iodic acid is only capable of very limited application on account of its feeble oxidising power. Sulphurous acid is almost the only body that may be conveniently estimated by its means. The reactions on which the method is based are as follows:—

$$2\,HIO_3 = H_2O + I_2 + O_5$$
$$2\,HIO_3 + 10\,HI = 6\,H_2O + 6\,I_2$$

It appears, therefore, that it is only necessary to know the thiosulphate equivalent of the standard solution of iodic or bromic acid before and after the addition of the reducing body which it is desired to estimate. The difference between the two volumes of thiosulphate is a measure of the oxygen consumed by the reducing substance. The author employs normal-tenth and normal-hundredth solutions of sodium thiosulphate, potassium bromate, and potassium bi-iodate. In carrying out an analysis a measured volume of iodate or bromate solution is acidified with an excess of sulphuric acid, and a known quantity of the substance to be estimated is added. After a short time an excess of potassium iodide is added, and the liberated iodine is titrated with sodium thiosulphate. The following example will show the method of calculation:—

10 cc. of a solution of sodium sulphite, containing 0·01038 grm. of Na_2SO_3 were treated with 10 cc. of normal-tenth iodate solution. Afterwards 8·35 cc. of normal-tenth thiosulphate were required to absorb the liberated iodine. The difference (10 cc. − 8·35 cc. = 1·65 cc.) represents the volume of iodate consumed. Now, 1 cc. of normal-tenth iodate equals 0·0063 grm. Na_2SO_3. Therefore, 1·65 cc. = 0·01039 grm. Na_2SO_3.

The other test analyses given are very satisfactory.

—H. T. P.

The Estimation of Carbon Dioxide. F. Tschaplowitz. Zeits. Anal. Chem. 1891, **30**, 279—282.

THE method here described relates to the estimation of carbon dioxide in carbonates, and is used by the author in cases where only a small quantity of material is available for examination. Schulze's method (Zeits. Anal. Chem. **9**, 290), in which the carbonic acid evolved is absorbed by a solution of barium hydrate of known strength, and the excess of barium hydrate afterwards titrated with oxalic acid, using turmeric tincture and paper as indicator, he finds too tedious. Weighing in an absorption apparatus, the gain in weight indicating the carbon dioxide absorbed, he finds open to two objections that the aqueous vapour evolved during the boiling required to expel the carbon dioxide from the generating flask is not completely absorbed by such drying materials as sulphuric acid, calcium chloride and anhydrous copper sulphate, and if hydrochloric acid be used for evolving the carbon dioxide, some of this passes the copper sulphate absorption tube and is weighed as carbonic acid. He also finds that self-contained apparatus, in which the carbonic acid is determined by the loss in weight after its expulsion, are unreliable owing to the difficulty due to surface condensation, as these apparatus, owing to their irregular shape, cannot be easily perfectly cleaned or brought to the same condition of surface at the beginning and end of the experiment. To avoid these objectionable features he uses an absorption apparatus consisting of a double-necked flask, with corks in each neck, through which pass wide tubes. The tubes are filled with glass beads about the size of peas, and a layer of beads 4 cm. thick covers the bottom of the flask. About 25 cc. of a 1·5 per cent. caustic potash solution is poured over the beads. The carbonic acid is evolved by sulphuric acid in a flask which is attached to the absorption flask by an india-rubber tube. This generating flask should be large enough to contain sufficient water to dissolve any calcium sulphate that may be formed in it. After boiling to expel all the carbon dioxide from the generating flask, the beads are rinsed with hot water out of the tubes of the absorption flask into the bottom of this flask, and a solution of barium chloride is added, and after closing the necks of the flask it is allowed to stand two hours. The excess of caustic potash is then titrated with 1·20 normal oxalic acid, using turmeric tincture and paper as indicator. A blank titration with the caustic potash, using the same quantity of hot water and barium chloride, and allowing to stand two hours, must also be made.

—H. S. P.

A New Volumetric Method of Estimating Manganese. L. Blum. Zeits. Anal. Chem. 1891, **30**, 284—288.

THIS method depends upon the precipitation of manganese as manganese ammonium ferrocyanide, $Mn(NH_4)_2Fe(CN)_6$, by a standard solution of potassium ferrocyanide, from an ammoniacal solution of manganese containing ammonium chloride. When tartaric acid and a ferric salt are present in such a solution, the iron is not precipitated by potassium ferrocyanide, but after the whole of the manganese has been precipitated an excess of ferrocyanide is indicated by taking out a drop of the liquid upon a porcelain plate and mixing it with a drop of acetic acid: the ferric salt and the excess of ferrocyanide then react and produce the blue colour of iron ferrocyanide. The presence of any of the precipitated manganese ammonium ferrocyanide in the drop of liquid does not interfere with the test, as the manganese salt and the ferric salt do not react together in an acetic acid solution, even after a considerable time. Manganese-ammonium ferrocyanide and acetic acid react and produce ammonium acetate and an acid manganese salt of ferrocyanic acid, viz., $MnH_2Fe(CN)_6$.

When much iron is present the yellow colour of the solution renders the finishing point of the titrations indefinite. This is the case in testing steels for manganese by this method, but the author has obtained good results in testing manganese ores. In testing manganese ores 5 grms. of the sample are dissolved in concentrated hydrochloric acid, and the solution made up to 250 cc. without removing the insoluble residue. 50 cc. of this solution (equal to 1 grm. of the sample) are then measured from a pipette into a beaker. If no iron or not enough iron be present, a few drops of ferric chloride are now added, then 20 cc. of a concentrated solution of ammonium chloride and 30 cc. of tartaric acid solution (1:2) are added, and finally the mixture is rendered strongly ammoniacal. It is then brought to the boiling point and titrated with a standard solution of potassium ferrocyanide, the strength of which has been accurately ascertained by standardising with a solution of pure manganese chloride of known strength. An excess of ferrocyanide solution is shown to be present when a drop of the liquid from the beaker placed upon a white porcelain plate gives a blue colour when mixed with a drop of concentrated acetic acid.

The author found that the potassium ferrocyanide supplied by manufacturers as pure, contained a considerable quantity of sodium ferrocyanide. If, therefore, the standard solution be made on the assumption that the potassium ferrocyanide is pure, results that are too low are obtained owing to the lower molecular weight of sodium ferrocyanide. The solution must therefore be standardised with a known quantity of manganese.

Ferrous salts and zinc salts when present in the manganese solution vitiate the accuracy of the test, as these salts are precipitated by potassium ferrocyanide. If ferrous salts are present they must therefore be oxidised by a few drops of nitric acid.

The standard solutions of potassium ferrocyanide used by the author was made by dissolving 38·487 grms. of crystallised potassium ferrocyanide in one litre of water. One cc. of this solution was found to be equal to 0·005552 grm. of manganese.—H. S. P.

Determination of Rhodium, Mercury, and Gold by Electrolysis. E. F. Smith. J. Anal. and Appl. Chem. 1891, **5**, 200—201.

Rhodium.—The author used for his experiments a solution of crystallised rhodium-sodium chloride, 10 cc. of which contained 0·098 grm. of the metal. 10 cc. of this solution were mixed with 30 cc. of a solution of sodium phosphate (sp. gr. 1·0358), and 3 cc. of solution of phosphoric acid (sp. gr. 1·347). After diluting up to 180 cc., a current yielding 1·8 cc. of electrolytic gas per minute was applied. The precipitation of the metal took place at the ordinary temperature, and was finished in seven hours. 0·0982 grm. of rhodium was found. The liquid was at first of a dark purple colour, but became gradually colourless, a sign that the metal had completely precipitated. The metal which was deposited on a platinum dish was black, and adhered so strongly that it could readily be washed with boiling water without danger of loss.

Mercury.—The best plan is to prepare a solution of mercuric sulphide in sodium sulphide. The latter is best prepared as follows:—A solution of caustic soda of 1·3 sp. gr. is saturated with hydrogen sulphide. The same quantity of soda is then added, and the liquid once more treated for several hours with hydrogen sulphide. The liquid is then rapidly concentrated and allowed to crystallise in a closed flask. After recrystallising the product, it will be fit for use.

The author carried out several experiments with the same solution containing 0·1903 grm. of mercury. It was mixed with 20, 20, 20, 20, and 30 cc. respectively of the sodium sulphide solution (sp. gr. 1·19), diluted up to 125, 125, 125, and 130 cc., and exposed to a current yielding 1, 1, 1, 1·2, and 1·2 cc. of gas per minute respectively. After the current had been acting over night, the amounts of mercury precipitated were respectively 0·1902, 0·1905, 0·1907, 0·1910 and 0·1910 grm. The deposit was greyish and very compact. It was dried by gently blowing over it. The presence of arsenic does not interfere with the process.

Gold.—A solution of gold chloride containing 0·1446 grm. of metal was mixed with 10 cc. of the sodium sulphide solution, diluted with 100 cc. of water, and exposed all night to the action of a current yielding 2·6 cc. of gas per minute. The precipitated metal was bright yellow,

adhered very firmly, was washed with water, and dried on a warm iron plate. Its weight amounted to 0·1446 grm. In a second experiment the double quantity of sodium sulphide was used and the current allowed to act for 5½ hours. The gold which was deposited on platinum was completely recovered. It may be readily removed from the dish by a solution of potassium cyanide.

Gold may be separated in this manner from arsenic, molybdenum and tungsten, but not from antimony or tin.

—L. de K.

New Methods of Quantitative Analysis. A. Baumann. Zeits. f. angew. Chem. 1891, **11**, 328—332.

The author has already described various methods of analysis depending upon the fact that 116·29 parts by weight of chromic acid will liberate 63·84 parts by weight of oxygen from an acid solution of hydrogen dioxide. In the present paper he describes methods, based upon the same principle for estimating lead, bismuth, and barium. These substances all yield chromates insoluble in acetic acid. The precipitated chromate is washed and is then introduced into an apparatus for testing and measuring gases, where it is mixed with hydrogen peroxide and dilute acid. The volume of oxygen evolved is then measured, and from this measurement the quantity of lead, bismuth, or barium, as the case may be, is calculated. Or the base to be determined may be precipitated with a measured quantity of potassium bichromate or chromate solution of known strength, an excess being used. The solution is then made up to a certain bulk, and the precipitate filtered off through a dry filter paper. An aliquot part of the filtrate is then taken and the quantity of chromic acid in excess determined in it by agitating with hydrogen peroxide and measuring the oxygen evolved. In the case of barium a solution of ammonium chromate is employed.—H. S. P.

ORGANIC CHEMISTRY.—QUALITATIVE.

Reaction for Cocaine. F. Flückiger. Pharm Zeit. 1891, **36**, 72.

The author confirms Schell's reaction for cocaine hydrochloride with moistened calomel, which latter is reduced, and shows further that cocaine itself behaves exactly similarly, despite Schell's statement to the contrary, when the two substances are boiled with water. When alcohol is substituted for water the reduction occurs in the case of the hydrochloride, but not with the free base.—C. A. K.

The Examination of Phenacetin by Means of Chloral Hydrate. L. Reuter. Pharm. Zeit. 1891, **36**, 185.

2·5 grms. of chloral hydrate are melted in a test-tube on the water-bath, and 0·5 grm. of the phenacetin to be tested is added. If the phenacetin be pure it will dissolve, forming a colourless solution, which only after prolonged digestion acquires a pink tint. But if the sample contain only a trace of *p*-phenetidin, the mixture will at once assume an intense violet to reddish or bluish-violet colour according to the amount of the impurity present.—H. T. P.

Some New Tests to Distinguish between Naphthalene and α- or β-Naphthol. L. Reuter. Pharm. Zeit. 1891, **36**, 289.

The author adds 0·1 grm. of any of these compounds to 2·5 grms. of fused chloral hydrate and warms for 10 minutes. In some of these experiments he also added hydrochloric acid, with or without zinc.

	—	0·1 Grm. Naphthalene.	0·1 Grm. α-Naphthol.	0·1 Grm. β-Naphthol.
1	+ 2·5 grms. chloral hydrate	Colourless	Intensely ruby-red, transparent, not fluorescent.	Pure blue, transparent, not fluorescent.
2	Ditto + 5 drops of acid.....	Very slight pink	Intensely dark greenish-blue, not transparent.	Intensely yellow, transparent.
3	Ditto, with a piece of zinc..	Violet, passing into brown .	Colour changes to a dark violet-blue. (Water gives a violet flocculent precipitate.) Alcoholic solution, reddish-violet with a violet fluorescence.	Colour becomes of a deep dark brown. (Water throws down a greasy body.) Alcoholic solution, yellow with a blue fluorescence.

—L. de K.

A New Test for Resorcinols. L. Reuter. Pharm. Zeit. 1891, **36**, 292.

If 0·1 grm. of resorcinol is dissolved in 50 cc. of potash ley and a little of this solution is heated in a test tube (placed in hot water) with addition of a drop of chloroform or bromoform, or with a little crystal of either chloralhydrate or bromalhydrate, the mixture quickly assumes an intensive ruby-red colour. The reaction is so delicate that even 1 part of resorcinol dissolved in 17,000 parts of potash ley will still show a distinct reddish colouration. (See following abstract).—L. de K.

Reaction for Resorcinol. L. Scholvien. Pharm. Zeit. 1891, **36**, 299.

The author calls attention to the fact that the reaction described as new by Reuter (preceding abstract), has been known since 1872, when it was published by Guareschi.

—B. B.

Honey Testing. E. Dieterich. Helfenberger Annalen, 1890, 50.

Haenle has submitted to dialysis, left- and right-handed honeys, also samples adulterated with starch syrup, and found that the genuine samples showed after 16—18 hours no polarisation, but the adulterated ones gave a fairly constant right-handed polarisation. Haenle therefore concluded that a sample of honey which after dialysis is right-handed may be taken to be adulterated with starch-syrup. In the author's laboratory these experiments were repeated. The samples were dissolved in 2 parts of water, and after being decolourised with animal charcoal, polarised. They were now submitted to dialysis, the outside water being constantly renewed. After respectively 10, 20, 30, and 45 hours dialysis, the liquid was evaporated to its original bulk and again polarised. The figures obtained show that prolonged dialysis may cause a right-handed polarisation even with pure samples, although there will of course be an interval when the polarisation will be *nil*.

—L. de K.

Testing Olive Oil. E. Dieterich. Helfenberger Annalen, 1890, 79.

Dieterich modifies Labiche's process for the detection of cotton-seed oil in olive oil as follows:—10 cc. of the oil are shaken in a test tube with 10 cc. of ether. 5 cc. of strong *liquor plumbi* are added, and finally, 5 cc. of ammonia, and the whole well shaken. In presence of Cotton-seed oil an orange-red colour gradually appears and may be more particularly noticed in the top layer. In the author's laboratory this test was tried with various oils with the following results:—Poppy oil, Nut oil, and Cotton-seed oil, all gave similar colours. Codliver oil, Arachis oil, Sunflower oil, Sesame oil, and Olive oil, were next examined and gave colours varying from orange to yellow, the colour being most intense in the codliver oil. Lard oil and Castor oil remained colourless. The test therefore fails to serve for the proper identification of cotton-seed oil, all the more because olive oil itself assumes a yellow colour. The test loses still more of its value when it is remembered that there are samples of Cotton-seed oil which do not give the reaction at all.—L. de K.

The Elaidine Test for Fatty Oils. C. Wellemann. Landw. Versuchst. 1891, **37**, 447.

The author applied the elaidine test to olive oil and ground nut oil. 10 grms. of the oil were shaken in a test tube with 5 grms. of nitric acid of 1·37 sp. gr. (at 19° C.), and 1 grm. of mercury for three minutes. After standing for 20 minutes it was once more violently agitated for one minute. After this the time was noticed which the oil took to solidify. It then appeared that the temperature was of great influence on the result, a lower temperature assisting the solidification. Temperature is also of influence on the colour the mixture assumes. The manner of shaking the mixture is also of great importance, the more violently the mass is agitated at first, the more quickly it will set.—L. de K.

Testing Glycerin. J. Lüthke. Apoth. Zeit. 1891, **6**, 263.

The value of the test for the purity of glycerin prescribed by the German Pharmacopœia, consisting in warming the liquid with an ammoniacal solution of silver nitrate (this Journal, 1891, 187) was recently disputed (Chem. Zeit. **14**, 316), and the author's present results justify that condemnation. Of 21 samples tested, the whole number gave a colouration on heating to boiling. Small quantities of arsenic cannot be detected, although that is one of the objects of the test. Similarly acrolein and aldehydic substances are overlooked. The test recommended by the author for acrolein in glycerin consists in heating 5 cc. of the sample with an equal bulk of rosaniline bisulphite solution containing 1 grm. of the dye, 10 grms. of sodium bisulphite, and 15 grms. of 25 per cent. hydrochloric acid made up to 1 litre.—B. B.

On the Testing of Oil of Turpentine. G. Vulpius. Apoth. Zeit. 1891, **6**, 289.

The author finds that reliable determinations of petroleum in turpentine oil may be made by the following modification of a method proposed by Hinsdale. 1 grm. of the sample and 1 grm. of a pure oil of turpentine are weighed on separate watch glasses, which are then floated on a basin of water maintained at about 80° C. As soon as the pure turpentine has evaporated both watch glasses are weighed. The weight of the residue from the pure oil of turpentine (small quantity of resin always present in pure turpentine) is deducted from that of the residue in the watch glass which held the sample. The difference is petroleum, which may thus be determined to one-tenth of a per cent.—G. H. B.

Detection of Rosin Oil in Oil of Turpentine. E. Baudin. J. Pharm. Chim. 1891, **23**, 279.

A drop of the oil to be examined is placed on the lower edge of a small piece of unglazed paper, such as cigarette paper, and there allowed to evaporate spontaneously. If the oil be pure no appreciable mark will remain on the paper, but if the sample contain rosin oil an oily spot is left behind. In doubtful cases 20—30 drops of the suspected oil are evaporated down to 6—8 drops in a small porcelain dish, and the residue is then tested as above.—C. A. K.

Sulphocarbazole as a Reagent for Distilled Waters. L. Viron. J. Pharm. Chim. 1891, **23**, 441.

The reagent employed to characterise such distilled waters as Cinnamon water, Cherry laurel water, Orange blossom water, &c., consists of a mixture of 0·15 grm. of sulphocarbazole and 100 cc. of pure sulphuric acid, which should be boiled for a few minutes to remove traces of nitrous acid. To make a test, 3 cc. of the yellowish fluorescent liquid are placed in a test tube and the water to be tested added gradually by means of a pipette until precipitation takes place. 4 cc. are generally required. Cinnamon water gives a brilliant red colouration, and then a rust-red precipitate; Cherry laurel water also first gives a red colouration followed by a brownish precipitate changing to dark blue; Orange blossom water gives a flesh coloured precipitate, the upper portion of which is of a chesnut brown colour. Pepperamint water, Rose water, Ysop water, Melilot water, and Lime blossom water give more or less whitish precipitates which darken on exposure to the air. These tests serve not only to characterise the various waters, but also to detect any change they undergo.—C. A. K.

On Payen's Process for the Detection of Free Mineral Acids in Vinegar. F. Coreil. Jour. Pharm. Chim. 1891, **23**, 444.

According to Payen's process 100 cc. of the suspected sample are boiled for 20 or 30 minutes with 0·05 grm. of potato starch. If no mineral acids were present the starch will have been but little inverted, and will consequently show with the iodine test; but the presence of even two parts per thousand of sulphuric acid is said to be sufficient to convert all the starch into dextrin or glucose. The author, however, cannot recommend the process as he still obtained the starch reaction with vinegar containing from four parts of sulphuric, or five parts of either hydrochloric or nitric acid per thousand.—L. de K.

Detection of Phenerythrene in Phenol that has turned Red. E. Fabini. Pharm. Post. 1891, **24**, 185.

10—12 cc. of strong sulphuric acid are treated in a test tube with double the volume of the phenol. An orange-coloured zone is formed at the junction of the two liquids, above which a more or less violet-blue zone appears, the latter being characteristic of phenerythrene (this Journal, 153—154).—C. A. K.

Method of Detection of Sugared Wine in Natural White Wines. Sochaczewski. L'Union pharm. 1891, **32**, 209.

See under XVII., *page* 782.

ORGANIC CHEMISTRY—QUANTITATIVE.

Estimation of Free Acids in Butter. C. Hesana. Chem. Zeit. 1891, **15**, 410.

The author has found that the volumetric estimation of the total free acids in butter only yields comparable results when the process is always conducted in exactly the same

way, even in the smallest particulars. He proceeds as follows :—

20 grms. of butter are melted on the water-bath, separated from the buttermilk, filtered, and 10 grms. of the liquid fat weighed out into a cylinder of about 40 cc. capacity 17—18 mm. in diameter, provided with a well-fitting ground stopper. The butter is then warmed up by dropping the cylinder into a water-bath, when 15 cc. of 95 per cent. alcohol are added, the whole warmed as before for a few minutes, shaken energetically for one minute and left in the water-bath until the alcohol separates from the oily layer. The latter is decanted into an Erlenmeyer flask and treated twice in the same way with successive quantities of 15 cc. of alcohol. The alcoholic solution, which contains the whole of the free acids, is titrated with decinormal soda in presence of 0·5 cc. phenolphthalein.

The author, like Schweissinger and others, has found that the rancidity of butter is entirely independent of the amount of free acid present, extremely rancid butter having often a low degree of acidity and vice versâ.—S. B. A. A.

Determination of Ash in the Products of the Sugar Manufacture. E. Donath and G. Hattensaur. Chem. Zeit. 1891, **15**, 520.

See under XVI., *page* 781.

Röse's Method for the Estimation of Alcohol. L. Grünhut. Chem. Zeit. **15**, 847—848.

Röse's method for the estimation of alcohol is based on the idea that under certain conditions alcohol is completely oxidised to carbonic acid by potassium permanganate, according to the following equation :—

$$5\,C_2H_6O + 12\,KMnO_4 + 18\,H_2SO_4 = 10\,CO_2 + 6\,K_2SO_4 + 12\,MnSO_4 + 33\,H_2O.$$

The author has had occasion to try the method and has followed Röse's instructions to the letter; but the results obtained were exceedingly unsatisfactory, the alcohol being found in all cases far too low. The discrepancies were discovered to be due to incomplete oxidation of the alcohol, the smell of acetic acid being plainly perceptible in several of the experiments. In fact by decreasing the volume of sulphuric acid employed with the permanganate the results agreed roughly with the hypothesis that the alcohol was oxidized to acetic acid. On the other hand, when the sulphuric acid was largely increased the alcohol found was also higher, but still unsatisfactory. In one case 200 cc. of strong sulphuric acid were used (50 cc. of permanganate, 2 cc. of dilute alcohol, and 3 cc. of water), the result obtained was 0·0509 grm. of alcohol, against the theoretical amount of 0·0585 grm. That Röse obtained satisfactory results by this process may possibly be due to the fact that he used absolutely pure alcohol in his experiments, whilst the author employed a more or less impure distillate from a fermented liquid. Still, under the circumstances, the author considers the method to be practically of very little use.—H. T. P.

On the Quality of various Lards. C. Engler and G. Rupp. Zeits. f. angew. Chem. 1891, 389—391.

The authors find that more than one half of the American lard consumed in Germany is either adulterated with cotton-seed oil or consists of a mixture of tallow, vegetable oil, and perhaps a small percentage of lard.

With a view to investigate the influence which the mode of feeding or different breeds of swine might exert on the composition of lard, the authors have collected and examined a number of samples of pure lard from different countries. The following methods of examination were adopted :—

1. Hübl's iodine absorption. This method gave the best results for deciding the quantitative composition.

2. Bechi's test of boiling with an alcoholic solution of silver nitrate. This was found very useful for qualitative information.

3. Labiche's colour test of treating with acetate of lead and ammonia. This test was not always found to be reliable, since it seemed much influenced by the action of light, also by the age and the rancidity of the sample.

4. Maumené's test of observing the increase in temperature on mixing with concentrated sulphuric acid. This gave satisfactory results when applied with care.

A useful reagent for indicating qualitatively the presence of vegetable oil in lard was found by Welmans in phosphomolybdate of soda dissolved in nitric acid. A solution of lard in chloroform shaken up with Welmans' reagent does not alter in colour when pure; the solution becomes green in presence of vegetable oil, increasing in intensity of colour with the quantity of oil. The green changes to blue on supersaturation with ammonia, whilst the solution of pure lard is not effected by excess of ammonia.

The table shows the results obtained by the authors on examination of a number of lard samples :—

Lard from	Hübl's Iodine Number.	Bechi's Silver Nitrate Test.	Silver Nitrate Test in Ethereal Solution.	Labiche's Lead Acetate Test.	Maumené's Reaction. Rise of Temperature.
					°
America (Eldred, Pennsylvania)	58·6	Colourless	Colourless	White	31·0
England (London)	59·0	,,	,,	,,	31·5
France (Paris)	58·5	,,	,,	,,	31·0
Italy (Grottamare)	57·8	,,	,,	,,	31·2
Hungary (Budapest)	58·6	,,	,,	,,	31·4
Butchers in Karlsruhe... I.	57·8	,,	,,	,,	31·0
Butchers in Karlsruhe... II.	58·0	,,	,,	,,	31·6
Butchers in Karlsruhe... III.	57·3	,,	,,	,,	31·0
Butchers in Karlsruhe... IV.	56·9	,,	,,	,,	31·4
Butchers in Karlsruhe... V.	58·3	,,	,,	,,	31·5
Butchers in Karlsruhe... VI.	57·5	,,	,,	,,	31·5
Butchers in Karlsruhe... VII.	57·6	,,	,,	,,	31·0
Butchers in Karlsruhe... VIII.	59·0	,,	,,	,,	32·0
Butchers in Karlsruhe... IX.	58·5	,,	,,	,,	31·5
Butchers in Karlsruhe... X.	58·6	,,	,,	,,	31·8
Cotton oil (pure American)	112·0	Dark brown	Dark brown	Brown	81·0
10 parts cotton oil, 90 parts lard	60—61	Brown	,,	White	34·0
20 per cent. cotton oil	67—68	,,	,,	Yellowish	40—42·0
50 per cent. cotton oil	82—85	Dark brown	Brown	Yellow-brown	58·0

The authors have further examined 61 samples of lard obtained from the Verwaltungs-behorden of the Grand Duchy of Baden; the following table will show to what extent lard has been adulterated with cotton oil. Samples marked with asterisks were pronounced adulterated.

Lard from		Hübl's Iodine Number.	Becchi's Silver Nitrate Test.	Silver Nitrate Test in Ethereal Solution.	Labiche's Lead Acetate Test.	Maumene's Reaction. Rise of Temperature.
	1*	87·6	Brown-black	Brown-black	Dark brown	57°0
	2*	83·6	.. ..	.. ..	Brown	54·5
	3	87·9	.. ..	.. ..	Dark brown	58·5
	4	63·3	Reddish	Yellow	White	36·0
	5*	81·1	Dark brown	Brown	Yellow	54·0
	6*	82·2	Brown	.. ..	.. ..	54·0
	7	62·7	Colourless	Colourless	.. ..	32·0
	8	57·4	.. ..	.. ..	.. ..	31·0
	9*	65·3	Brown	Brown	Brown	41·0
	10*	85·4	.. ..	.. ..	.. ..	53·0
	11	63·0	Colourless	Colourless	White	35·5
	12*	67·5	Brown	Brown	Yellowish	43·0
	13	63·2	Colourless	Colourless	.. ..	36·0
	14	63·0	Reddish	Reddish	Yellow	36·0
	15	65·1	Colourless	Colourless	White	41·0
	16	63·5	.. ..	.. ..	Yellowish	36·0
	17*	86·3	Brown-black	Dark brown	Brown	53·0
District Karlsruhe	18	65·5	Colourless	Colourless	White	41·0
	19*	88·64	Black	Dark brown	Brown	55·0
	20*	90·0	Grey black	.. ..	.. ..	57·0
	21	60·8	Colourless	Colourless	White	33·0
	22*	79·1	Brown	Yellow	Yellow	46·0
	23*	87·4	Black	Dark brown	Brown	58·0
	24	65·5	Reddish	.. ..	Yellow	41·0
	25	65·0	Colourless	Colourless	White	40·0
	26	61·8	Brown	Brown	Yellow	42·0
	27*	74·8	Black	.. ..	Brown	44·0
	28	62·2	Reddish	Pink	Light yellow	35·0
	29	63·0	Colourless	Colourless	Yellowish	36·5
	30*	87·2	Black	Dark brown	Brown	58·0
	31	62·1	Reddish	Reddish	Light yellow	36·0
	32	64·3	Colourless	Colourless	White	34·0
	33	69·4	Brownish	Brownish	.. ..	35·0
	34	65·0	.. ..	Yellow	.. ..	35·0
	35	59·0	Colourless	Colourless	.. ..	32·2
	36*	75·5	Brown	Brown	Yellowish	41·0
	37*	80·0	.. ..	.. ..	Dark yellow	56·0
	38	58·9	Colourless	Colourless	White	31·5
	39*	66·1	Brown	Brown	Yellow	42·0
District Pforzheim	40*	71·0	.. ..	.. ..	Brown	47·0
	41*	78·7	Dark brown	Dark brown	Yellow	44·0
	42*	69·4	.. ..	Brown	Brown	44·5
	43*	71·4	Brown	.. ..	Yellow	42·0
	44*	72·7	.. ..	.. ..	.. ..	42·5
	45*	81·9	Brown-black	.. ..	Brown	44·5

Lard from		Hübl's Iodine Number.	Bechi's Silver Nitrate Test.	Silver Nitrate Test in Ethereal Solution.	Labiche's Lead Acetate Test.	Maumené's Reaction. Rise of Temperature.
		°				°
District Bruchsal	46.....	57·0	Colourless	Colourless	White	32·5
	47.....	63·3	.. ..	.. ..	.. ..	34·0
	48*.....	94·8	Black	Brown black	Brown	57·0
	49.....	69·85	Reddish	Reddish	White	34·0
	50*.....	85·76	Brown black	Brown	Brown	56·0
	51.....	65·0	Reddish	Reddish	.. ..	39·0
Rastatt	52	62·7	..	..	White	36·0
	53*.....	85·8	Brown	Brown	Light brown	53·0
	54	62·0	Colourless	Colourless	White	35·0
	55*.....	87·2	Black	Dark brown	Brown	58·0
	56*.....	80·28	Brown	Brown	Yellow	49·5
	57*.....	77·7	Dark brown	Dark brown	..	46·5
	58	63·5	Reddish	Reddish	..	35·0
Offenburg	59*	78·55	Brown	Brown	Dark yellow	44·0
Mannheim Prisons	Wilcox 60*	65·0	Light brown	..	Yellow	37·0
	Fairbank 61*	85·6	Brown-black	..	Brown	56·5

—K. E. M.

Some Experiments on the Changes in Weight which Fatty Oils undergo on Exposure to Air. R. Kissling. Zeits. f. angew. Chem. 1891, 395—398.

See under XII., *page* 778.

On the Determination of Glycerol by Benedikt and Zsigmondy's Method. C. Mangold. Zeits. f. angew. Chem. 1891, 400—401.

The author has simplified Benedikt and Zsigmondy's method (this Journal, 1889, 6) of determining glycerol as follows :—

To 0·2—0·4 grm. of glycerin dissolved in 300 cc. water containing 10 grms. of caustic potash, as much of a solution containing 5 per cent. potassium permanganate is added as will correspond to $1\frac{1}{2}$ times the theoretical quantity of glycerol (for one part of glycerol 6·87 parts of potassium permanganate). The operation is conducted in the cold and the solution must be agitated on addition of the permanganate. After standing for about half an hour at the ordinary temperature, sufficient hydrogen peroxide is added to completely decolourise the liquid; no large excess of peroxide should be used. The whole is now made up to 1,000 cc., well shaken, and 500 cc. filtered through a dry filter. After heating the filtrate for half an hour to destroy all hydrogen peroxide, and cooling to about 60° C., sulphuric acid is added, and the liquor titrated with permanganate.

Heating after the addition of permanganate is superfluous. The presence of butyric acid does not affect the result, since butyric acid does not become oxidised in the cold by an alkaline solution of permanganate; butyric acid yields oxalic acid only when boiled for a considerable time with an excess of alkali and potassium permanganate. Repeated determinations show that even the original method of Benedikt and Zsigmondy in the presence of butyric acid does not yield an appreciable increase of oxalic acid. A number of results of analysis by the above method are given by the author which prove the method of determination to be accurate even in presence of 90 per cent. of butyric acid.—K. E. M.

A New Method for the Valuation of Lubricating Oils. J. Lew. Dingl. Polyt. J. 1891, **280**, 16—19 and 40—44.

See under XII., *page* 777.

On an Important Source of Error in the Gravimetric Estimation of Tannins. R. Koch. Dingl. Polyt. J. **280**, 141—144 and 159—162.

The author fully agrees with the conclusions arrived at by v. Schroder (Dingl. Polyt. J. **269**, 38 and 82; this Journal, 1888, 647) with regard to possible errors in tannin estimations by the gravimetric method. He finds, however, that a still more important error is liable to creep into the results owing to the varying capacity of different samples of hide-powder for absorbing tannin, and especially the different colouring matters present in the material under examination. To be suitable for this process the hide-powder should be in a fine state of division, and have a woolly appearance; its colour should be white or yellowish-white, not grey, even when it is washed with water, pressed, and dried, and the cakes so obtained must retain their porous and friable nature. On extracting 7 grms. of the powder with 100 cc. of water, not more than 0·016 to 0·018 grm. of soluble matter should be found upon evaporating 50 cc. of the filtrate, as otherwise it is probable that owing to carelessness in the manufacture, so much decomposition of the skin will have occurred that its action will be abnormal. The smell is also important, and if it gives evidence of decomposition, the sample should be rejected. For the preparation of a hide-powder answering to these requirements, only the best fresh skins unhaired by lime should be employed, and the lime should be removed by as rapid washing as possible, the water being quite cold, and the purification being assisted by mechanical means. The drying should be hastened by removing by pressure as much water as possible, and should take place at ordinary temperatures in a well-ventilated room.

To show the large differences in the results caused by the employment of different samples of hide-powder, the author made a large number of tannin estimations on different materials. The first sample of hide-powder (I.) employed was obtained from Tharand. It gave rather too much (0·020 grm.) soluble matter on extraction (*ut supra*), and was rather too powdery in appearance, its smell also was

suggestive of decomposition. After washing with water several times, the soluble matter was reduced to 0·005 grm. Powder II. was prepared by the author in the manner previously indicated, and it may be regarded as a standard. After washing, it gave 0·004 — 0·005 grm. of soluble matter. Powder III. was an ordinary commercial sample, having a greyish colour and on moistening with water a very putrid smell. The soluble matter amounted to 0·129 grm. Powder IV. from the same maker contained only 0·018 grm. of soluble substances. On washing with water, the fibres cohered strongly together, had a very dark colour, and also a somewhat objectionable smell; which properties are probably due to the skins having been unhaired by "sweating" instead of by lime. Powder V. was prepared from II. by washing in 70 per cent. alcohol instead of water; it differed in appearance but little from the original, but was found to be wetted again with difficulty, hence the employment of this method of purification is not to be recommended. Powder VI. was obtained from König and closely resembled I.; and Powder VII. was prepared by Trommsdorf. Powder VIII. was a sample from Schuchardt, having a dark grey colour and rather strong smell and yielding on extraction 0·058 grm. of soluble matter. By washing, however, it was found to yield a product of first-rate quality, a peculiarity which is due to its being prepared from skin other than that of the ox. Before powdering this hide had a thickness only of about 1·5 mm., hence the drying took place much more quickly than usual, not allowing time for decomposition to occur.

The varying nature of these different samples of hide-powder was readily shown by treating on hide-filters Nos. I., II., IV., and V. with a 2 per cent. extract of fir bark. After standing half an hour the solution was gradually run off, and was found to possess in each case a different colour. That from IV. was water-white; I. yellowish; II. yellow-brown; and V. rather dark. A second quantity of solution was then passed through the hide, when the filtrates showed similar appearances. On examining the powders, IV. was found to be coloured very deeply for half the length of the column; I. for about two-thirds, and II. almost the whole amount; while V. was much lighter in appearance, but the colouration extended through the whole length.

Hide-Powder.	I.	IV.	V.	VI.	VII.	VIII.
Sumach	+0·49	..	..	..	..	..
	+2·77	..	..	..	..	..
Sumach extract	+1·28	..	..	..	..	..
	+2·03	..	..	..	..	..
	+0·25	..	..	..	..	..
Oak bark	+0·30	..	..	..	..	..
	+0·50	+0·85	..	..	..	..
Chestnut extract	+1·40	..	..	..	..	..
	+1·08	..	..	..	..	..
Myrabolam	..	+3·20	..	..	..	..
" extract	+1·01	..	..	..	..	..
Quebracho	+1·01	+2·37	..	..	..	..
	+1·05	+0·75	..	..	..	..
Fir bark	+1·55	1·00	.	..	..	..
	..	..	..	..	..	..
	+4·40	+7·70	..	+2·51	..	+0·08
	+3·21*	+4·50*	3·61*	..	.	0·42*
Fir bark extract	+2·05*	+3·40	..	..	..	..
	+0·57*	+2·84*	..	..	..	..
	..	+2·93	.	..	..	..
Fir bark extract ("non-tannins" estimated by the hide-filter)	..	+3·60	..	+1·48	+0·65	+0·18
	..	..	.	..	+0·31	0·30

In the analyses, from which the accompanying table is derived, the amount of tannin found in Powder II. is taken as the standard and the difference between it and that given by the other samples indicated; those figures marked with an asterisk being obtained by difference from the estimation of the "non-tannins" according to v. Schröder's method (*loc. cit.*)—F. H. L.

Separation of Rosin from Fatty Acids. E. Twitchell. Journal Analyt. and Appl. Chem. 1891.

By saturating a solution of fatty acids in absolute alcohol with gaseous hydrochloric acid the ethyl ethers of fatty acids are formed. By treating resin acids in a similar manner it was found that no combination took place when the solution was kept cool, and the resin acid could be subsequently separated by dilution with water and boiling to collect the precipitate.

The method of analysis depends upon the fact that in the reactions specified all fatty acids combine to form ethers neutral in alcoholic solution and unacted on by alkalis in the cold, while the rosin is left intact. The rosin reacts acid in alcoholic solution with phenolphthalein and unites readily with caustic potash to form a soluble soap. All that is necessary therefore is, by the means indicated, to combine the fatty acids with alcohol, when the resin acids may be titrated with standard caustic soda solution, using phenolphthalein as indicator, or they may be combined with potash, and the rosin soap thus formed separated from the unsaponified fatty ethers by extracting with naphtha in a separating funnel.

The gravimetric method is carried out as follows: 2 or 3 grms. of the mixture of fatty acid and rosin are dissolved in 10 times their volume of absolute alcohol in a flask, and dry hydrochloric acid passed through in a moderate stream. The flask is set in a vessel with water to keep it cool. The acid is rapidly absorbed, and, after about 45 minutes, the ethers separate, floating on the solution, and no more hydrochloric acid is absorbed. The flask is then removed and allowed to stand half an hour longer to ensure a complete combination of the alcohol and fatty acid. It is next diluted with about five times its volume of water and boiled until the acid solution is clear, the ethers, with rosin in solution, floating on the top. To this is added some naphtha and the whole transferred to a separating funnel, the flask being washed out with naphtha. The acid solution is then run off and the naphtha solution (which ought to measure about 50 cc.) washed once with water and then treated in the funnel with a solution of 0·5 grm. KOH and 5 cc. alcohol in 50 cc. water and agitated. The rosin is immediately saponified and the two layers separate completely. The solution of rosin soap can then be run off, treated with acid, the rosin collected in any manner desired, dried, and weighed. A second washing of the soap with naphtha is hardly necessary, as very little remains after the first extraction. The naphtha used is "74 gasoline," and for this purpose is to be preferred to ether.

The first stages of the volumetric method are similar to those of the gravimetric, with the exception that the contents of the flask are washed into the separating funnel with ether instead of naphtha, and the ether solution in the funnel is then thoroughly washed with water, until the wash-water is no longer acid; 50 cc. of alcohol, previously neutralised, are then added and the solution titrated with standard caustic soda solution. If the combining equivalent of rosin be known, its percentage may be calculated, or some of the original mixture may be also titrated, when the difference in caustic soda required will correspond to the fatty acids converted into ether.

The author has tested this method by a number of experiments, some of which are described. The following experiments show the action of gaseous hydrochloric acid on alcoholic solutions of fatty and resin acids.

(1.) Five grms. of distilled fatty acids were dissolved in 50 cc. absolute alcohol, treated with gaseous hydrochloric acid in the manner described, then treated with water, boiled, washed in a separating funnel, and dried. They yielded 5·451 grms. of ethyl ethers. These ethers were dissolved in neutralised alcohol and titrated with a normal

solution of caustic soda. They required for neutralisation 0·14 cc. of the solution. This would represent 0·97 per cent. of resin acid, taking 346 as the combining equivalent of rosin. *i.e.*, the weight of rosin neutralised by 1 cc. of normal alkali = 0·346 grm.

(2.) Five grms. fatty acids from a low grade tallow were treated in the same way, and required 0·06 cc. for neutralisation = 0·41 per cent. rosin.

These figures, although not indicating a perfect combination, are still very small, and can be explained, especially in the first case, by the supposition that there were actually some resin acids present, natural constituents of the crude fats.

On attempting to use alcohol of 90 per cent. instead of the absolute, the author only succeeded in etherifying 92 per cent. of the fatty acids.

(3.) Five grms. of an average sample of rosin were treated in exactly the same manner as in working with the fatty acids. After diluting with water and boiling, the rosin was collected by dissolving in a little ether and found to weigh 4·9382 grms. This was dissolved in alcohol and required 14·27 cc. of the caustic soda solution to neutralise it. Five grms. of the original rosin were titrated and required 14·45 cc. There had been a slight loss in drying, but no change in the combining weight.

When the alcoholic solution became heated by the passage of the hydrochloric acid or when the solution was boiled without first diluting with water, the rosin suffered some change and required less caustic soda to neutralise it.

Analyses were made of a number of mixtures. In using the volumetric method the mean combining weight of fatty acids was taken at 275, and of rosin 346.

A mixture consisting of 20 per cent. rosin, 80 per cent. fatty acid gave, by the volumetric method, 20·36 per cent., 21·40 per cent., and 19·91 per cent. of rosin. The same by the gravimetric method: 18·93 per cent. of rosin.

A sample of soap said to be made of 100 parts of fat to 40 of rosin, and therefore containing 28·67 per cent. of rosin, assayed by the volumetric method, 73·7 per cent. of fatty acid, and by the gravimetric method, 25·7 per cent. of rosin.

Unsaponifiable matter in the fat does not affect the process, but can be determined by the volumetric method in one operation, as follows: Two grms. of the original fatty mixture are titrated with normal caustic soda solution and saturate *a* cc. Two grms. are treated with hydrochloric acid &c., then filtered and are found to saturate *b* cc. Then

$$b \times 0{\cdot}346 = \text{weight of rosin.}$$

$$a - b \times 0{\cdot}275 = \text{weight of fatty acid.}$$

The remainder is unsaponifiable matter.

A mixture of rosin, fatty acid, and paraffin was prepared and analysed in this manner, with the following results:—

—	Calculated.	Found.
Rosin	21·3	22·6
Fatty acid	43·6	42·7
Paraffin	35·1	34·7

The author has since analysed a number of samples of soaps and always obtained the resins distinctly brittle and therefore practically free from fat. This he found to be the case even when the percentage of rosin was so low as 4 or 5 per cent.

In his experiments the caustic soda solution was normal, but a more dilute solution might be used with advantage, as a smaller sample could be taken and the operation considerably hastened.

The figures given have been those actually obtained, without correction for error, such as unsaponifiable matter in the original rosin, which would affect the gravimetric determination. The volumetric method he would prefer in all cases except where an examination of the rosin was desired.

ANALYTICAL AND SCIENTIFIC NOTES.

On the Influence of Climate on the Amount of Nicotine in Tobacco. A. Mayer. Landw. Versuchst. 1891, **37**, 453.

According to the author's investigations a liberal amount of heat and light, together with a sufficient moisture in a rich soil, will not only cause a luxurious development of the plants, but a large increase in the percentage of nicotine. The other organic constituents of the tobacco plant are not so much affected by climatic conditions.

—L. de K.

Hypoiodous Acid. A. Schwicker. Chem. Zeit. 1891, **15**, 630.

The following fact affords evidence in favour of the existence of hypoiodous acid. When urea is added to a freshly prepared solution of iodine in concentrated sodium hydroxide a brisk evolution of nitrogen commences; the same reaction proceeds even better when iodine is added to a solution of urea in sodium hydroxide. It is thus analogous to the action of sodium hypobromite on urea, and the presence in the above solution of sodium hypoiodite, whose existence has already been foreshadowed by the observations of Schönbein and of Berthelot, is rendered probable.—A. R. L.

Trade Report.

(*From the Board of Trade and other Journals.*)

TARIFF CHANGES AND CUSTOMS REGULATIONS.

Switzerland.

Classification of Articles in Customs Tariff.

Note.—Quintal = 220·4 lb. avoirdupois. Franc = $9\frac{6}{10}d$.

The following decisions affecting the classification of articles in the Swiss Customs tariff were given by the Swiss Customs authorities in the month of July last:—

Zinc ashes, zinc scoriæ (waste from the manufacture of zinc powder, composed from metallic zinc and impurities).—Category 1. Free of duty.

Agalithe (asbestine, silicate of magnesia, used in paper factories as a substitute for kaolin or china clay); hydrated alumina in powder, calcined, &c., used as a substitute for kaolin in the manufacture of paper.—Category 160. Free of duty.

Gypsum paste.—Category 167. Duty, 20 cents. per quintal.

United States.

Customs Decisions.

The following decisions respecting the construction to be given to Acts of Congress relating to the classification of articles in the Customs tariff, and the application of the Customs laws of the United States, have recently been given by the Customs authorities in that country:—

Ammoniacal cochineal is dutiable at 25 per cent. *ad valorem* under the provision for colours.

Grecian red, a colour composed of barytes 98 per cent. and aniline colour 2 per cent., is dutiable at 25 per cent. under paragraph 61 as a colour not specially provided for.

Prussiate of soda, a chemical salt composed of a certain percentage of carbon, nitrogen, iron, and sodium when in the dry state, and when crystallised of the same elements with about $41\frac{1}{2}$ per cent. of water in addition, is dutiable under the provisions of paragraph 92 of Act of 1883, which levies a duty of 25 per cent. *ad valorem* on "all chemical

compounds and salts, by whatever name known," not specially enumerated or provided for in said Act.

Certain so-called "cocoa butterine" is dutiable at 25 per cent. under paragraph 76, N. T., as an expressed oil.

Concine hydrobromate crystals, concine hydrobromate powder, and concine hydrochlorate crystals, which are salts crystallised from an extract of the fruit of the hemlock plant, used exclusively as medicines, are dutiable at 50 cents a pound under paragraph 74.

EXTRACTS FROM DIPLOMATIC AND CONSULAR REPORTS.

France.

Olive Oil.

In discussing some of the injurious effects of the Franco-Italian tariff war the British Consul at Nice makes some interesting observations on the "olive oil question." Encouraged by the low import duty formerly exacted on the olive oils of Italy, some 30 or 40 firms were gradually established in Nice, which did large business in mixing the finest Nice oils with the more fruity Neapolitan variety from Bari, and then exporting the whole as Nice oil. To such an extent was this practice carried that about three times as much oil was annually exported from Nice as was produced in the entire territory. It is stated in defence of this practice of *coupage* that the flavour acquired by the oil rendered it more acceptable to northern palates, and considerable skill was exercised in the proper manipulation of the oil previous to placing it on the French or foreign markets, and there appears to have been no secrecy as to this manipulation. The duty on Italian olive oils has, however, been raised of late to 15 frs. the 100 kilos., or, in other words, has been quintupled; and it is anticipated that the large oil trade which has become the principal source of export from Nice will be ruined by the new duty as soon as the stocks previously laid in are exhausted. It is said that the Tunis and Algerian oils are so inferior as to afford no proper substitute for the South Italian variety used in the *coupage*. It is felt that if any raw materials are to be exempt from the new exorbitant duties it should be the Bari oils, as being the raw material of the most profitable industry that has grown up in Nice. The new duty has already caused adulteration of a totally different form from that above described, and an ingenious process has been invented at the Station Agronomique de Nice by M. Brullé, by which it has been discovered that Nice oil is now mixed to a large extent with cotton-seed oil and other grain oils, being subsequently re-exported as pure Nice olive oil. This process consists in the mixture of nitrate of silver and alcohol with the oil, which is subsequently boiled and changes colour, becoming reddish or brown, instead of retaining the greenish gold of the pure olive oil.

Norway.

Iodine

A new industry, which promises to become of permanent value to the coast inhabitants of Jarderen, has recently been started in Norway. This is the burning of seaweed, which is found in great abundance on the coast, and the preparation of kelp for the manufacture of iodine.

Siam.

Benzoin

Benzoin is brought by traders from Luang Phrabang to Chiengmai, whence it is sent down to Bangkok. Some is sent to Bangkok *viâ* Korat, but that route is so infested with thieves that traders prefer to bring their gum to Chiengmai. A "huk Chin" (son of a Chinese father by a Siamese mother) is the principal benzoin buyer in Bangkok. According to him 9,386⅔ lb. were brought to market in 1890. There are two qualities; the best kind fetching 300 r. (22*l.* 10*s.*) per "sën" (293⅓ lb.), and the inferior quality 100 r. (7*l.* 10*s.*) per "sen." Four parties of traders came from Luang Phrabang to Chiengmai with benzoin during 1890. A 3 per cent. duty was charged on this article in Bangkok.

Sticklac.

Sticklac is abundant in Chiengmai, and is sent down to Bangkok. Last year 8,800 lb. were bought there by one trader at prices varying from 80 r. (6*l.*) to 90 r. (6*l.* 15*s.*) per "sën," (293⅓ lb.). The trade in sticklac was formerly much hampered by the heavy duty on it, which was 33⅓ per cent. The duty was levied last year, but has now been taken off, and the trade, which has been in a moribund state for some time, may now perhaps revive.

GENERAL TRADE NOTES.

The Iron Industry of Hungary.

A. von Asbóth. Chem. Zeit. 1891, **15**, 845.

The iron industry of Hungary has only been developed to any great extent during the last 2—3 years, *i.e.* since the native blast-furnace owners have entered into an agreement with their Austrian confrères. At present the Hungarian iron market is so active that the demand for various iron products exceeds the supply. Rolled iron, especially, has been in great request, and the price rose by 50 kreutzers in 1889 and again by 50 kreutzers in 1890 per 100 kilos. Considerable business was also done in girders, rails, boiler plates and sheet iron, iron beams, &c. used in building construction, and light sheet iron. The favourable influence of the "Cartell" on the Hungarian iron trade may be traced in the rise in value of the shares of various iron companies. The shares of the *Rimamorány-Salgótarjáner Iron Company* were quoted in 1886 at 83 florins; in 1890 they had risen to 158 florins; and similarly in the case of other companies. It is satisfactory to know that the agreement ("Cartell") with the Austrian manufacturers, which expired in 1890, has been renewed for three years.

The total production of the Hungarian refining and rolling works in 1890 was 200,000,000 kilos., compared with 166,000,000 kilos. in 1885. The pig iron for the purpose was all of native manufacture, and in consequence every existing blast-furnace was kept in full swing. In fact, in 1889 and 1890 the supply of native pig iron was not equal to the demand. The price of bloom iron rose from 2·80 florins in 1886 to 5 florins in 1890 per 100 kilos.

The production of raw iron in 1890 was 280,000,000 kilos. Most blast-furnace works also produce cast-iron goods, partly directly from the furnace iron and partly from more or less refined iron. The production of cast-iron ware in 1890 was 35,000,000 kilos. In 1885 240,000,000 kilos. of raw iron were manufactured.

During the year 1890 50 blast furnaces, 11 Bessemer converters, 9 Siemens-Martin furnaces, 28 gas regenerative double puddling furnaces, 7 puddling furnaces, and 26 forges, &c. were at work.—H. T. P.

The Metal Industry of Hungary.

A. von Asboth. Chem. Zeit. 1891, **15**, 881.

With the exception of Russia, there is scarcely any country so rich in metals as Hungary, which is nevertheless behind most European countries in the actual production of metals, a fact which must be ascribed to want of enterprise and capital. A large portion of the industry is carried on under Government auspices which favour antiquated methods of work and causes the industry to languish under the competition of newer and more economical processes. For the treatment of lead and copper ore, methods in the dry way are mostly in vogue, but a treatment in the wet way is sometimes used in working up the residues, and in the case of copper electrolysis is in some cases employed for precipitation of the metal from solution. In 1890 the production amounted to 10,670 centners of commercial lead, worth 188,503 fl.; 7,179 centners of lead glance worth 94,837 fl.; and 2,669 centners of copper, worth 169,073 fl. Of nearly 400 undertakings, for which concessions have been granted, a large proportion base their prospects on the possibility of finding gold. The largest gold-producing concern in Hungary is the Harkort Company in Brad. This firm turned out 687·630 kilos. of raw gold in 1890 against 467·035 kilos. in the previous year. The

total production of noble metals in Hungary is 2,304 kilos. of fine gold and 16,660 kilos. of fine silver, together worth 4,713,489 fl.—G. H. B.

Production of Infusorial Earth in the United States.

Infusorial earth has been found in useful quantity in a number of places in California, Connecticut, Maryland, Nevada, New Hampshire, New Jersey, New Mexico, Oregon, and Virginia, but the production in 1889 was limited to five States, namely, New Jersey, New Hampshire, Connecticut, Maryland, and California. The bulk of the product was obtained from the Dunkirk district, in Maryland, the ledge at Dunkirk producing 3,000 short tons and all other localities 466 short tons. An excellent deposit of infusorial earth was opened at Pope's Creek, Md., in 1887, and a considerable quantity taken out, but owing to a slack demand only 50 tons were produced at this point in 1889. In Storey County, Nev., there is a mine of a fine quality of infusorial earth, but no work was done upon it in the census year. The following table shows the production of infusorial earth in 1889, by States :—

States.	Short Tons.	Value.
		Dols.
California*	50	8,000
Connecticut†	211	422
Maryland†	3,050	10,700
New Hampshire*	80	2,750
New Jersey*	75	1,500
Total	3,466	23,372

* Separated and ground. † Crude at the mines.

The mines at Dunkirk, Maryland, were the only ones which were operated actively during the year. The total number of men employed in the industry was 52. The expenses incurred in mining infusorial earth during 1889 were as follows : Wages, 8,388 dols. ; paid contractors, 575 dols. ; paid for supplies, 760 dols. ; paid for other expenditures (rent, insurance, taxes, &c.), 6,955 dols. ; total, 16,678 dols. The amount of capital invested was : In land, 61,380 dols. ; in buildings, machinery, &c. 21,900 dols. ; in tools, implements, live stock, &c., 16,970 dols. ; in cash, 10,500 dols. ; total, 110,750 dols.

The table following shows the analyses of infusorial earths from different localities :—

—	From Pope's Creek, Md.	From Morris County, N. J.	From near Richmond, Va.	From Storey County, Nev.
	Per Cent.	Per Cent.	Per Cent.	Per Cent.
Moisture	3·47	..	8·37	..
Silica	81·53	80·66	75 86	81·08
Alumina	3·43	3·81	9·88	..
Protoxide of iron	3·33	..	..	..
Lime	2·61	0·58	0·29	..
Ferric oxide	..	..	2·92	..
Magnesia, soda, potash, sulphur, and organic matter	5·63	..	1·63	..
Loss on ignition	..	14·01	..	..
Water at red heat	..	..	..	18·44
Loss	..	..	..	0·48
Total	100·00	99·09	98·95	100·00

Infusorial earth is used to a considerable extent in the manufacture of various cleansing preparations, either in the form of powder or so-called soap. There is but a step between the crude mineral and the merchantable articles used for cleansing purposes. To manufacture a polishing powder it is necessary only to clean and grind the crude mineral, the particles of which are loosely adherent, while in making soap the pulverised mineral is mixed with the other ingredients of soap manufacture. The greater portion of the product of this country is dried in furnaces at the pits and used for making protective coating for boilers. Some infusorial earth has been imported from Germany and used as an absorbent in the manufacture of dynamite from nitroglycerin. The American product, however, does not possess sufficient absorbent properties for this purpose, and the German product has been supplanted by the use of wood pulp, which answers the purpose excellently and is much cheaper. The first development of infusorial earth properties in California was made in 1889. This was due to the discovery of a valuable ledge by Mrs. Emma Eells on her ranch near Calistoga, Napa County. By practical tests she learned that the mineral was excellently adapted for use as a polishing powder, and, with a number of ladies, organised a stock company for the purpose of mining and manufacturing the mineral.—*Census Bulletin, No.* 75.

The American Chemical Society.

A conference of American chemists was held on August 18th, which was attended by delegates from the American Chemical Society (of New York City), the Washington Chemical Society, the Association of Official Chemists, the Cincinnati Chemical Society, the Brooklyn Institute, the Franklin Institute, the Association of Manufacturing Chemists, and the Louisiana Association of Sugar Chemists. For several years the chemists have been trying to get together to form a national society, but the American Chemical Society, the New York organisation, which was the leading one, did not wish to give up its name and be absorbed. It has, however, finally agreed that the national society shall be known by its name, and that it will become the New York branch. Each of the other local societies will retain its identity as a branch. This basis of agreement will be reported by the conferees to their respective societies for adoption, and the national organisation will be perfected at a general meeting, which will probably be held in October. The formation of the new American chemical society is a matter for congratulation to the chemists of the whole country.—*Eng. and Mining Journal.*

Production of Fluorspar in the United States.

The production of fluorspar in the United States in 1889 was limited to one locality near Rosiclare, Ill. The product was 9,500 tons, valued at 45,835 dols., an increase of 3,500 tons over the product of 1888. The price remains about the same. The following table gives the quantity and value of fluorspar produced in the United States for all the years for which figures are obtainable :—

Years.	Short Tons.	Value.	Years.	Short Tons.	Value.
		Dols.			Dols.
1882	4,000	20,000	1886	5,000	22,000
1883	4,000	20,000	1887	5,000	20,000
1884	4,000	20,000	1888	6,000	30,000
1885	5,000	22,500	1889	9,500	45,835

The mining of fluorspar gives employment to about 100 men, who work on an average of 200 days in the year. The demand for the mineral is not heavy, and the mines are operated only about two-thirds of the time. The expenses incurred in the mining of fluorspar in the United States for the year 1889 were as follows :—Wages, 14,213 dols. ; paid for supplies, 5,025 dols. ; other expenses,

3,008 dols.; total, 22,246 dols. The amount of capital represented in the industry was 192,000 dols., distributed as follows: In land, 13,100 dols.; in buildings, machinery, &c., 12,500 dols.; in tools, implements, live stock, &c., 13,000 dols.; cash used as working capital, 35,500 dols.; total 192,000 dols.

Fluorspar is used principally as a flux in melting iron in foundries, for the manufacture of opalescent glass, and for producing hydrofluoric acid for chemical purposes.

Fluorspar (calcium fluoride) is not imported into the United States, but is obtained as a by-product in the reduction of cryolite to the salts of aluminium and sodium. All of the cryolite consumed in the United States is imported from Greenland. The amount of cryolite imported into the United States from 1871 to 1889, inclusive, is shown in the following table:—

Years	Long Tons.	Value.	Years.	Long Tons.	Value.
		Dols.			Dols.
1871	..	71,058	1881	..	103,529
1872	..	73,195	1882	3,758	51,789
1873	..	84,226	1883	6,508	97,400
1874	..	20,118	1884	7,380	106,029
1875	..	79,472	1885	8,275	110,750
1876	..	103,530	1886	8,230	110,152
1877	..	126,632	1887	10,328	138,068
1878	..	105,884	1888	7,288	98,830
1879	..	66,912	1889	8,603	115,158
1880	..	91,395			

—*Census Bulletin, No.* 75.

Production of Barytes in the United States.

Barytes, or natural barium sulphate, is a well-known mineral and liberally distributed, but it is only recently that it has become of any commercial importance. Barium sulphate has been prepared artificially for a number of years, and is used to a considerable extent in the place of white lead, which it resembles closely. Improvements in machinery and in the process of treating natural barytes have overcome many of the objections which formerly existed to its utilisation, and considerable attention is now being given to the localities in the United States where it is found. The material, in order to be available for the uses to which it is put, must be fairly free from quartz grains, the stain of iron rust or other impurities. If the barytes is stained to any extent it is practically valueless, as a good white colour is essential to its usefulness. Quartz grains or other hard substances with which it is apt to be associated injure the machinery in grinding. The purest barytes so far produced in this country comes from Missouri, though a very fair grade is now being mined in considerable quantities in Virginia.

The returns from all producers of crude barytes show a product in the United States, for 1889, of 21,160 short tons, valued at 106,313 dols., against 20,000 short tons in 1888, valued approximately at 110,000 dols. The production was limited to four States, as shown in the following table:—

States.	Short Tons.	Value.
		Dols.
Illinois	200	1,300
Missouri	7,558	32,715
North Carolina	3,000	15,000
Virginia	10,702	57,298
Total	21,460	106,313

Barytes mining in Missouri is carried on in so irregular a manner that it is impossible to obtain any reliable statistics relative to labour and wages. Farmers mine it in off seasons; that is, when there is no farming to do, they employ themselves and their hands in getting out the barytes found on their farms, haul it to the nearest tradesman, and receive in exchange dry goods, groceries, or other necessaries, or cash. The farmers thus occupy time which would otherwise be idle, and dispose of the barytes at a less figure than it would pay to mine it systematically. The supply thus obtained is nearly sufficient to keep the mills up to their fullest capacity.

A few mines are, however, operated with some degree of system, though for want of proper records it is necessary to estimate a considerable portion of the matter of labour and wages. The mines altogether give irregular employment to about 580 men. The rate of compensation for foremen is about 2·50 dols. per day, and for labourers from 1 dol. to 1·50 dols. per day. It is rarely, however, that the men make full time, and their daily earnings are reported at from 50 to 75 cents. From 75 to 100 women obtain the same sort of irregular employment, earning about 35 cents per day. Boys get from 25 to 30 cents per day. One mine was active nearly the entire year, but in most cases the number of days worked at the mines ranged from 125 to 200.

The following statement shows the amount of money paid for operating and developing barytes mines in Virginia, North Carolina, and Illinois: Wages (including office force at mines), 54,524 dols.; paid for supplies, 8,200 dols.; other expenditures (rent, taxes, insurance, &c.), 2,083 dols.; total, 64,807 dols. The amount of capital represented in barytes mines in the United States, worked in 1889, was as follows: In land, 184,450 dols.; in buildings, machinery, &c., 66,450 dols.; in tools, implements, live stock, &c., 76,350 dols.; cash, 23,900 dols.; total, 351,150 dols. The aggregate value of the lands on which barytes is found in Missouri is placed at 4,500,000 dols., but the estimates are based on prospects rather than on actual development.

The consumption of barytes seems to be steadily increasing. It is used quite extensively in the arts, finding its greatest service as an adulterant in the manufacture of paint. Its great weight, its likeness in many respects to white lead, and the fact that it can be used in place of that commodity, enable manufacturers to replace the costlier article with a substitute much to their own advantage. It is claimed by some that a mixture composed of one-third barytes, one-third zinc white, and one-third white lead makes a better paint than the pure white lead. This is probably true for some special purposes. Barytes is remarkable for its weight, having a specific gravity of about 4·5, or about the same as iron ore. It can therefore be used with white lead without any appreciable loss of weight in the mixture.

Besides the localities from which the supply has been thus far derived, there are deposits in South Carolina which are now being investigated with prospects of development at an early date. The mineral is found along the line of the Charleston, Cincinnati, and Chicago railroad, in the building of which a considerable vein was exposed, but occurs in largest quantities in the vicinity of King's Creek, where a side track can be run in and the material loaded on cars. Lack of transportation was one of the drawbacks to its development in the past, but this difficulty has been removed by the railroad builders. Diffused through the barytes is a small percentage of quartz grains, which make it necessary to use other grinding machinery than the buhr mills ordinarily used for that purpose. It is expected that mills for this purpose will be put up in the vicinity of the mines, thereby insuring a more profitable business than can be obtained by sending the barytes elsewhere to be ground and floated.

At Terrazas station, State of Chihuahua, Mexico, there are some six or eight veins of barytes from 1 to 5 ft. thick, said to be of a good white colour, free from yellow, brown, or black iron stains, and a considerable portion of which has a very delicate pale blue tint, considered valuable in the highest classes of barytes, as it tends to neutralise the yellowish tint of inferior qualities. The company

owning the property upon which these veins are found offered to sell the barytes in car loads at 5 dols. per short ton, free on board cars at the shipping point.

Nearly all, if not all, of the barium sulphate imported into the United States is artificially prepared. Importations are quoted under various names, such as blane-fixe or permanent white, satin white, enamelled white, lime white, &c. The imports of manufactured barium sulphate in 1889 amounted to 3,601,506 lb., valued at 22,458 dols.; unmanufactured, 13,571,206 lb., valued at 7,660 dols.—*Ibid.*

German Drug Imports.

The following figures, representing the imports of some of the principal drugs and drysalteries into Germany, are taken from recent official statistics published in that country :—

Years.	Cinchona Bark.	Cochineal.	Gum Arabic and Tragacanth.	Shell, Seed, and Stick Lac.	Camphor.
	Tons (average).				
1872-75	1,028	526	1,363	..	..
1876-80	967	308	1,084	..	..
1881-85	2,876	111	1,513	1,135	(1885) 183
1886	4,673	97	1,201	1,124	157
1887	4,222	67	1,081	1,613	332
1888	4,671	77	1,150	1,396	378
1889	5,120	35	1,318	949	353

—*Chemist and Druggist.*

The Nitrate Combination.

The recent formation of a combination of nitrate of soda producers has been followed by a considerable advance in the quotations for the article. The combination, it is said, have decided to reduce the total export during the present year to 18,000,000 quintals, equal to 800,000 tons. Last year the total exports were 1,043,000 tons.—*Ibid.*

West African Gum Arabic.

Mr. Levan Millson, who has lately been commissioned to investigate the resources of Yoruba land (B. W. Africa) reports that in the territories visited by him the supplies of gum-yielding trees of the kind called "Akkow L'odo" by the natives (*Brachystegia*, n. sp. ?) is practically unlimited. The trees yield a gum apparently of the acacia description, and similar to gum arabic. The gum could only be gathered during the dry season.—*Ibid.*

Chemical Patents in Germany.

In seeking to protect an invention by a patent, it is sometimes difficult to decide what constitutes the patentable principle of the invention, and in what manner the claims must be limited. According to the Chemiker Zeitung, this important question has now been cleared up, as far as Germany is concerned, by a decision of the highest court of that country (the Reichsgericht at Leipzig) as follows :—

If a valuable product is obtained by a previously unknown application of a known process the new application of the process is patentable. A process can only be patented as far as its effect has been recognised and described by the inventor at the time of applying for a patent. The fact that a patent could be circumvented will not justify the inventor to frame the claims in such a manner that they exceed the limits of the actual invention. A patent cannot be founded upon a rule, if that rule has any exception, and if the absence of any exception has not been recognised and mentioned. If, nevertheless, such a patent has been granted, and if the party applying for the revocation of the patent has proved that the rule embodied in the claim is not applicable everywhere, he cannot be required to prove in which individual cases the invention does not give the required result. The general idea to obtain by a process a useful result is not patentable, but only a definite and practically realisable method of carrying that idea into effect. The use of a known substance for the production of another known substance can only be patented as an invention if the process employed is new and patentable.—*J. Wetter.*

Rules of Legal Procedure against Foreign Firms.

Some new Rules of Court have just received the sanction of the Lord Chancellor, which will prove of great importance to commercial firms. They lay down the rules to be observed in regard to bringing actions against foreign firms, which have hitherto, owing to conflicting opinion, been of much difficulty and very perplexing. There have always been two very pronounced difficulties, viz., whether the firm should be sued in the name of the firm or in the names of the partners, and whether the writ should be served upon the partners in this country, or on one partner only, or all the partners. As a consequence it frequently happens that foreign firms, either carrying on business by a branch in this country, or having their businesses wholly abroad, but making a contract here, either wholly escaped or forced their British creditors to go to a foreign country for redress. This has been entirely removed, for it has been decided that those partners who happen to be in this country can be sued, and that if there is a branch of the firm here a summons or writ must be served in the name of the firm, and at their office, to anyone who appears to be in authority there.—*Chemist and Druggist.*

BOARD OF TRADE RETURNS.

Summary of Imports.

	Month ending 31st August	
	1890.	1891.
	£	£
Metals	1,868,582	1,948,888
Chemicals and dyestuffs	514,524	496,852
Oils	640,373	589,870
Raw materials for non-textile industries.	4,137,800	4,436,652
Total value of all imports	31,322,897	32,746,279

Summary of Exports.

	Month ending 31st August	
	1890.	1891.
	£	£
Metals (other than machinery)	3,629,295	2,791,552
Chemicals and medicines	711,201	615,628
Miscellaneous articles.....	2,836,418	2,549,918
Total value of all exports.....	22,817,609	20,670,489

Imports of Metals for Month ending 31st August.

Articles.	Quantities.		Values.	
	1890.	1891.	1890.	1891.
			£	£
Copper:—				
Ore ..... Tons	1,613	7,548	34,333	59,434
Regulus ..... „	7,019	5,500	224,250	161,169
Unwrought .... „	3,848	6,458	226,434	320,549
Iron:—				
Ore ..... „	330,913	272,983	253,422	204,521
Bolt, bar, &c. ... „	9,069	7,188	93,033	73,350
Steel, unwrought .. „	768	1,065	7,810	10,304
Lead, pig and sheet „	12,629	14,320	164,681	181,491
Pyrites ..... „	52,770	59,629	99,856	110,284
Quicksilver ..... Lb.	84,396	65,140	11,249	6,676
Tin ..... Cwt.	45,548	34,718	214,577	158,958
Zinc ..... Tons	4,793	4,712	108,980	111,432
Other articles ... Value £	..	..	420,570	531,660
Total value of metals	..	..	1,843,582	1,948,888

Imports of Raw Materials for Non-Textile Industries for Month ending 31st August.

Articles.	Quantities.		Values.	
	1890.	1891.	1890.	1891.
			£	£
Bark, Peruvian .. Cwt.	5,054	6,472	13,661	14,586
Bristles ..... Lb.	207,075	311,091	28,509	46,029
Caoutchouc ..... Cwt.	12,286	24,870	135,130	298,212
Gum:—				
Arabic ..... „	1,383	6,078	10,557	14,534
Lac, &c. ..... „	2,417	8,906	9,757	32,576
Gutta-percha .... „	4,796	4,939	55,709	70,864
Hides, raw:—				
Dry ..... „	28,335	33,470	74,901	103,074
Wet ..... „	64,888	51,304	156,155	115,292
Ivory ..... „	691	654	38,045	30,966
Manure:—				
Guano ..... Tons	347	785	1,745	5,859
Bones ..... „	3,058	4,450	15,852	23,345
Paraffin ..... Cwt.	14,312	36,538	56,198	51,605
Linen rags ..... Tons	2,108	3,222	24,167	33,745
Esparto ..... „	9,854	19,314	52,468	91,155
Pulp of wood .... „	11,484	15,155	66,678	78,017
Resin ..... Cwt.	174,747	139,894	33,113	35,642
Tallow and stearin ..	92,867	165,847	111,566	215,944
Tar ..... Barrels	14,381	23,179	31,911	20,575
Wood:—				
Hewn ..... Loads	248,867	273,640	386,711	503,922
Sawn ..... „	745,867	7[illegible]	1,752,416	1,561,104
Staves ..... „	17,854	17,407	50,019	57,840
Mahogany ..... Tons	2,479	3,[illegible]	30,825	34,649
Other articles .... Value £	..	..	788,101	955,571
Total value	..	..	4,147,800	4,[illegible]

Besides the above, drugs to the value of 57,001*l.* were imported as against 50,658*l.* in August 1890.

Imports of Chemicals and Dyestuffs for Month ending 31st August.

Articles.	Quantities.		Values.	
	1890.	1891.	1890.	1891.
			£	£
Alkali ..... Cwt.	1,191	6,579	3,786	4,120
Bark (tanners, &c.) „	71,773	67,027	33,190	35,037
Brimstone ..... „	16,434	49,377	4,842	14,045
Chemicals ..... Value £	..	..	108,122	127,101
Cochineal ..... Cwt.	165	723	958	4,269
Cutch and gambier Tons	2,849	2,791	78,973	55,741
Dyes:—				
Aniline ..... Value £	..	..	24,029	16,765
Alizarine ..... „	..	..	25,732	27,045
Other ..... „	..	..	1,349	1,335
Indigo ..... Cwt.	1,063	654	12,482	9,105
Madder ..... „	456	1,776	573	2,563
Nitrate of soda .... „	59,075	37,989	24,490	16,358
Nitrate of potash . „	25,056	22,840	22,330	20,501
Valonia ..... Tons	2,604	1,190	52,110	22,403
Other articles ... Value £	..	..	121,567	139,856
Total value of chemicals	..	..	514,524	496,852

Imports of Oils for Month ending 31st August.

Articles.	Quantities.		Values.	
	1890.	1891.	1890.	1891.
			£	£
Cocoa-nut ..... Cwt.	12,680	13,864	17,630	26,191
Olive ..... Tuns	1,349	1,219	54,093	48,396
Palm ..... Cwt.	49,292	88,265	57,578	101,663
Petroleum ..... Gall.	11,023,713	8,338,372	258,245	172,301
Seed ..... Tons	1,670	1,530	43,333	41,882
Train, &c. ..... Tuns	1,978	2,562	42,395	55,842
Turpentine ..... Cwt.	64,134	54,331	100,550	74,321
Other articles .. Value £	..	..	60,549	69,271
Total value of oils ...	..	..	610,373	589,870

Exports of Drugs and Chemicals for Month ending 31st August.

Articles.	Quantities.		Values.	
	1890.	1891.	1890.	1891.
			£	£
Alkali ..... Cwt.	540,113	428,053	181,059	158,344
Bleaching materials „	150,718	114,739	42,681	30,615
Chemical manures. Tons	30,417	35,102	181,022	141,747
Medicines ..... Value £	..	..	80,173	80,942
Other articles ... „	..	..	226,266	189,080
Total value	..	..	711,201	615,028

EXPORTS OF METALS (OTHER THAN MACHINERY) FOR MONTH ENDING 31ST AUGUST.

Articles.	Quantities.		Values.	
	1890.	1891.	1890.	1891.
			£	£
Brass..... Cwt.	7,746	10,282	37,623	45,585
Copper:—				
Unwrought ..... „	70,632	43,899	217,345	124,309
Wrought..... „	15,354	27,363	56,153	80,650
Mixed metal .... „	30,160	28,539	87,376	80,672
Hardware ..... Value £	..	..	212,098	193,817
Implements..... „	..	..	100,009	99,170
Iron and steel..... Tons	345,857	272,209	2,613,662	1,834,692
Lead ..... „	5,924	3,071	83,474	42,698
Plated wares... Value £	..	..	30,967	31,035
Telegraph wires, &c. „	..	..	55,601	112,690
Tin ..... Cwt.	9,511	8,295	46,750	39,655
Zinc ..... „	12,530	11,334	12,252	12,207
Other articles .. Value £	..	..	75,985	84,682
Total value	..	..	3,620,295	2,791,552

EXPORTS OF MISCELLANEOUS ARTICLES FOR MONTH ENDING 31ST AUGUST.

Articles.	Quantities.		Values.	
	1890.	1891.	1890.	1891.
			£	£
Gunpowder..... Lb.	1,078,700	815,300	30,129	21,334
Military stores.. Value £	..	..	102,129	91,027
Candles..... Lb.	1,166,800	1,362,900	22,480	26,674
Caoutchouc ..... Value £	..	..	110,293	96,422
Cement..... Tons	51,308	52,766	106,031	104,194
Products of coal Value £	..	..	83,266	108 189
Earthenware ... „	..	..	155,972	165,018
Stoneware ..... „	..	..	12,099	10,778
Glass:—				
Plate..... Sq. Ft.	265,345	265,517	13,563	19,717
Flint..... Cwt.	9,743	9,553	21,103	19,629
Bottles..... „	66,690	61,578	32,281	29,847
Other kinds.... „	15,938	17,582	14,063	15,047
Leather:—				
Unwrought .... „	13,452	12,189	115,628	111,362
Wrought ..... Value £	..	..	30,281	33,151
Seed oil..... Tons	4,621	4,909	109,788	108,298
Floorcloth ..... Sq. Yds.	1,284,300	1,518,500	59,098	66,133
Painters' materials Val. £	..	..	125,393	129,768
Paper ..... Cwt.	64,720	78,822	114,543	133,779
Rags..... Tons	4,836	3,799	36,833	26,689
Soap ..... Cwt.	38,084	42,739	38,556	45,120
Total value	..	..	2,836,418	2,549,918

Monthly Patent List.

* The dates given are the dates of the Official Journals in which acceptances of the Complete Specifications are advertised Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the said dates.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

Applications.

13,875. E. Casper and W. Sowerby. Improvements in drying moulds. August 17.

14,221. J. Tobin. A new method of applying soda to internal parts of boilers for preventing the formation of scale. August 22.

14,440. W. Arrol and W. Foulis. *See* Class II.

14,640. O. Intze. Improvements relating to gas-holders. August 29.

14,861. W. W. Horn.—From J. Stanard, United States. Improvements in refrigerators. September 2.

14,870. W. E. Proctor. Improvements in evaporators, to be known as "Proctor's system of evaporising." September 3.

14,986. P. Borgarelli. Improvements in apparatus for drying grain and other granular or pulverulent materials. September 4.

15,092. O. Lindemann. Improvements in steam and vacuum pumps for raising liquids. Complete Specification. September 7.

15,192. O. M. Row. Improvements in apparatus for condensing steam or other vapours, also applicable for heating or cooling fluids. September 8.

15,367. J. Kent and F. S. Tomey. An improvement in thermometers. September 10.

15,441. J. Molas. Improvements in apparatus for detecting and indicating the presence of explosive gases in mines and other places. September 11.

Complete Specifications Accepted.*

1890.

14,051. H. Rouart. Sterilising water and other liquids, and apparatus therefor. September 2.

15,976. G. J. Davis and E. Jones. Manufacture of compounds suitable for coverings for floors, walls, ceilings; also for tubes, insulating coverings, and other purposes. September 16.

16,384. J. Dunn. Apparatus for drying semi-liquid granular or pulverulent substances. August 26.

16,404. T. E. Caddy. Improvements in or relating to furnaces. September 16.

16,528. T. E. Wilson. Apparatus for evaporating, distilling, or concentrating liquids. August 26.

16,679. W. H. Le Mesurier. Apparatus for refrigerating air; also applicable to the evaporation of liquids. August 26.

17,117. D. Rylands. Means of manufacturing glass vessels and adapting the same for the storage and conveyance of compressed gases, and for similar purposes. September 16.

17,237. P. Callibures. System of apparatus for evaporation and distillation. September 9.

17,702. C. J. Copeland. Apparatus for feeding fuel to gas producers. September 2.

17,815. F. Ellershausen. Reverberatory furnaces. September 9.

1891.

6488. P. M. Pinal, V. Lethuillier, and C. L. Pinal. Liquid gauges. August 26.

9311. W. P. Thompson.—From J. A. Bowden. Filters. August 26.

12,111. W. McLaren and P. Holmes. Refrigerating medium. August 26.

12,389. H. C. Sergeant. Compound compressors for air and other gaseous or aeriform bodies. August 26.

12,706. B. Rettenmeyer. Cooling apparatus for liquids. September 2.

12,805. R. P. Barnstead, R. H. Spalding, and J. C. Bullard. Water distilling apparatus. September 9.

II.—FUEL, GAS, AND LIGHT.

Applications.

14,030. B. Redwood, R. Redwood, and H. Barringer. A method of and apparatus for measuring depth of water in oil tanks. August 19.

14,140. W. Arrol and W. Foulis. Improvements in apparatus for charging gas and other retorts, and in part applicable for other purposes. August 26.

14,548. C. C. Black and S. Alford. The utilisation of shale and other colliery waste. August 28.

14,978. G. Eastham. Improvements in firewood relating to increase of combustible energy. September 4.

15,105. W. C. Owston. An improved fire-lighter. September 7.

15,249. W. R. Lake.—From A. Hennin, United States. Improvements relating to the manufacture of ammonia and gas. Complete Specification. September 8.

15,286. The Incandescent Gas Light Co., Lim.—From C. A. von Welsbach, Austria. An improved manufacture of incandescence bodies. September 9.

15,305. The Manchester Oxygen (Brin's Patent) Co., Limited, and W. M. Jackson. Improvements in the manufacture of oxygen. September 10.

15,390. H. Williams. Improvements in apparatus for use in the manufacture of illuminating gas. September 11.

15,443. L. H. Armour. Improvements in or connected with the manufacture of illuminating or heating gas. September 11.

15,469. H. Tourness. Improvements in the manufacture and storage of illuminating and heating gas. September 12.

Complete Specifications Accepted.

1890.

14,724. J. Ruscoe. Apparatus for charging and drawing gas retorts. September 9.

14,906. C. W. Jones. The revivification of materials employed for the purification of coal gas, and treatment of the residues. September 9.

14,925. J. H. Parkinson. Obtaining or separating oxygen from atmospheric air. September 9.

15,388. J. F. Bradwood. Method of and apparatus for charging retorts for the manufacture of gas and other like purposes. August 26.

16,214. A. Coze. Apparatus for charging inclined gas retorts. August 26.

16,846. F. E. Ross. Method of and apparatus for producing gases from bituminous fuel. August 26.

20,752. W. B. Lewes. Manufacture of hydrogen gas, or a mixture of hydrogen and carbon monoxide, and apparatus therefor. August 26.

1891.

3031. F. Fanta. New process for producing oxygen gas. September 2.

4131. W. B. Lewes. Manufacture or production of hydrogen. August 26.

5022. J. Moeller. Incandescent illumination, and apparatus for that purpose. September 2.

7983. A. A. Dixon. Apparatus for the manufacture of crude peat into fuel. September 2.

8067. T. Keetman and W. Bach. Charging and discharging gas retorts and other vessels. August 26.

8893. A. Parks. *See* Class XVII.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

Applications.

14,548. C. C. Black and S. Alford. *See* Class II.

14,651. J. Weirich. *See* Class XII.

15,287. L. Hugues. Improvements in apparatus for distillation of fatty acids and other substances. September 9.

IV.—COLOURING MATTERS AND DYES.

Applications.

13,831. J. Dawson and Co., Limited, and J. H. Lutkehermolle. A process of obtaining new basic compounds and colouring matters therefrom. August 17.

14,291. J. Y. Johnson.—From The Badische Anilin and Soda Fabrik, Germany. The manufacture and production of new sulpho-acids, and of new colouring matters therefrom. August 24.

14,666. J. Frost and E. C. Kayser. Improvements in preparing colouring matters, and in dyeing textile fibres and similar materials. August 31.

14,723. J. Y. Johnson.—From The Badische Anilin and Soda Fabrik, Germany. The manufacture and production of new dyes related to the rhodamine series. August 31.

15,113. J. A. Hewitt.—From L. Cassella and Co., Germany. Manufacture of blue dyestuffs. September 7.

15,494. The Clayton Aniline Co., Limited, and J. Hall. Improvements in the manufacture and production of colouring matters. September 12.

Complete Specifications Accepted.

1890.

17,195. D. Dawson. Production of blue colouring matters. September 9.

18,024. O. Imray.—From The Farbwerke vormals Meister, Lucius, and Brüning. Production of a novel pynazolon. September 16.

18,025. O. Imray.—From The Farbwerke vormals Meister, Lucius, and Brüning. Production of sodium formylphenylhydrazine and of symmetric alkylphenylhydrazine. September 16.

18,729. B. Willcox.—From The Farbenfabriken vormals F. Bayer and Co. Manufacture of new derivatives of anthraquinone. September 16.

1891.

1742. S. Pitt.—From L. Cassella and Co. Manufacture of a new amidonaphtholsulphonic acid, and colouring matters therefrom. September 16.

11,218. H. H. Lake.—From K. Oehler. Manufacture of colouring matter. August 26.

V.—TEXTILES, COTTON, WOOL, SILK, Etc.

Applications.

13,967. E. Appenzeller and E. Filleul. An apparatus for testing the strength of cotton, wool, and other fibres in the raw or unmanufactured state. August 19.

14,272. J. C. Chapman.—From the United Indurated Fibre Co., United States. *See* Class XIX.

Complete Specification Accepted.

1891.

12,817. A. J. Boult.—From B. Beyer. Manufacture of yarns and fabrics from waste silk, and washing the resulting material. September 9.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, and BLEACHING.

Applications.

9228A. E. A. Marchand. *See* Class VII.

13,955. W. J. S. Grawitz. Improvements in dyeing and printing textile fibres with aniline and its homologues or derivatives. Complete Specification. Filed August 18. Date applied for January 19, 1891, being date of application in Belgium.

14,657. E. Gessler. Improved process and apparatus for the treatment of textile fibres with liquids and vapours or gases. August 29.

14,666. J. Frost and E. C. Kayser. *See* Class IV.

15,174. A. Graemiger and J. Graemiger. Improvements in apparatus for dyeing, scouring, bleaching, and otherwise treating yarn in cop or other similar compact form. September 8.

15,263. S. Knowles. Improvements in keirs employed in dyeing and otherwite treating yarn and other materials. September 9.

Complete Specifications Accepted.

1890.

14,302. T. Ingham. Dyeing cotton. September 9.

14,839. O. Hoffmann. Process and appliances for washing, bleaching, and dyeing fibrous materials. September 2.

16,751. W. Laidlaw. Method of and apparatus for dyeing yarns, tops, and the like. August 26.

17,326. C. D. Abel.—From M. M. Rotten. Dyeing textile materials of all kinds in the hyposulphite vat. August 26.

19,158. P. J. Grandsire. Machinery for dyeing skeins or hanks. September 2.

VII.—ACIDS, ALKALIS, and SALTS.

Applications.

9228A. E. A. Marchand. A process for preparing alkaline permanganates for bleaching purposes. August 25. Originally included in No. 9228, and therefore dated June 1, 1891.

13,869. W. Walker. *See* Class VIII.

14,159. T. Parker and A. E. Robinson. Improvements in the treatment of solutions containing nickel and iron for the obtainment of useful products therefrom. August 21.

14,213. H. Y. Castner and H. Baker. Improvements in the manufacture of salicylic acid. August 22.

14,342. H. W. Wallis. Improvements in the regeneration of the alkaline sulph-ferrites of soda waste, with recovery of elemental sulphur, and reproduction of sodium ferrite, carbonate, and hydrate. August 25.

14,868. R. C. Wilson. Improvements in or connected with the manufacture of salt from brine. September 3.

14,914. K. Walter and E. Boenig. Improvements in lead chambers used in the manufacture of sulphuric acid. Complete Specification. September 4.

15,116. G. J. Warner. Improvements in the utilisation of metallic chloride and other waste liquors, and in the production of valuable products therefrom. September 7.

15,136. F. Fichstädt. A process for the production of caustic alkali, carbonate of alkaline metals, and useful by-products. Complete Specification. September 7.

15,251. C. G. Collins. Process for purifying brine. Complete Specification. September 8.

15,288. R. J. Brice. A process of utilising galvaniser's waste. Complete Specification. September 9.

15,357. The Compagnie Générale de Produits Antiseptiques, H. Gall, G. de Bechi, and the Société Centrale de Produits Chimiques. *See* Class XVIII.—*C*.

15,515. A. Vogt. Improvements in the treatment of nitrate of an alkali for the manufacture of nitric acid and fertilising compounds. September 12.

Complete Specifications Accepted.

1890.

14,084. E. Meyer. Manufacturing hydrate of alumina from silicates of alumina or clay. September 9.

17,765. J. Simpson. Employment of sulphuretted hydrogen in the manufacture of alkali and certain by-products. September 9.

1891.

8293. H. H. Leigh—From J. Elsner and R. Gasch. Process and apparatus for procuring cyanogen and its compounds from gases. September 9.

11,965. P. de Wilde. Method of utilising the "Weldon" plant for the manufacture of precipitated phosphates. August 26.

13,334. A. L. H. Knoop. Extraction of carbonic acid from minerals, and apparatus therefor. September 16.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

Applications.

13,869. W. Walker. Improved process and apparatus for making glass and obtaining hydrochloric acid. August 17.

14,064. L. Wilson. Improvements in and connected with blocks and tiles for paving and flooring, for facing walls and ceilings, and for similar purposes. August 20.

14,076. J. Sherwin. Improvements in the encaustic method or process of decorating tiles, plaques, and other articles of earthenware, china, and stoneware. Complete Specification. August 20.

14,164. J. P. Guy. Improvements in the manufacture of solid earthenware articles, such as tiles and bricks, and in machinery or apparatus therefor. August 21.

14,381. C. G. y Losada. Improvements in baking ceramic pastes and pottery. August 25.

14,482. D. Rylands. Improvements in connexion with glass-melting furnaces. August 27.

14,496. C. L. Startup. Improvements in machines for blowing glass. August 27.

14,918. J. P. Guy. Improvements in the manufacture of earthenware articles, such as tiles and bricks, and in machinery or apparatus therefor. September 3.

15,067. A. Cay. Improvements in the manufacture of certain kinds of articles of glass, and in machinery or apparatus to be employed in the said manufacture. September 5.

15,108. E. G. Cole and H. Keston. Improvements in means or apparatus for forming clay into pots or vessels. September 7.

15,240. H. Warrington. Improvements in or applicable to ovens or kilns for burning porcelain, bricks, tiles, and the like. September 8.

Complete Specifications Accepted.

1890.

15,301. D. Rylands. Machinery for manufacture of bottles and other hollow glass ware or pressed ware. September 16.

16,629. G. L. Schultz. *See* Class X.

17,117. D. Rylands. Manufacturing glass vessels, and adapting the same for the storage and conveyance of compressed gases, and for similar purposes. September 16.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

Applications.

13,836. W. H. Munns. From H. A. Rue, jun., United States. An improved mill for grinding hard substances. August 17.

13,983. W. P. Winter. Improvements in and relating to securing moulds in the manufacturing of artificial stone, paving, and other uses. August 19.

14,600. W. J. Lea, W. Murray, and A. Bates. The improved compound granulite fire-lighting and fire-resisting cement, and also of boiler and steam pipe and service pipe covering. August 29.

14,952. J. S. Robertson. Interlocking impervious brick. September 4.

15,101. E. Lodge and F. Jury. A new or improved chemical treatment or application for cleaning stone, marble, granite, and the like. September 7.

15,139. F. Haines. Improvements in constructing cement or the like pavements, floors, platforms, or other surfaces or structures. Complete Specification. September 7.

15,195. C. Tompkins and J. A. Kinder. Improvement in buildings, fireproof walls, partitions, and roofs. September 8.

15,281. W. F. Thomas. An invention for the decoration of artificial stone and pavements. September 9.

15,509. G. Dolenz. An improved process for the manufacture of artificial stone and marble. September 12.

Complete Specifications Accepted.

1890.

14,398. C. von Forell. Manufacturing from Roman cement a composition similar to Portland cement. September 16.

16,789. R. Stone. Manufacture of fireproof plastic material for cement, also applicable to smelting and various other useful purposes. September 9.

X.—METALLURGY, MINING, Etc.

Applications.

13,888. J. E. Stead. Carbonising fluid iron and steel. August 18.

13,906. J. H. Darby. Improvements in or appertaining to basic-lined furnaces. August 18.

13,907. J. H. Darby. Improvements in the manufacture or treatment of steel or iron bars, plates, or the like. August 18.

14,031. O. Imray.—From F. C. Glaser, Germany. Process for hardening the interior of iron or steel tubes. August 19.

14,155. J. B. Freeman and others. An improved method of and apparatus for flaking or "feathering" lead or other metal. August 21.

14,251. A. French and W. Stewart. Improvements in obtaining nickel and cobalt from ores. August 24.

14,290. H. L. Herrenschmidt. Improvements in the treatment of certain mattes and ores for the separation of nickel and cobalt from copper. August 24.

14,449. H. Pieper. A new or improved process for the production of damascened metal bars for use in the manufacture of fire-arm barrels. August 26.

14,737. W. D. Bohm. Improvements in apparatus for leaching ores in separating gold and silver therefrom. September 1.

14,791. E. Edwards.—From L. Pszeolka, Germany. An improved process for the manufacture of compound armour plates and armour-plated turrets. September 1.

14,795. E. Martin. An improved manufacture of compound or metal coated wires. September 1.

14,823. W. H. Martin and W. Pethybridge. The Martin-Pethybridge gold extraction apparatus. September 2.

14,825. W. R. Hinsdale. Process of preventing segregation in large ingots. September 2.

14,951. E. L. Mayer. A new or improved process of extracting antimony from certain of its ores and compounds. September 4.

15,048. The London Metallurgical Co., Lim., and S. O. Cowper-Coles. Improvements relating to the coating or plating of metals and metallic articles, which improvements are also applicable for the manufacture of bullets. September 5.

15,142. W. R. Lake.—From G. F. Simonds, United States. Improvements relating to the hardening or tempering of steel, and to apparatus therefor. September 7.

15,204. J. von. Langer and L. Cooper.—From G. Pietzka, Austria. Improvements in reverberatory or open-hearth furnaces. September 8.

15,288. R. J. Brice. *See* Class VII.

15,359. J. A. Crawford. Improvements in the manufacture of malleable and gun iron by the hand-puddling system. September 10.

15,418. J. E. C. Koch.—From W. E. Koch, United States. Improvements relating to the production of metallic oxides and to apparatus therefor. September 11.

15,444. T. H. J. Eskuchen and H. A. Haarmann. Improvements in the burning of pressed blocks of purple ore and in apparatus or kilns therefor. September 11.

15,482. T. H. J. Eskuchen and H. A. Haarmann. Improvements in the manufacture of briquettes of purple ore. September 12.

Complete Specifications Accepted.

1890.

12,831. E. Zappert.—From C. Searneo. Manufacture of material to be employed in the manufacture of armour plates. August 26.

13,413. T. Held. Obtaining a new metallic alloy. August 26.

15,102. T. Sturgeon and T. C. P. Crampton. Method of casting metals in moulds. September 16.

15,806. A. J. Campion and J. E. Tenison-Woods. Treatment and reduction of metallic ores or compounds, and recovery of metals and products therefrom. August 26.

16,629. G. L. Schultz. Extraction of iron from minerals used in manufacture of glass, china, earthenware, and similar goods. September 16.

16,694. J. Harris. Machinery or apparatus to be used for the extraction of gold and silver from their ores by the amalgamation process. August 26.

16,887. T. S. Lindsay. Preparation of aluminium fluoride and double fluorides, and manufacture of aluminium from fluoride. September 9.

17,053. W. Truran. Machinery or apparatus for cooling or discharging slag. September 16.

17,623. J. Garnier. Process for the manufacture of metallic nickel, together with alloys of nickel and iron, utilisable either direct or for the manufacture of nickel steel or nickel and carbonised iron castings. September 16.

17,625. B. Richards. Furnaces for smelting copper and other ores. September 9.

17,935. N. Lébédeff. Means or apparatus for the extraction of metals from metallic ores or matters containing metals. August 26.

18,276. J. Riley. Ingot moulds, used in the manufacture of steel. September 16.

21,221. W. D. Bohn. Apparatus for the separation of gold and silver from ores or materials containing them. September 16.

1891.

946. N. Lébédeff. Extracting iron or steel or other metals from ores or metalliferous materials. August 26.

9686. A. Longsdon.—From F. Asthower. Compound armour plates. September 9.

11,563. C. James. Method and process for the production of zinc or spelter from ores or compounds containing the same. September 9.

12,165. J. Wilmotte. Converter for the manufacture of iron and steel. August 26.

12,405. J. W. Richards. Manufacture of galvanised iron. September 2.

XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

Applications.

14,518. H. Weymersch. An improved construction of primary battery. August 27.

14,702. H. Hauser. Improvements in or connected with accumulators or secondary batteries. August 31.

14,800. H. H. Lake.—From H. Lemp, United States. Improvements in and relating to electric metal-working apparatus. September 1.

14,967. G. Steinle. Improved process and apparatus for extracting aluminium and its alloys by electrolysis. September 4.

15,050. E. A. Le Sueur. Improvements in or connected with electrolysis. September 5.

15,123. H. Edmunds. Improvements in or connected with systems of electric distribution wherein electrical storage batteries are used. September 7.

15,125. A. J. Jarman. Improvements in electrical storage cells and elements therefor. September 7.

15,407. G. Cohen. Improvements in galvanic batteries. September 11.

Complete Specifications Accepted.

1890.

18,896. A. S. Elmore. Process and apparatus for manufacturing copper tubes, sheets, strips, and wires by electrolysis. August 26.

1891.

7949. P. Goward. Secondary batteries. September 16.

11,134. C. A. Faure. Apparatus for the electrolysis of aluminium. September 16.

12,069. H. D. Fitzpatrick.—From K. F. Scholler and R. H. Jahr. Electrodes for secondary batteries. August 26.

XII.—FATS, OILS, AND SOAP MANUFACTURE.

Applications.

14,327. E. Simpson, C. H. Simpson, and H. McPhail. Improvements in the manufacture of soap. August 25.

14,365. O. K. Thomassen. Improvements in apparatus for purifying waste oil. Complete Specification. August 25.

14,651. J. Weirich. Improvements in the distillation and rectification of stearic acid, raw fatty acids, and tars. August 29.

14,902. J. Cathrein. Improvements in the method of and means for manufacturing soap. September 3.

Complete Specifications Accepted.

1890.

16,025. W. H. Lever, J. D. Lever, and E. G. Scott. Plant or apparatus for extracting oil or grease from granular or pulverulent material. September 2.

16,059. C. A. O. Rosell and J. C. Pennie. Manufacture of soap. August 26.

16,579. W. Wright. Improved soap powder. September 16.

XIII.—PAINTS, PIGMENTS, VARNISHES, AND RESINS.

Applications.

14,137. R. W. E. McIvor. The production of the pigment known as blue ultramarine from the material known as green ultramarine by a new process. August 21.

14,160. A. McCowatt. An improved anti-fouling composition for ships' bottoms. Complete Specification. August 21.

14,618. J. C. Martin. Improvements in the manufacture or treatment of sulphate of lead. August 29.

14,948. H. Seiling. Paint. September 4.

15,330. S. Banner. Improvements in substances applicable for varnish, and in the method of manufacturing the same. September 10.

Complete Specifications Accepted.

1890.

11,359. J. Baptista. Facilitating the use of mineral or other non-oxidising oils in compounding paints and paint oils. September 2.

1891.

10,524. A. L. Rath. Manufacture of india-rubber. September 9.

10,528. A. F. B. Gomess. Process of devulcanising vulcanised india-rubber, gutta-percha, and similar gums, and reclaiming the rubber therefrom for re-manufacture, without the addition of pure rubber. August 26.

XIV.—TANNING, LEATHER, GLUE, AND SIZE.

Applications.

14,174. T. Dunn. An improvement in the production or manufacture of leather. August 22.

14,291. H. Courtonne. Improvements in the treatment of skins used in the felt manufacture. August 24.

XV.—AGRICULTURE AND MANURES.

Applications.

14,719. H. W. Wallis. Improvements in the manufacture of fertilising compounds. August 31.

15,258. M. C. Guster. Improvements in the manufacture of manure and fertilisers. September 9.

15,515. A. Vogt. *See* Class VII.

XVI.—SUGARS, STARCHES, GUMS, Etc.

Application.

14,575. A. Schneller and W. J. Wisse. Improvements in the refining of sugar juice or molasses. August 28.

Complete Specifications Accepted.

1890.

13,444. J. Y. Johnson.—From A. L. Peck. Manufacture of lactose or milk sugar. August 26.

17,557. A. Whol and A. Kollrepp. Production of invert sugar. September 9.

1891.

8893. A. Parks. *See* Class XVII.

12,058. R. F. Cordero. Apparatus for defecating and evaporating saccharine juices. August 26.

12,808. R. F. Cordero. Apparatus for washing sugar. September 9.

XVII.—BREWING, WINES, SPIRITS, Etc.

Applications.

13,953. A. J. Boult.—From H. Lissagaray, France. Improvements in the distillation of wine, and of various simple or compound alcoholates, and in apparatus therefor. August 18.

14,053. H. Wilson. An improvement relating to brewers' and distillers' refrigerators. August 20.

14,117. F. A. J. Fitzgerald and G. Prescott. A method of restoring fermented liquors which have turned or are turning "flat." August 21.

14,276. A. Bruns. A process and apparatus for the production of sparkling wines and other sparkling beverages. August 24.

14,658. F. J. Money. Improvements in malt-mashing apparatus. August 29.

14,779. J. E. Johnson-Johnson. Improvements in the manufacture of materials for the production of alcoholic and non-alcoholic beverages, and apparatus therefor. September 1.

15,467. S. A. Croxford. An improved method of and apparatus for straining brewers' wort. September 12.

Complete Specifications Accepted.

1890.

15,352. H. H. Lake.—From A. Brunn, Denmark. Manufacture of yeast. September 9.

1891.

8893. A. Parkes. Utilising the waste of distilleries, breweries, glucose and starch works, for the preparation of fuel. August 26.

12,506. C. Bach. Preparation of wort from malt alone or mixed with unmalted cereals. September 16.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

Applications.

A.—Chemistry of Foods.

13,873. W. R. Dodd. Improvements in the preparation of food for infants. August 17.

13,921. C. Reul. Improvements in the manufacture of bread. August 18.

14,521. J. Falcimagne. Improvements relating to the preservation of meat and to apparatus therefor. Complete Specification. August 27.

14,755. E. Wilhelm, A. Brougier, and H. Trillich. A method and apparatus for manufacturing malt coffee. September 1.

15,389. A. Davey. Improvements in or connected with the preparation of the banana as an article of food. September 11.

B.—Sanitary Chemistry.

14,038. J. Makinson. Improvements in apparatus for treating foul air and noxious vapours or gases. August 19.

14,181. W. D. Scott-Moncrieff. Improvements in or relating to the treatment of sewerage and other contaminated liquids. August 22.

14,394. J. Russell. Improvements relating to the treatment of sewer gas. August 25.

14,735. E. Devonshire. Improvements in apparatus for purifying or treating water. Complete Specification. September 1.

15,172. R. S. Brownlow. Improvements in apparatus for purifying water or other liquids. September 8.

15,391. F. P. Candy. Improvements in the oxidation of sewage and impure waters and of material for use in the treatment of such sewage and impure waters. September 11.

C.—Disinfectants.

14,788. H. H. Lake.—From A. G. Pummerer, Austria. An improved fluid insecticide. September 1.

15,357. Compagnie Générale de Produits Antiseptiques, H. Gall, G. de Bechi, and Société Centralé de Produits Chimiques. Improved manufacture of sulphate of copper. September 10.

Complete Specifications Accepted.

A.—Chemistry of Foods.

1890.

14,051. H. Ronart. *See* Class I.

15,981. W. Geddes. Improved malted food preparations. September 2.

16,508. G. W. Homer and J. Hazel. Manufacture of cream, and the protection of cream, meat, fish, and other perishable articles from atmospheric air and other influences. August 26.

16,857. M. A. E. Schneider and R. H. Coall. Treatment of a certain fruit in order to convert it, either alone or combined with other substances, into food and drink for infants, invalids, and others. September 2.

B.—Sanitary Chemistry

1890.

17,453. J. W. Slater and the Native Guano Co., Lim. Preparation of agents for use in the purification of sewage and other polluted water by precipitation, and treatment of sewage and other polluted water, in order to effect the purification thereof. September 2.

1891.

4243. C. W. Chancellor. Method and apparatus for the treatment and disposal of sewage. September 2.

C.—Disinfectants.

1891.

3242. F. Idle and F. Pearson. Fire-lighter and disinfectant. September 9.

XIX.—PAPER, PASTEBOARD, Etc.

Applications.

14,032. J. D. Tompkins. An improvement in the treatment of vegetable fibre for pulp manufacture. Complete Specification. August 19.

14,272. J. C. Chapman.—From the United Indurated Fibre Co., United States. Composition of matter for waterproofing pulp articles. Complete Specification. August 24.

14,652. E. W. H. Walker. An improvement in the treatment of paper before printing on same. August 29.

14,756. C. Schæuffelen. Process and appliance for producing fine granulated paper with uniform grain of pyramidical shape. Complete Specification. September 1.

14,897. A. Schlumberger. Process for producing safety paper by means of water-mark. September 3.

14,973. A. Schlumberger. Process for producing paper safe against forgery. September 4.

15,222. C. W. Robinson. Improved machine for making parchmentised fibre, &c. September 8.

Complete Specifications Accepted.

1890.

16,408. E. Misch. Manufacture of cellulose. September 9.

16,546. B. J. Beckmann. Manufacture of paper, pasteboard, and the like, and apparatus therefor. August 26.

16,928. H. B. Watson and J. S. Watson. Manufacture of strainer or knotter plates for straining paper pulp, wood pulp, and the like. August 26.

1891.

12,970. C. Kellner. Boiling process for producing cellulose by means of sulphurous acid. September 9.

12,971. C. Kellner. Process and apparatus for preparing the wood in the manufacture of wood fibre. September 9.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES, AND EXTRACTS.

Applications.

14,223. G. A. Clowes. Improvements in the preparation of peptone extracts, and in the application of the same to various useful purposes. August 22.

14,224. P. Ernert.—From P. Ernert, Germany. A process for the preparation of phenylester salicylic acid or salol from salicylic acid. August 22.

14,430. A. Schmitz and E. Toenges. Process for the production of oxysebacic glycerin ethers and oxy-sebacides, as well as the derivatives: sulpho-oxy, di-oxy, and sulpho-dioxy-sebacides. August 26.

15,514. S. Pitt.—From R Pietet and Co., Germany. Improvements in the purification of chloroform. Complete Specification. September 12.

Complete Specifications Accepted.

1890.

18,021. B. Willcox.—From The Farbenfabriken vormals F. Bayer and Co. Manufacture of periodides of isobutyl phenols, and of isobutyl cresols. September 9.

18,022. B. Willcox.—From The Farbenfabriken vormals F. Bayer and Co. Manufacture of methyl- and ethyl-phenacetin. August 26.

18,246. O. Imray.—From The Amsterdamsche Chininefabrik. Production of anthranilic acid. August 26.

19,576. O. Imray.—From The Farbenfabriken vormals Meister, Lucius, and Brüning. Manufacture of a compound of antipyrine and iodine. September 16.

XXI.—PHOTOGRAPHIC PROCESSES AND MATERIALS.

Applications.

13,961. H. Foster. The opaque negative photo-printer. August 19.

15,134. J. Hauff. The preparation and employment of aromatic amido-compounds as developing means in photography. September 11.

XXII.—EXPLOSIVES, MATCHES, Etc.

Applications.

14,129. G. C. Dymond.—From E. Lagneau, Belgium. Improvements in or connected with the manufacture of matches, and in apparatus or machinery therefor. August 26.

15,217. A. L. Harrison. Improvements in time fuses. September 8.

15,456. J. V. Johnson. An improved match. September 12.

Complete Specifications Accepted.

1890.

19,076. W. M. Mordey. Electric safety fuses. September 2.

1891.

9196. J. B. Scarlett. Manufacture of lucifer and other matches made of wood and cotton and other combustible and suitable material. August 26.

XXIII.—ANALYTICAL CHEMISTRY.

Application.

14,697. E. de Pass.—From F. Gossart, France. A method of analysing alcohols and other liquids or liquefiable bodies and apparatus therefor. August 31.

XXIV.—PATENTS UNCLASSIFIABLE.

14,371. F. C. Valentine.—From V. I. Gadesden, United States. Improvements in the treatment of a natural product to adapt it for various useful and ornamental purposes. August 25.

14,385. A. J. Boult.—From A. Kuhne, Germany. A process of imparting a permanent colouring to turquoises and other precious stones. Complete Specification. August 25.

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SESSION 1891-92.

1891:—

Nov. 2nd (Monday):—

Mr. W. C. Young. "On Volatile Organic Matter in Potable Water and a simple Method of Estimating Volatile and Non-Volatile Matter in Water."

Dr. S. Rideal. "Some Experiments on Solidifying Petroleum."

Dec. 7th:—

Mr. Watson Smith. "A Contribution to our Knowledge of the Soluble and Resinoid Constituents of Bituminous Coals."

Dr. Murray Thompson. "The Salt Industry of India."

1892:—

Jan. 4th—Mr. Boverton Redwood. "The Galician Petroleum and Ozokerit Industries."

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SESSION 1891—92.

1891:—

Nov. 3rd (Glasgow):—

Mr. R. Hamilton. "Note on the Precipitation of Phosphorus from Solutions of Iron and Steel."

Mr. A. Werner Cronquist. "The Fire-Clays and Fire-Brick Industry of Sweden."

Dec. 1st (Edinburgh):—

1892:—

Jan. 5th (Glasgow):—

Prof. W. Dittmar. "The Availability of Metallic Vessels for Chemical Operations in the Laboratory."

Mr. D. J. Playfair. "Notes on the Production of Cyanides."

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I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

PATENT.

Improvements in Apparatus for Evaporating, Concentrating, and Distilling Liquids. R. A. Robertson and D. Ballingall, Glasgow. Eng. Pat. 15,698, October 4, 1890. 11*d.*

THE object of this invention is the economical heating of the liquid treated in multiple-effect distilling apparatus before it enters the first "effect" of the system. For this purpose the fresh liquid is passed through tubes or coils exposed to the heat of the liquid under treatment in the last effect, or to the vapour given off from that liquid. From the last effect the liquid is passed through similar apparatus in the second last effect, and so on until it has been passed through and received the last increment of heat from the liquid in the first effect, into which it is then fed for treatment. The drawings accompanying the specification show three different arrangements for effecting this purpose, and there are two claims.—B.

* Any of these specifications may be obtained by post, by remitting the cost price, *plus* postage, to Mr. H. Reader Lack, Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C. The amount of postage may be calculated as follows:—

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Improvements in or connected with Apparatus for Making Fresh Water from Salt Water. T. Hocking, Bootle. Eng. Pat. 16,232, October 13, 1890. 11*d.*

This invention relates mainly to that kind of apparatus in which the salt water is heated by steam, which is separated from it by metal walls, the steam being subsequently condensed. Instead of being heated in bulk, as usual, the salt water is broken up into thin streams or drops, and in this state caused to flow over the metallic heating surface, which may be of any suitable form, a convenient one being that of a tube or cylinder, or a spirally coiled tube, and in so doing is quickly converted into steam. The water may fall by its own gravity on to the heating surface, or this latter may be made to move and take up salt water in comparatively small and divided thin layers, or in drops, and in such quantities that all the water is not evaporated, but a residue of strong brine remains and passes away into a receptacle, and can be afterwards further concentrated if desired. The heating surface is all placed within a case, with which it is connected by suitable pipes having apertures for the passage of the heating fluid, and which convey it in the manner described in Eng. Pat. 16,452 of 1889. For details of construction and mode of working, the specification and three sheets of drawings accompanying it must be consulted. There are eight claims.—E. S.

Improvements in Apparatus for Drying Semi-Liquid, Granular, or Pulverulent Substances. J. Dunn, Kelso. Eng. Pat. 16,384, October 15, 1890. 8*d.*

A FIXED vertical cylindrical vessel, made in two parts, has a vacuum maintained in it by a pump. In the upper part, constructed of iron or steel plates, are arranged rotating discs, all or some of which are heated by steam admitted through the hollow vertical shaft upon which they are fixed. The discs are of two kinds, of different diameters, and placed alternately, such that the substances to be dried, and which are fed in at the top of the vessel, are moved inwards and outwards by means of stationary inclined blades, the substances when moved inwards descending through a central opening in the next lower disc, and when moved outwards descending over the outer edge of the disc to the next lower disc. The lower part of the vessel, made of cast iron, is heated by steam admitted into recesses under the bottom, and has rotating stirrers arranged within it. The materials are allowed to accumulate to any suitable depth in the lower part of the vessel, when they are subjected to the final drying action of the steam in the recesses, and afterwards discharged into a barrel arranged so as to prevent any ingress of air whilst the materials are being transferred to its under delivery side.—E. S.

Improvements in Apparatus for Evaporating, Distilling, or Concentrating Liquids. L. J. Wilson, Lille, France. Eng. Pat. 16,258, October 17, 1890. 8*d.*

This invention relates to apparatus in which steam or other heating agent is applied to the evaporation of liquids, which are spread in thin layers over extended surfaces so as to be more rapidly and thoroughly acted upon by it. The apparatus, as claimed, consists of two thin corrugated sheets of a conducting metal, copper preferred, fixed back to back, with the ridges and furrows of their corrugations straight and horizontal, having the spaces between them supplied with the heating medium, while the liquid to be treated flows in a thin layer down the outside.—E. S.

An Improvement in Feeding Apparatus for Filters. R. Morris, Blackheath. Eng. Pat. 16,616, October 18, 1890. 6*d.*

A WATER-COCK and float are provided to feed the upper part of the filter. The lower part containing the filtered water is also supplied with a float, from which a rod extends upwards immediately under the lever of the upper float. The filtered water having reached a determined height, the float and rod are raised, and prevent the upper float from descending, and thus cuts off the supply of water. By this means the over supply of water to the filter is obviated, and the filtering material can be aërated.—E. S.

Improvements in Filtering Machinery. E. Martin, Watford. Eng. Pat. 6186, April 10, 1891. 11*d.*

AN endless travelling band made of any material suitable for filtering purposes is so arranged as to assume for a portion of its length the form of an open horizontal shallow trough or cistern. For this purpose the band is mounted in a manner to cause it to make a slight descent at one end, and simultaneously to have the two sides or edges of the fabric turned up. In this form the band extends horizontally for a certain length, and is then made to rise again on an incline and to spread out flat. In this manner a shallow travelling cistern is formed between the two inclines wherein the water for filtering is received. The speed of the travelling bed may be regulated in such a way as to allow it to be coated to any desired degree with matter arrested from the filtered liquid, and on continuing to travel it may be conducted through cleansing apparatus, whence it will return cleaned and ready for the renewal of the operation. The specification and drawings indicate various arrangements for the purpose, but there is only one claim made.—B.

Improvements in Filters. W. P. Thompson, Liverpool. From J. A. Bowden, Detroit, U.S.A. Eng. Pat. 9311, June 2, 1891. 8*d.*

THE improvements consist (1) in preventing the weight of the filter-bed coming directly on to the outlet strainer; (2) in securing a more thorough cleaning of the filter-bed; (3) in simplifying the general operations. For the means by which these are effected the specification must be consulted. There are nine claims.—E. S.

Improvements in Filtering Apparatus. W. P. Thompson, Liverpool. From J. A. Bowden, Detroit, U.S.A. Eng. Pat. 9311, June 2, 1891. 8*d.*

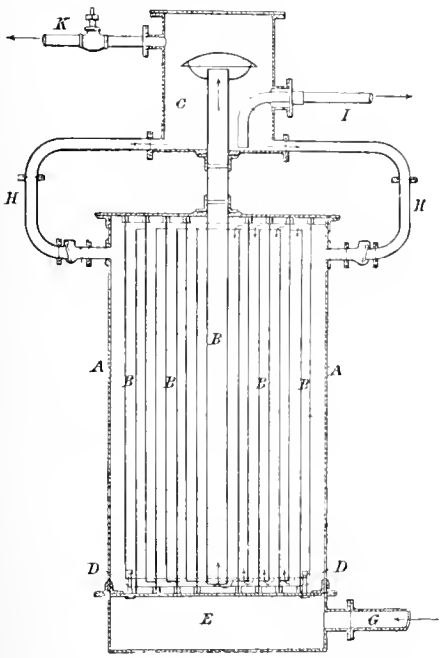
THIS invention is intended to produce a filter capable of filtering with rapidity a large body of water, and also for rapidly cleaning the filter-bed. For the mode by which it is proposed to effect this, and for details of construction, the specification and four sheets of drawings attached to it must be consulted. The patentee claims, 1st: "In a filter, the combination with its case of a water inlet pipe, at its top a horizontal perforated wash pipe at the bottom of the filter bed, a shield beneath the latter, and a horizontal strainer beneath the shield . . ." There are eight claims.—E. S.

Improvements in Centrifugal Apparatus for Testing Relative Volumes of Mixtures of Liquids of Different Specific Gravities. J. Laidlaw, Glasgow. Eng. Pat. 10,492, June 20, 1891. 6*d.*

THE object of this invention is to prevent the tendency of the testing bottles being burst by the pressure of the contained fluid arising from centrifugal action. To effect this a revolving disc has pockets for holding the testing bottles, whilst the centre of the disc forms a trough for holding water or other liquid of suitable density, which is caused by centrifugal action to flow over the edge of the trough and into the pockets, and to surround the bottles. The pressure of the liquids inside and outside the bottles being equalised, the liability of their being burst by a high rate of speed is greatly reduced.—E. S.

Improvements in Condensing or Liquefying Vapours or Gases and in Apparatus therefor. J. Gamgee, Wimbledon. Eng. Pat. 10,374, July 4 1890. (Under Internat. Conv. December 9, 1889.) 8*d*.

This invention claims to embody a novel method of condensing steam or vapour, in causing it to be incorporated



Novel Condensing Apparatus.

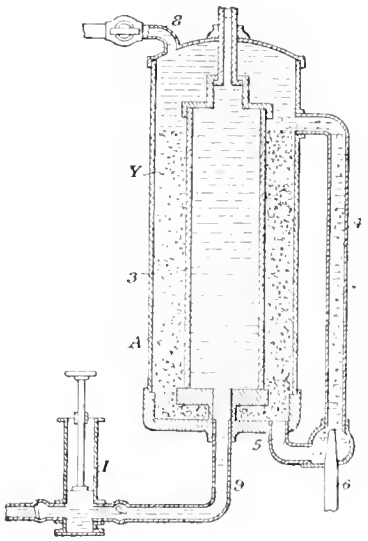
and mixed intimately with a certain fixed quantity of water or other liquid which is violently agitated by the vapour itself. The liquefaction is caused by forcing the vapour to perform work in overcoming the resistance of columns of liquid in its passage to the receiver of the condensed product. In the case of exhaust steam from a motor, a vacuum is maintained above the liquid columns through which the steam has to pass, in order to facilitate its escape from the motor. The accompanying illustration shows the apparatus as arranged for that purpose.

A is a vessel fitted with concentric cylinders or pipes B B, which are connected alternately to the top and bottom plates of the vessel A, so as to form a continuous, annular up-and-down passage of diminishing area from the outer to the inner pipe B. The inner pipe reaches into the chamber C above, whilst the lower end of the outer pipe B is provided with a number of nozzles D, communicating with the steam chamber E, which receives the exhaust steam from the motor through the pipe G. The top of each nozzle is closed with a small check valve opening upwards. The vessel A and chamber C having been filled with water up to and covering the upper edge of the inner pipe B, the steam is passed through the nozzles D and overcomes the resistance of the water, aided by the vacuum produced in the chamber C through the pipe K. The branch-pipes H with check-valves return the water from C to A, and thus a vigorous circulation is set up through the whole apparatus. The pipe I carries away the surplus hot water, representing the steam condensed in the apparatus.

A similar arrangement can be employed without vacuum in the process of the distillation of essences or for other similar purposes. When so applied, all losses of valuable vapours are avoided owing to the whole apparatus being hermetically sealed to the outer atmosphere. There are five claims and two sheets of drawings.—B.

Improvements in Filters and in the Method of and Means for Cleansing Filtering Surfaces. P. M. Justice, London. From "The Automatic Filter Company," Washington, U.S.A. Eng. Pat. 11,594, July 8, 1891. 8*d*.

The object of this invention is the automatic removal of impurities deposited by water on stationary filtering surfaces. The removal is effected by means of a solid body of sand which is passed slowly across and in contact with those surfaces, whilst the current of water through the filtering medium is periodically reversed with a view to loosening the impurities thereon. The simplest form of filter constructed on these lines is shown by the accompanying illustration.



An Improved Filter.

In the figure A is the outer vessel, 3 the porous filtering tube, Y the filling of sand, 4, 5, a circulating tube with an injector tube 6 at the lower corner, through which the filtering water is admitted. The current created by the injected water draws sand from below and re-deposits it on the top of the body of sand, and the impurities attached to the sand during its descent are swept off in its passage through the pipe 4, and are led out of the filter through the pipe 8. The tube 9 leads to a small hand pump I, which is used from time to time for creating a surplus pressure in the tube 3, thereby reversing the current and loosening the impurities, which are then carried away by the descending sand. The specification covers 20 claims, and the drawings show various modifications and combinations.—B.

Improvements in or relating to the Refrigerating Medium employed in Freezing and similar Machines. W. McLaren, Liverpool, and P. Holmes, London. Eng. Pat. 12,111, July 16, 1891. 4*d*.

For the purpose of detecting any leakage of carbonic acid from the refrigerator, the patentees impart to the carbonic acid a pungent smell by the addition of peppermint or similar substance.—H. A.

Improvements in Filters. J. Haslam, Tonge. Eng. Pat. 12,512, July 23, 1891. 6*d*.

This patent relates more particularly to the construction of portable filters and to their tube joints, and embraces the use of internal partitions or shelves which project from alternate sides and hold the filtering material between them, the object being to lengthen the passage of water through the filter. There are 12 figures and three claims.—B.

II.—FUEL, GAS, AND LIGHT.

PATENTS.

Manufacture of Illuminating Gas and other Useful Products from Refuse of the Kind known as Town's Refuse. T. Spudder, London. Eng. Pat. 10,313, July 3, 1890. 4*d*.

See under XVIII. *B*, *page* 845.

Improvements in the Manufacture of Artificial Fuel. W. H. Lacey, Brentford. Eng. Pat. 11,514, July 23, 1890. 6*d*.

Various mixtures for forming blocks of artificial fuel are given, of which the following is one that will serve as an example:—Charcoal powder and a soluble silicate are mixed together by simply stirring, to which is added calcium hydrate and a small proportion of freshly precipitated alumina or magnesia. The calcium hydrate is in chemical excess in order that sufficiency (on ignition) shall remain free to absorb or combine with the carbonic acid. The entire mass after mixing is merely poured into a mould and allowed to set. The best proportions are these:—enough soluble silicate (preferably sodium silicate) is taken to well wet the charcoal. Then about one fifth calcium hydrate is mixed in together with 1 or 2 per cent. of freshly precipitated alumina or magnesia."—H. S. P.

Improvements in the Treatment of Tar and Pitch. W. H. Nevill, Fettyside. Eng. Pat. 13,398, August 26, 1890. 4*d*.

Peat made from wood or other vegetable matter, or paper (preferably the coarser or brown qualities) which has been steamed and disintegrated is mixed in the proportion of 1 or 2 per cent. with tar or a mixture of tar and pitch, and the mixture is heated for several hours with frequent stirring. "It may then be used with advantage in the manufacture of patent fuel, for road making, and for various other purposes."—H. S. P.

Improvements in the Treatment of Sewage. A. O. Jones, Harrogate, and S. Fox, New Wortley. Eng. Pat. 14,253, September 10, 1890. 6*d*.

See under XVIII. *B*., *page* 846.

Improved Method of and Apparatus for Producing Gases from Bituminous Fuel. T. E. Ross, Croydon. Eng. Pat. 16,846. October 22, 1890. 8*d*.

The apparatus described in this patent is employed for the production of carburetted hydrogen or gaseous hydrocarbons, and producer gas, from bituminous fuel; the process is carried out in such a manner as to avoid the formation of clinker, and at such a temperature that the gas is free from any considerable quantity of readily-condensible vapours.

The fuel is placed in a gas producer and distilled from above by heat developed by the combustion of gaseous fuel, which is forced into the upper part of the producer, together with a suitable quantity of air. The products of distillation pass downwards through the incandescent coke resulting from coal previously carbonized, and in this way the condensible hydrocarbons are decomposed, and the carbonic anhydride is converted into carbonic oxide. The gas employed for heating the fuel is drawn off directly from the bottom of the producer.—F. S. K.

Improvements in the Manufacture of Hydrogen Gas or a Mixture of Hydrogen and Carbon Monoxide, and Apparatus therefor. V. B. Lewes, Greenwich. Eng. Pat. 20,752, December 19, 1890. 8*d*.

A retort, partly filled with iron borings, or with a mixture of iron and carbonaceous material, or with asbestos containing iron in a very fine state of division (see Eng. Pat. 4134 of 1891; following abstract) is placed in the centre of a gas producer which is charged with carbonaceous material and lighted from the bottom; by means of an air blast the fuel is raised to a bright red heat and then a little steam is admitted together with the air. The gaseous mixture of carbonic oxide, nitrogen, and hydrogen produced in this way is led from the top of the producer down through the retort, and then away; as soon as the iron oxide in the retort is completely reduced, and the requisite temperature has been attained, the producer-gas is turned off and steam, previously heated in the producer, is passed over the iron, the hydrogen being led away to a gasometer. The process is then repeated as described.

The advantages claimed for this form of apparatus are: 1. The iron can be used over and over again. 2. The rapid cooling of the iron during the decomposition of the steam is prevented.—F. S. K.

Improvements in or Appertaining to the Manufacture or Production of Hydrogen. V. B. Lewes, Greenwich. Eng. Pat. 4134, March 7, 1891. 8*d*.

The patentee claims the use of a mixture of carbonic oxide, nitrogen and hydrogen, for the reduction of oxide of iron in the process described in Eng. Pat. 20,752 of 1890 (see preceding abstract). This gaseous mixture is a far better reducing agent than carbonic oxide, and is easily obtained in the manner already stated.

The finely-divided iron employed for the production of hydrogen is prepared by saturating asbestos or pumice with certain iron salts, which are easily decomposed into oxide of iron on heating, or by mixing moist hydrated oxide of iron with asbestos fibre and iron filings.—F. S. K.

Improvements in Apparatus for Burning Liquid Hydrocarbons. W. L. Wise, London. From "The Aërated Fuel Company," Springfield, U.S.A. Eng. Pat. 5020, March 20, 1891. 8*d*.

The invention comprises an apparatus consisting essentially of an oil tank, from which the oil is forced by an air compressor to a burner or series of burners, the same compressor also giving a supply of air to the burners. There is also a special form of nozzle-burner, of which more than one modification is described, fitted with arrangements for regulating the feed of oil and air to the burner. Drawings accompany the specification.—H. S. P.

An Improvement in Incandescent Illumination and Apparatus for that Purpose. J. Moeller, London. Eng. Pat. 5022, March 20, 1891. 8*d*.

This invention relates to the production of a gas, suitable for use in incandescent lamps, in situations where coal-gas is not available. For this purpose a current of air, obtained by means of bellows, or by means of a rotating drum partitioned like that of a gas meter, and partly immersed in water, is passed through "benzolene" or through fibrous material soaked in "benzolene"; the gaseous mixture obtained in this way is burnt in a Bunsen burner, and heats to incandescence a hood or mantle of refractory metallic oxide. —F. S. K.

Improvements in and in Apparatus for the Manufacture of Crude Peat into Fuel. A. A. Dickson, Quebec, Canada. Eng. Pat. 7983, May 9, 1891. 8*d*.

This is an improved process for the conversion of crude peat into good fuel, the object of the invention being, more especially, to dry the material, as it comes from the bog, without causing any deterioration in its fibrous condition and without the aid of artificial heat.

The crude peat is first compressed in a conical screw conveyor and compressor, and then between rollers covered with some absorbent material such as felt, until most of the water is removed. It is then agitated in a heated cylinder or chamber, where it is at the same time exposed to a blast of air. The dry material is finally ground to a powder, and the sifted powder compressed into blocks.

The apparatus required is shown in two sheets of drawings.—F. S. K.

Process of Utilising the Waste of Distilleries, Breweries, Glucose and Starch Works and the like for the Preparation of Fuel. A. Parks, Martinsburg, U.S.A. Eng. Pat. 8893, May 26, 1891. 6*d*.

See under XVII., *page* 844.

Improvements in and relating to Incandescent Gas Burners. A. J. Boult, London. From J. C. O. Chemin, Paris, France. Eng. Pat. 9240, June 1, 1891. 8*d*.

The object of the improved burner is to enable ordinary coal gas, or other gas, under low pressure, to be used in incandescent lamps. This is effected by placing round the gas jet a number of superposed porcelain or metal truncated cones, between which air sufficient for combustion is drawn; in the uppermost cone there is placed a piece of wire gauze which acts as a mixer. The gaseous mixture burns on the outer surface of a cap or dome, made of platinum, magnesium oxide, or other suitable material, and fixed on the top of the uppermost cone; the whole is surrounded by an ordinary chimney.—F. S. K.

An Improved Compound for Treating Fuel. H. H. Lake, London. From The Standard Coal and Fuel Company, Boston, U.S.A. Eng. Pat. 9796, June 9, 1891. 4*d*.

A mixture of the following substances is made:—

	Parts by Weight.
Saltpetre (nitre or preferably Chili saltpetre)	25
Common salt as free from moisture as possible	50
Sodium sulphate (Glauber's salt, or preferably "salt cake").	15
Carbonate of soda (or soda crystals)	5
Sal-ammoniac	5

"The above ingredients should be dried, ground, and thoroughly mixed together, and will form a mixture which does not deliquesce under ordinary climatic conditions, and consequently may be stored and shipped in a dry condition without necessitating the use of air-tight packing cases." The powder may be either sprinkled upon the coal or other fuel, or preferably a solution of it in water may be made and sprinkled over the fuel, to assist the combustion of the fuel.—H. S. P.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

Constitution of the Oxygen Compounds in Petroleum. R. Zaloziecki. Ber. 1891, **24**, 1808—1815.

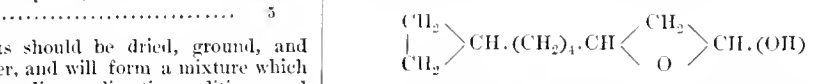
After referring briefly to the work of previous investigators, the author gives an account of the acids obtained from petroleum in a works at Kolema, which were sent to him in the form of sodium salts by H. Wisniowski. These were separated from the petroleum still present therein by repeated treatment with alkalis and reprecipitation by mineral acids, a large quantity of a dark brown oil being eventually obtained. This was dissolved in alcohol, the solution subjected to the action of hydrochloric acid gas, and the mixture of ethyl salts thus obtained submitted to fractional distillation.

The following fractions were obtained:—

Fraction.	Boiling Point.	Carbon.	Hydrogen.
1	220—225	72·05	11·37
		71·91	11·63
2	225—230	72·60	11·52
3	230—235	73·08	11·56
		73·25	11·81
4	235—240	72·66	11·33
		73·32	11·48
5	240—245	73·65	11·62
6	245—250	73·86	11·75
7	250—260	74·20	12·05

Fraction (2) corresponding to the ether of the formula $C_{12}H_{24}O_2$, fractions (3) and (4) corresponding to $C_{13}H_{24}O_2$, and (6) and (7) corresponding to $C_{14}H_{26}O_2$, appear to be approximately of the same character and yield the corresponding acids on hydrolysis. From the analysis of both acids and ethyl salts it would appear that the former have the composition $C_{10}H_{18}O_2$, $C_{11}H_{20}O_2$ and $C_{12}H_{22}O_2$ respectively, and therefore belong to a series having the general formula $C_nH_{2n-2}O_2$, which is in conformity with the results obtained by previous authors.

With regard to the condition of these acids, the author, after an exhaustive investigation, found that on treating the acid fraction $C_{10}H_{18}O_2$ with iodine and phosphorus, an iodine compound was obtained having the formula $C_{10}H_{17}IO$ and not $C_{10}H_{17}IO_2$. This result precludes the presence of a carboxyl group supposed to exist, and the author concludes that these compounds are lacto-alcohols. For the compounds $C_{10}H_{18}O_2$ he gives the following constitutional formula—



In conclusion, it is stated that although these acids exist in petroleum in small quantities, their presence is of importance in the purification of petroleum, a circumstance which the author intends to discuss on a future occasion.

—D. B.

The Pierce Process for the Production of Charcoal, Wood Alcohol, and Acetic Acid. W. L. Dudley. J. Analyt. and Applied Chem. May 1891.

The special advantages of this process, which was devised in its original form in 1876, consist in the larger yield of charcoal which is obtained from the wood carbonised, and in the far smaller loss of by-products, the charcoal being also of better quality than any otherwise prepared. The

average amount of charcoal obtained by the other processes is 17·5 per cent. of the wood employed, while the yield in this case is shown in the table :—

	Per Cent.
Charcoal	25·30
Methylalcohol	0·75
Acetic acid	1·00
Tar	1·00
Water	45·95
Permanent gases	23·00
	100·00

The wood is heated in brick kilns, shaped like a beehive of 32 feet diameter, and 16 feet height in the centre, by means of the combustion of the permanent gases produced during a previous operation. During the drying, the steam is allowed to escape through a hole in the top of the kiln, but when the carbonisation begins, the hole is stopped up, and the products of distillation are drawn away by an exhaust fan into a large main leading into a series of condensers, where the acetic acid, tar, and alcohol are deposited. The uncondensed gases are then forced back into the kilns, where they are mixed with the requisite amount of air, by means of a steam jet, and burned in the furnaces. In this way, the carbonic acid gas and the water vapour being decomposed into carbonic oxide and hydrogen respectively, more gas is accumulated than is needed for carbonising, and in fact more than sufficient to yield steam for the engines driving the fans, &c., and for the stills in the alcohol house. The liquor from the condensers is allowed to stand in tanks, and when the tar has subsided, it is drawn off and neutralised with milk of lime. The neutral liquor is distilled in wooden stills by dry steam to obtain the alcohol, which is afterwards twice rectified, and the residue is evaporated and the crude calcium acetate sold as such. The tar is chiefly employed in painting the gas mains, condensers, &c.

A complete plant on this system consists of 48 kilns, which hold 55 cords of wood each, and take from 14 to 18 hours for drying, and six to eight days for carbonising. The kilns are set in three batteries of 16 each, each battery having its own fan and set of five condensers in series, the fan being placed after the first condenser. These are wooden boxes about 4 feet square and 14 feet long, filled with copper tubes, in which the condensing water circulates. The alcohol house contains eight "primary" stills, for the first distillation, four "intermediate," and two "stripping" stills. Of these, the primary are made of wood, the others being of sheet iron, and fitted with a "weak liquor" condenser, consisting of a worm passing through a trough filled with water at a temperature of 80—95° C., to strengthen the alcohol as much as possible. The alcohol having to pass through two of these baths, often becomes of as much as 90 per cent strength, in which case it is diluted with water to 82 per cent. for shipment.—L. H. L.

Ohio Petroleum. J. and A. Mandel and A. Bourgougnon. J. Amer. Chem. Soc. **13**, 168—169.

The petroleum from Lima, Ohio, is dark green in colour, and very mobile, specific gravity at 15° = 0·791. The authors did not observe that peculiar objectionable odour which crude oil pumped from the oilfields of Ohio is said to possess, and the various fractions had the same smell as the corresponding fractions from Pennsylvania petroleum. The naphtha was easily refined by means of sulphuric acid and washing. The burning oil, purified in the usual way by means of sulphuric acid, caustic soda, acid washing, was colourless and nonfluorescent. On fractionation the oil yielded 16 per cent of naphtha of 70° B., 68 per cent of burning oil, 6 per cent of paraffin oil, and 10 per cent. of residue. Distillation began at 23° owing to the large amount of naphtha present, but when 60 per cent. had passed over, the temperature was 310°; beyond the point the specific gravity and boiling point of the distillate decreased, the extremes of specific gravity of the fractions being 0·680 and 0·830.—C. H. B.

Some Crude Petroleums. D. Woodman. J. Amer. Chem. Soc. 1891, **13**, 179—181.

Distillations were performed of three samples of petroleum; one was a sample of crude oil from California, specific gravity at 15·5° C. = 0·835, colour dark brown, opaque, no appearance of fluorescence except on dilution, odour peculiar and different from the under-mentioned samples, not being so disagreeable. A second sample was crude oil from the Lima (Ohio) field, specific gravity at 15·5° C. = 0·835, colour brown, slight fluorescence, odour peculiar and disagreeable. A third sample was likewise from the Lima field, its specific gravity was 0·850, in appearance and odour, however, it did not differ from the preceding.

Tables of specific gravities of the various fractions are given, the approximate classification in percentages being as follows :—

	California.	Lima No. 1.
Naphtha under 0·73 sp. gr.	10	10
Illuminating oil	40	50
"Lubricating" oils	40	30
Residuum	10	10

The California oil contained :—

Sulphur (Carius method)	0·18
Sulphuric acid (oil washed and washings, represented by $BaCl_2$)	0·0003
Water	0·27

The oil remained perfectly fluid at − 32° C., the viscosity at that temperature being apparently equal to that of boiled linseed oil; the heaviest distillates solidified at − 18° C.

The second sample of Lima oil gave :—

	Per Cent.
Naphtha and burning oil	56·8
Heavy oils	32·0
Residuum	9·6
Water	0·7
Sulphur	0·65

Notwithstanding the strong odour of the Lima oil, it rarely contains as much as 1 per cent. of sulphur. Analyses of samples of crude Ohio oils from different localities have given, on the average, about 0·50 per cent. of sulphur (Mabery and Smith, Amer. Chem. J. **13**, 234). The removal of the sulphur compounds, or the destruction of those accountable for the disagreeable odour in Lima oil is a problem still open for a satisfactory solution.—T. L. B.

The Formation of Inactive Tartaric Acid by the Oxidation of Phenol with Potassium Permanganate. O. Doebner. Ber. 1891, **24**, 1753—1757.

See under XX., *page* 849.

IV.—COLOURING MATTERS AND DYES.

Fast and Fugitive Dyes. J. J. Hummel. J. Soc. Arts, 1891, 535—548.

See under VI., *page* 832.

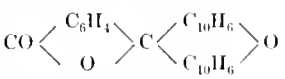
Permanent and Fugitive Colours to Light on Wool. T. Frusher. J. Soc. Dyers and Colourists, 1891, 82—84.

See under VI., *page* 833.

Phthaleïns. R. Meyer. Ber. 1891, **24**, 1412—1418.

According to the view advanced some time ago by the author (this Journal, 1889, 116) fluoresceïn contains the ring—

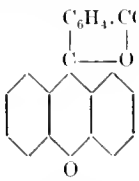
composed of one oxygen and five carbon atoms, and he believes this ring to be an essential character of the phthaleïns of the fluoresceïn type and that these owe their tinctorial and fluorescent properties to this grouping. This ring is formed when the so-called methane carbon atom takes up an ortho-position to hydroxyl groups in the two phenol nuclei. In accordance with this view, phenols such as α-naphthol in which the para-position to the OH group is free, should yield true phthaleïns, whilst phenols such as β-naphthol, which cannot give para-substitution products, might be expected to yield phthaleïn anhydrides containing the above ring. The author has treated both α- and β-naphthol with phthalyl chloride and finds that the former yields a true phthaleïn as previously shown by Grabowski (Ber. **4**, 725), whilst β-naphthol yields the anhydride—



as expected. This crystallises in rhombic plates or needles melting at 115°—117°. Its solution in concentrated sulphuric acid exhibits an intense reddish-yellow fluorescence. When it is boiled with alcoholic potash it yields a substance crystallising in slender colourless needles; this is nearly insoluble in boiling alcohol, readily soluble in water, and is probably the potassium salt of—

$$COOH.C_6H_4(OH).C(C_{10}H_6)_2O$$

Phenolphthaleïn anhydride in all probability belongs to the same class of phthaleins and should accordingly be represented by the formula—



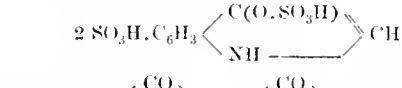
The author has examined residues obtained in the manufacture of phenolphthaleïn and in one sample found nearly 44 per cent. phenolphthaleïn anhydride. The purified anhydride dissolves in concentrated sulphuric acid and the solution exhibits a yellow colour and an intense green fluorescence. It crystallises from alcohol in long and broad lustrous needles containing water of crystallisation, and when dried at 130° has the composition $C_{20}H_{12}O_3$. It melts at 180° and not at 173°—175° as stated by Baeyer. When it is boiled with alcoholic potash it is apparently converted into the unstable acid—

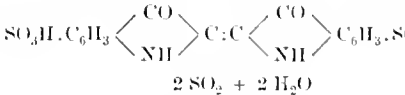
the solution obtained is no longer precipitated by the addition of water, but if the alcohol be driven off from the diluted solution, some anhydride forms and separates and the remainder can be thrown down as anhydride by the addition of hydrochloric acid.—A. K. M.

Synthesis of Indigodisulphonic Acid (Indigo-carmine). B. Heymann. Ber. 1891, **24**, 1476—1478.

It has been shown by Heuman and others (this Journal, 1890, 1121) that when phenylglycocine is fused with caustic potash a leuco-compound is obtained which yields indigo on oxidation. The reaction could not be induced by other reagents, such as zinc chloride or concentrated sulphuric acid. The author finds, however, that the condensation is readily effected when fuming sulphuric acid is employed, but that in this case indigodisulphonic acid is produced. The reaction is best conducted as follows:—One part of phenylglycocine is mixed with 10—20 parts of sand, and the mixture added to 20 parts of fuming sulphuric acid (containing 80 per cent. anhydride) at a temperature of 20°—25°, and the temperature is not allowed to rise above 30°. The glycocine dissolves readily to a yellow solution, but on adding concentrated sulphuric acid sulphur dioxide is evolved, and the solution assumes the deep blue colour of indigo. Ice is then added to the product and the indigo-carmine precipitated by the addition of salt. This synthetic indigo carmine produces purer shades than the best natural indigo of commerce.

In explanation of the above reaction, it is assumed that possibly the sulphonic acid of indoxyl sulphate is first formed, and that this undergoes the following change when the concentrated sulphuric acid is added:—





$$2\,SO_2 + 2\,H_2O$$

The yield of indigo-carmine amounts to about 60 per cent. of the phenylglycocine employed. (See also this Journal, 1891, 758.)—A. K. M.

Azonium Bases. O. N. Witt. Ber. 1891, **24**, 1511.

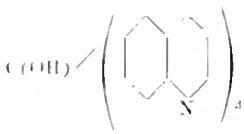
The reaction recently described by Kehrmann and Messinger for the synthesis of azonium bases (Ber. **24**, 1239) was discovered by the author in 1887 (this Journal, 1887, 543).—A. K. M.

On Triquinylmethane. E. Nölting and C. Schwartz. Ber. 1891, **24**, 1606—1609.

This compound can be obtained either from paraleuco-aniline or from pararosaniline in the following manner. A mixture of 22 grms. of pararosaniline, 64 grms. of glycerol, 52 grms. of sulphuric acid, and 7 grms. of 4-picric acid are heated for 3—4 hours to 140°—150° C. until all the rosaniline has disappeared. After purification (preparation of the free base by precipitation with carbonate of soda at a low temperature, and by its crystallisation from benzene after resinous matters have been removed by

addition of petroleum spirit), the base was obtained in white needles melting at 202° C. On oxidation with the theoretical quantity of potassium bichromate and acetic acid the triquinylmethane—

yields the triquinylcarbinole—



white needles melting at 108° C., forming salts. But *no colouring matters* could be obtained from either body.

Diquinylketone—

was prepared by heating 10 grms. of diamidobenzophenone, 29 grms. of glycerol, and 3 grms. of picric acid for about 4 hours to 140—150° C. After purification it forms colourless needles, easily soluble in alcohol, with difficulty in boiling water, and melting at 174° C.—A. L.

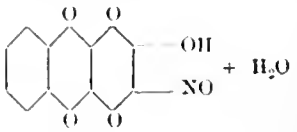
On Nitro-Derivatives of Alizarin and Purpurin. R. Brash. Ber. 1891, **24**, 1610—1619.

Diacetyl-α-Nitroalizarin.—One part by weight of diacetylalizarin is gradually added to 2 parts of colourless nitric acid sp. gr. 1·5, care being taken that the temperature does not rise above 0° C. One part of nitric acid is then added to the mixture and it is poured into ice-water as soon as a sample in an alcoholic alkaline solution ceases to show the alizarin spectrum. The diacetyl-α-nitroalizarin crystallises from glacial acetic acid in light yellow needles melting at 194—195·5° C. Sodium carbonate saponifies it at ordinary temperatures; mordanted cotton is gradually dyed by it, though boiling water does not seem to have any saponifying action on it.

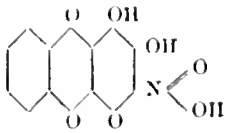
α-Nitroalizarin, which was first prepared by Perkin and then examined by Schunck and Romer, was obtained by saponifying the acetyl compound. It crystallises from glacial acetic acid in brownish-yellow needles melting with evolution of gas at 289° C.

α-Amidoalizarin was first obtained by Perkin by the reduction of α-nitroalizarin by sodium amalgam. Schunck and Romer prepared it by treating a solution of α-nitroalizarin in ammonia with sulphuretted hydrogen. After precipitation with hydrochloric acid and purification from sulphur with carbon bisulphide, the body was recrystallised from glacial acetic acid and obtained in dark brown plates with a yellowish green lustre. On treating an acid solution of α-amidoalizarin with nitrous acid and boiling it after diazotisation, purpurin is formed. If, however, the diazo-compound be rendered alkaline, alizarin is obtained after extraction with ether. Diazoalizarin does not combine with phenols. *β*-amidoalizarin does not yield purpurin after diazotisation but alizarin, and Auerbach's statement to the contrary must be due to a mistake.

Pseudo-Nitropurpurin is obtained by mixing alizarin with so much fuming nitric acid that a thin paste is formed. The mixture is poured on to ice, diluted, and washed with water until neutral. As soon as the acid disappears the yellow compound is dissolved by the water with a dark red colour, a sign that the pseudo-nitropurpurin is changed into nitropurpurin. The dry pseudo-compound is of a light yellow colour and can be kept; the moist body, however, changes easily into the nitropurpurin. The two compounds are isomerides, the pseudo-nitropurpurin, perhaps, having a constitution represented by one of the two following formulæ:—



or



Pseudo-nitropurpurin dissolves in a solution of carbonate of soda with a brownish-yellow colour, changing on heating to a red, a sign that it is converted into nitropurpurin.

Nitropurpurin is prepared in the manner before described and contains the nitro group in the meta-position, whilst the hydroxy groups occupy the positions 1 : 2 : 4. It resembles purpurin and dyes fibres mordanted with chrome, iron, or chromium salts nearly the same shades as purpurin does. Its solution in alum does not show any fluorescence; its solution in concentrated sulphuric acid is yellowish red, whilst the solution of purpurin in the same solvent is carmine-red. The nitration of purpurin produces the same results as the nitration of alizarin, namely pseudo-nitropurpurin and nitropurpurin.

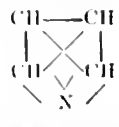
β-Nitroalizarin when heated at ordinary temperature with 7 parts of nitric acid, sp. gr. 1·5, is changed into pseudo-nitropurpurin.

Perkin observed on nitrating diacetylalizarin the formation of a deep-red compound besides α-nitroalizarin. The formation of this by-product can be entirely avoided if colourless nitric acid be used.

Amidopurpurin (*OH.OH.NH₂.OH*) (1 : 2 : 3 : 4) is obtained from the nitro-compound by reduction with ammonium sulphide and forms a brownish-red powder, producing very dull colours on mordanted fibres. In alcohol and concentrated sulphuric acid it dissolves with a reddish-yellow colour; its alcoholic solution is turned carmine on addition of caustic potash.—A. L.

The Constitution of 5-membered Ring Systems. E. Bamberger. Ber. 1891, **24**, 1758—1764.

The paper consists of a theoretical discussion, which is to be followed by a series of experimental investigations of the constitution of pyrrol, pyrazol, furfuran, and allied bodies, the main issue of which is to point out that the generally accepted constitutional formulæ are quite out of keeping with the chemical behaviour of the substances in question. For instance, the nitrogen atom in pyrrol does not behave in any way like a trivalent nitrogen atom, but much more like saturated pentavalent nitrogen. Hence it is proposed to represent it by a "centric" formula thus:—



a formula much more in keeping with its properties.

Similar formulæ are proposed for other 5-membered ring systems. The author admits, however, the explanation of all the properties of this group is not entirely cleared up by his conception, and refers especially to the facts that indole is more basic that pyrrol, and that the pyrrol azo-colours have basic properties which are not in accordance therewith.—C. A. K.

Action of Sulphur on Benzaldehyde. G. A. Barbaglia and A. Marquardt. Ber. 1891, **24**, 1881—1883.

Having in a previous communication studied the action of sulphur on aldehydes of the fatty series, the authors now give an account of the action of sulphur on other aldehydes.

On heating 30 grms. of benzaldehyde with 10 grms. of sulphur in a sealed tube for 36 hours at 180° a reddish-coloured crystalline mass is obtained which consists of small lustrous plates and long rectangular prisms. On opening the sealed tube little or no hydrogen sulphide escapes, showing that substitution has not taken place. On treating the product with ether the crystals are dissolved, whilst nearly the whole of the sulphur and another compound remain in the residue. The ethereal solution is shaken with a solution of sodium carbonate and the alkaline extract acidified with hydrochloric acid. A copious precipitate of benzoic acid is thus obtained, and on evaporating the ethereal solution a crystalline substance remains, which on repeated crystallisation from alcohol yields beautiful white lustrous plates melting at 121°—122°. This compound proved to be stilbene by analysis and by its melting point and that of the dibromide obtained therefrom. It may therefore be assumed that the initial action of sulphur on benzaldehyde is the formation of thiobenzaldehyde, which by prolonged heating is decomposed into stilbene and sulphur. The authors in point of fact succeeded in extracting from the residue insoluble in ether by means of benzene or chloroform a compound crystallising from alcohol in lustrous white needles melting at 164°—167°. This product exhibited all the properties of the γ-thiobenzaldehyde described by Baumann and Fromm. The conversion of benzaldehyde into stilbene and benzoic acid should therefore be effected by very small quantities of sulphur, and it is shown by experiment that 1 grm. or even as little as 0·25 grm. of sulphur is sufficient for the decomposition of 25 grms. of benzaldehyde.—D. B.

Indigo-green. V. H. Soxhlet. Chem. Zeit. 1891, **15**, 913—914.

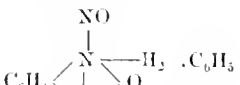
On leaving Indigo-carmine in contact with an excess of commercial ammonia (20° B.) for 8 to 10 days, the solution acquires a green colour. When this is feebly acidified with dilute sulphuric acid, a solution of salt added and the whole briskly agitated and filtered, a pasty mass is left which resembles commercial Indigo-carmine in appearance, without possessing, however, its coppery lustre. It dissolves readily in warm water, and the solution dyes white yarn a colour resembling Methyl-green but retaining its green colour by artificial light. The dye is as fast to light as ordinary Indigo-carmine, but it is much more resistant to washing and to alkalis. The colour of the dye obtained by the action of ammonia on Indigo-carmine varies in shade from bluish-green to yellowish-green according to the quantity of ammonia used and the time the reagents are left in contact: the prolonged action of an excess of ammonia results in the formation of a yellowish-brown solution, from which, however, a green dye of almost the normal shade is precipitated on neutralisation with sulphuric acid. The new green is in all probability a mixture of a pure green with a yellow dyestuff. On treating a solution of Indigo-carmine with ammonia and caustic soda, a yellow colouration soon appears, but the product only yields inferior shades on wool or silk.—S. B. A. A.

p-Nitrosobenzylaniline and -tolnidine. W. Boeddinghaus. Annalen, 1891, **263**, 300—313.

p-Nitrosobenzylaniline has been briefly described by O. Fischer and Hepp (Ann. **255**, 147), who first prepared it. At their request, the author has made a special study of it and some analogous compounds. It was prepared in the present instance by dissolving benzylaniline in absolute alcohol, adding amyl nitrite and alcoholic hydrochloric acid, and heating the mixture at 60° for an hour. After standing several hours, the mixture was poured into water, whereupon untransformed benzylphenylnitrosamine separated out in the solid condition, leaving the hydrochloride of *p*-nitrosobenzylaniline in solution; from this solution the free base was precipitated by addition of ammonia. Crystallised from absolute alcohol, the base forms splendid green plates with a blue reflex; it melts at 129°, is easily soluble in benzene and hot alcohol, and sparingly so in ether; its hydrochloride crystallises in brown-yellow needles.

Benzyl-p-phenylenediamine, $H_2N.C_6H_4.NH.CH_2.C_6H_5$, formed by reducing the preceding compound with alcoholic ammonium sulphide, melts at 30°. It must be preserved out of contact with air, as it is quickly altered by exposure to the same.

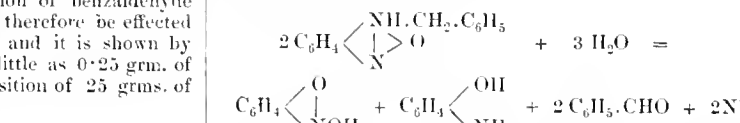
p-Nitrosophenylbenzylnitrosamine—



is produced by the action of nitrous acid on a solution of the sulphate of *p*-nitrosobenzylaniline. The compound forms yellow needles, which, crystallised from ether, melt at 77°.

Reactions of p-nitrosobenzylaniline. — Hydroxylamine hydrochloride acts upon *p*-nitrosobenzylaniline, forming benzylaniline hydrochloride and quinonedioxime; the production of the latter proves that in the above-described nitrosobenzylaniline the nitroso group occupies the *p*-position.

Sodium hydrate decomposes *p*-nitrosobenzylaniline into *p*-nitrosophenol, *p*-amidophenol, benzaldehyde, and ammonia, thus:—



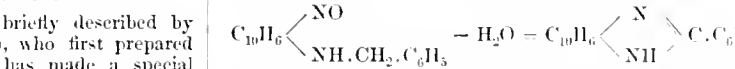
p-Nitrosobenzyl-o-toluidine was prepared from benzyl-*o*-toluidine by the same method as its lower homologue. After crystallisation from absolute alcohol, it melts at 115°. On reduction it yields *benzyl-o-methyl-p-phenylenediamine*, which forms an oil at the ordinary temperature, but at 6° is precipitated by sodium hydrate from its solution as hydrochloride in a solid powdery state. Sodium hydrate acts on *p*-nitrosobenzyl-*o*-toluidine similarly to what it does on *p*-nitrosobenzylaniline.

p-Nitroso-benzyl-m toluidine, obtained from benzyl-*m*-toluidine (boiling point 300°) in the manner described above for *p*-nitrosobenzylaniline, melts at 121°.

p-Nitrosobenzylmethylaniline, similarly prepared from benzylmethylaniline, melts at 56°. A 70 per cent. yield of this base was obtained as against 40 per cent. in the case of the other nitroso bases prepared. Sodium hydrate decomposes it chiefly into benzylmethylaniline and *p*-nitrosophenol, but small quantities of methylamine and benzaldehyde are also produced.—E. B.

α-β-Benzenylnaphthylenediamine. A. Koll. Annalen, 1891, **263**, 313—315.

β-Benzylnaphthylamine is formed by condensing β-naphthylamine with benzaldehyde and reducing with sodium amalgam the benzylidene compound so produced. By the action on its alcoholic solution of amyl nitrite and hydrochloric acid at 18°, α-β-benzenylnaphthylenediamine is obtained, the nitroso compound formed intermediately undergoing condensation according to the equation—



α β-Benzenylnaphthylenediamine forms colourless, crystalline aggregates, melting at 214°. It crystallises from methyl alcohol in colourless tables or plates, containing $\frac{1}{2}$ CH_3OH, and is identical with the base described by Ebell (Ann. **208**, 328) under the name of anhydrobenzdiamidonaphthalene.—E. B.

1 : 2 : 3 *Ortho-xylidine.* K. Menton. Annalen, 1891, **263**, 316—339.

For the preparation of *methyl-o-xylidine* from *o*-xylidine ($CH_3 : CH_3 : NH_2 = 1 : 2 : 3$) Hepp's method (Ber. **10**, 327) was used, since by it the simultaneous formation of tertiary and ammonium bases is avoided. Acetylmethyl-*o*-xylidine was readily prepared by heating at 140° for 2—3 hours well-dried acetoxylide, xylene, and sodium, cooling the solution, adding methyl iodide, and carefully warming on the water-bath until the reaction was completed. After filtering from separated sodium iodide, the acetyl compound was extracted from its xylene solution by repeated agitation with warm, concentrated hydrochloric acid. An attempt made to hydrolyse it by prolonged boiling of this hydrochloric acid solution failed, as also did several other methods tried with the same object, the compound being singularly stable. It was eventually hydrolysed by boiling under a reflux apparatus for 15 hours with a mixture of two parts of concentrated sulphuric acid and three of water. But even after this treatment the hydrolysis was imperfect, turbidity being produced on dilution with water. This was due to the presence of undissolved particles of the acetyl compound, which were removed by agitation with ether. The solution was then alternately treated with sodium nitrite and extracted with ether as long as a turbidity was produced on addition of the former. The nitrosamine so formed was, after evaporating off the ether, converted by the action of zinc-dust and hydrochloric acid into methyl-*o*-xylidine, which was separated by distillation with steam. Methyl-*o*-xylidine is a pale yellow oil, boiling at 222°—223°; it possesses the characteristic smell of secondary aromatic bases, and is easily soluble in dilute acids.

p-Nitrosomethyl o-xylidine was prepared by acting upon an ice-cold solution of methyl-*o*-xylidine hydrochloride with nitrous acid as long as oily drops of the nitrosamine separated. These were extracted with ether; the ethereal solution, after being dried with calcium chloride, was mixed with alcoholic hydrochloric acid and allowed to stand several hours, when *p*-nitrosomethyl-*o*-xylidine crystallised out. The free base was separated from this salt by dissolving the latter in warm water and adding a slight excess of sodium carbonate; after washing with water, it was crystallised from 80 per cent. alcohol, and thus obtained in lustrous green needles, melting at 160°—161°.

As one of the objects of this research was the preparation of a dimethylpheninduline from nitroso-*o*-xylidine, and as, owing to difficulty in its preparation, an insufficient amount of the latter was obtained, the author prepared acetylethyl-*o*-xylidine, in the hope that it would be more readily hydrolysed. In this, however, he was disappointed, the acetylethyl compound being even more stable than its lower homologue. *Ethyl-o-xylidine* closely resembles the methyl derivative; it boils at 227°—228°. *p-Nitroso ethyl o-xylidine* forms green needles with a blue reflex, melting at 123°—124°.

Experiments were made with the small quantity of *p*-nitroso-ethyl-*o*-xylidine obtained, with a view to preparing the diethyl analogue of the induline whose formation is mentioned by Fischer and Hepp (Ann. **256**, 262), but with negative results. An endeavour to prepare the latter induline, by heating phenylazo-*o*-xylidine hydrochloride with aniline, resulted in the production of a dark coloured mass from which the author extracted a *dimethylsafranine*, $C_{20}H_{19}N_4Cl$, but failed to isolate any induline compound. The formation of this safranine is scientifically of importance, as supporting Nietzki's theory. Nietzki concluded that 1 : 2 : 3 o xylidine was incapable of yielding a safranine, since, when making the experiment, he only succeeded in obtaining a trace of safranine from that base, and the production of this he attributed to the presence of isomeric xylidines in the preparation he used.

Dimethyl-o-xylidine was obtained by heating trimethyl o xylidine ammonium iodide, direct methylation of *o*-xylidine with methyl alcohol and hydrochloric acid under pressure, producing chiefly the monomethyl derivative; it boils at 209°—209°. Nitrous acid is without action upon it. This is probably due to the protecting influence on the molecule exerted by the alkyl group in the ortho-position to the substituted amido group, as Riedel (Ber. **13**, 126) has shown that *o*-dimethyltoluidine is similarly unattacked by nitrous acid.—E. B.

Condensation-Products of m-Nitro-benzaldehyde with Phenol and Resorcinol. G. de Varda and M. Zenoni. Gazz. Chim. 1891, **21**, 174.

m-Nitro-dihydroxytriphenylmethane—

$$HC\begin{cases} C_6H_4NO_2 \\ (C_6H_4OH)_2 \end{cases}$$

is formed by carefully heating at 130° fused *m*-nitro-benzaldehyde (1 mol.) and phenol (2 mols.) with dihydrated sulphuric acid (rather more than 1 mol.). It forms an amorphous powder, melting at 59°—60°, is soluble in alcohol, slightly so in hot water, but is almost insoluble in ether, chloroform, and benzene. It dissolves readily in concentrated sulphuric acid with a red colour and in alcoholic potash with a deep purple colour, which gradually fades.

m-Nitro-tetrahydroxytriphenylmethane—

$$HC\begin{cases} C_6H_4NO_2 \\ [C_6H_3(OH)_2]_2 \end{cases}$$

obtained by heating *m*-nitro-benzaldehyde (1 mol.) with resorcinol (2 mols.) at 150°, has a yellow colour, melts at 97°—100°, is feebly soluble in boiling water, and more easily so in alcohol, ether, and acetic acid.—E. B.

Ortho-Hydroxyazo Dyestuffs. I. D. Zibell. Schweiz. Wochenschr. Pharm. 1891, **29**, 186.

The same bodies, namely, hydroxyazobenzene and phenyldisazophenol, are obtained by the action of diazobenzene chloride on *p*-hydroxybenzoic acid as by that of the former compound on phenol, the carboxyl group in the *p*-hydroxybenzoic acid being eliminated. Diazobenzene sulphonic acid, similarly, yields hydroxyazobenzene-sulphonic acid with *p*-hydroxybenzoic acid. On the other hand, salicylic and *m*-hydroxybenzoic acids interact normally with diazobenzene chloride. The compound thus obtained from salicylic acid dyes mordanted cotton; that from *m*-hydroxybenzoic is devoid of colouring power.—E. B.

PATENTS.

The Manufacture and Production of a Sulpho-Acid suitable for Dyeing and Printing. J. Y. Johnson, London. From the "Badische Anilin und Soda Fabrik," Ludwigshafen, Germany. Eng. Pat. 14,836, September 19, 1890. (Second Edition.) 6*d*.

This is an extension of Eng. Pat. 15,259 of 1888 (this Journal, 1889, 877), and describes the preparation of a yellowish-red dyestuff for wool, by the action of dilute sulphuric acid on the so called "higher sulpho-acid," alluded to in the previous patent. The best results are obtained by boiling the sodium salt of the "higher sulpho-acid" with about 15 times its weight of dilute sulphuric acid (containing 75 per cent. H_2SO_4) under an inverted condenser until a sample diluted with water gives a copious precipitate and the mother-liquor is yellowish-red. The melt, after cooling, is diluted with an equal weight of ice, filtered, and the precipitate dissolved in caustic soda lye, again filtered, and the filtrate precipitated with dilute sulphuric acid. It appears in commerce as the sodium salt, in the form of a brownish powder, soluble in cold water to a yellowish-red solution.—T. A. L.

The Production of Azo-Colours in Substance or on the Fibre. S. Pitt, Sutton. From L. Casella and Co., Frankfort-on-the-Maine, Germany. Eng. Pat. 15,347, September 27, 1890. 6*d*.

The base for producing these colours is known as "Naphthylene-violet," obtained by combining 1 mol. of the tetrazo compound from diamidonaphthalene-β-disulphonic acid with 2 mols. of α-naphthylamine. The substance has a great affinity for animal and vegetable fibres, giving a violet shade, which, however, is not stable to acids. It can be diazotised on the fibre, and combines then with a variety of amines and phenols and their derivatives, giving a number of different shades, of which a table is given in the specification.—T. A. L.

The Manufacture of Sulpho-Acids of a Red Basic Naphthalene Colouring Matter. J. Y. Johnson, London. From the "Badische Aniline und Soda Fabrik," Ludwigshafen, Germany. Eng. Pat. 17,168, October 27, 1890. 6*d*.

An extension of Eng. Pat. 14,836 of 1890 (see above). The yellow-red dyestuff there described when heated with aniline and aniline hydrochloride gives a new monosulphonic acid of phenylrosinduline. This in turn can be further sulphonated, yielding a disulphonic acid, and a higher sulphonic acid which appears to be identical with the "higher sulpho-acid" of Eng. Pat. 15,259 of 1888 (this Journal, 1889, 877). In place of aniline, its homologues may be employed, and corresponding products obtained by sulphonation of the compounds so formed.—T. A. L.

Process for the Production of Anthranilic Acid. O. Imray, London. From "Amsterdamsche Chininefabrik," Amsterdam, Holland. Eng. Pat. 18,246, November 12, 1890. 6*d*.

Anthranilic acid is formed when phthalimide is treated with a hypochlorite or hypobromite in molecular proportions, in presence of an alkali or of an alkaline earth. The finely divided phthalimide is treated with two parts of solid caustic soda dissolved in seven parts of water, the mixture being kept cool and stirred continuously. To this the hypochlorite is added gradually in a 5·06 per cent. solution, and the whole heated to about 80° C. On cooling the solution is neutralised with hydrochloric or with sulphuric acid, and an excess of acetic acid added when a considerable portion of the anthranilic acid separates out in crystals which are dried in a hydro-extractor. The remainder of the acid is precipitated out by copper acetate, and the resulting copper salt reconverted into the acid. The hypochlorite or hypobromite of potassium, sodium, calcium, barium, strontium, or magnesium can be employed in the reaction, or chlorine or bromine may be led into an alkaline solution of the phthalimide, or, phthalimide may be first treated with bromine, subsequently an excess of alkali slowly added, and the mixture heated. The caustic soda used in the preparation as described above may be substituted by caustic potash, lime, baryta or strontia.

The reaction may be represented thus :—

$$C_6H_4\begin{<}{CO \atop CO}\end{>}NH + 3\,NaOH + NaOCl$$

$$= C_6H_4\begin{<}{CO.ONa \atop NH_2}\end{>} + Na_2CO_3 + NaCl + H_2O$$

Instead of taking phthalimide, phthalimic acid, which is readily prepared from it, can be employed (Aschan, Ber. 1886, **19**, 1401). Anthranilic acid is of value in the manufacture of colouring matters and of chemical preparations.

—C. A. K.

Improvements in the Manufacture of Sulpho-Acids of a Red Basic Naphthalene Dyestuff. J. Y. Johnson, London. From the "Badische Anilin und Soda Fabrik," Ludwigshafen, Germany. Eng. Pat. 19,167, November 25, 1890. (Second Edition.) 6*d*.

A method for obtaining a trisulphonic acid of phenylrosinduline, and also a higher non-crystalline acid by the action of fuming sulphuric acid on phenylrosinduline. The patent is an extension of Eng. Pat. 15,259 of 1888 (this Journal, 1889, 877), which describes the preparation of a mono- and disulphonic acid, and also of a non-crystalline acid. This latter frequently contains trisulphonic acid, which can be separated by dissolving the sodium salts in water and adding dilute sulphuric acid when the trisulphonic acid crystallises out and can be recrystallised from water containing a little brine. The non-crystalline acid remains in the mother-liquor and can be obtained as the sodium salt by neutralising the sulphuric acid with milk of lime, converting the calcium salt by soda into the sodium salt, filtering and evaporating the solution to dryness. Both the products dye animal fibres red from an acid bath. (See also Eng. Pats. 14,836 and 17,168 of 1890, abstracted above.)—T. A. L.

Improvements in the Manufacture of Colouring Matter. H. H. Lake, London. From K. Oehler, Offenbach-on-the Maine, Germany. Eng. Pat. 11,218, July 1, 1891. 4*d*.

By reacting with 2 mols. of diazotised *p*-amido-acetanilide on 1 mol. of *m*-phenylene diamine in an alkaline solution a product is obtained which dissolves with difficulty in dilute hydrochloric acid. This is converted into a dyestuff by heating with concentrated hydrochloric acid on the water-bath, the colouring matter being precipitated by adding zinc chloride and salt. It forms a black powder easily soluble in water, and is specially adapted for dyeing jute and leather a dark brown.—T. A. L.

V.—TEXTILES: COTTON, WOOL, SILK, Etc.

Morrenine and Morrenol. P. Arata and C. Gelzer. Ber. 1891, **24**, 1849—1853.

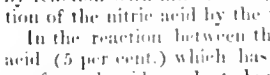
See under XX., *page* 849.

Action of Nitric Acid upon Plant Fibres. C. F. Cross and E. J. Bevan. Ber. 1891, **24**, 1772—1776.

The conclusions of J. Lifschutz in a recent paper (Ber. 1891, **24**, 1186) on the action of "nitrosulphuric acid" upon plant fibres, are criticised by the authors with the view of showing that they apply only within the limited range of the experiments described. Their purpose was to ascertain the conditions for economically carrying out the well-known oxidising action of dilute nitric acid upon pine wood, *i.e.* with a minimum expenditure of the reagent to secure a maximum yield of the cellulose and oxalic acid, the chief products. Lifschutz has succeeded in obtaining a yield of 40 per cent. of the former and 30 per cent. of the latter, using a dilute acid containing 20 per cent. of its weight of HNO_3 and 32 per cent. H_2SO_4, this mixture of acids and at this degree of concentration being found to give the best results. The conclusion is also drawn that under these conditions the action is limited to one of simple oxidation.

Reference is made by the authors in criticism of these conclusions to their previous publications in which the interaction of nitric acid and the lignocelluloses has been dealt with and shown to depend upon the specific combination of a deoxidised "residue" of the nitric acid with the

molecule of the latter. It is now pointed out that the presence of the closed ring molecules characteristic of the lignocellulose, viz. of the type—



might be expected to lead to the formation of quinonoximes by reaction with nitrous acid, the first product of deoxidation of the nitric acid by the fibre substance.

In the reaction between the jute fibre and dilute nitric acid (5 per cent.) which has been specially studied, there are formed acid products having the empirical composition $C_{12}H_{20}O_{11}(NOH).H_2$ and these are decomposed as the digestion proceeds with evolution of nitrous oxide gas. The formation of the oxime and its decomposition by the nitrous acid may be expressed as follows:—

I.

$$X.CH_2 + O.NOH = X.C:NOH + H_2O.$$

II.

$$X.C:NOH + O.NOH = N_2O + X.CO + H_2O.$$

The consequent accumulation of oxygen determines the rupture of the carbon rings with formation of oxalic and carbonic acids as the main products, and this view satisfactorily explains the transitory character of the proximate derivatives of the lignone groups.

The formation of oximes and therefore the above views of the reaction are confirmed by the formation of hydrocyanic acid in greater or less quantity in the process of digestion.

It is probable that in the conversion of lignocelluloses into the nitrated products which are the basis of a number of the new explosives, the reaction is not simple as in the case of cotton and the pure celluloses, but complicated more or less by combination of the fibre substance with deoxidised residues of the nitric acid; and the observations contained in this paper deserve consideration in regard to this branch of manufacture.

The results may be expected to throw some light on the functions of nitric acid in the vegetable world, and further investigations in this direction are in progress.—C. F. C.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

Fast and Fugitive Dyes. J. J. Hummel. J. Soc. Arts, 1891, 535—548.

The Action of Light on Dyed Colours.—Dyed patterns of cotton, wool, and silk, were exposed for a month (February) on the sea-coast near Bombay, a test considered equivalent to a year's exposure in England. From the results produced the following inferences have been made.

On *wool* most of the natural colouring matters suffer very considerably: Turmeric, Orchil, Catechu, and Indigo-carmine almost entirely disappear; Camwood, Brazilwood, and their allies, and Young Fustic are, on all mordants, much decolourised; Weld, Old Fustic, Quercitron bark, and Persian berries give fast colours (olives) on the chromium, copper, and iron mordants, but fugitive colours (yellows) on aluminium and tin; Logwood gives a fast greenish-black on copper, very fugitive colours on aluminium and tin, and colours holding an intermediate position on chromium and iron; Madder, Cochineal, Lac-dye, and Kermes, give fast colours on all the usual mordants; vat Indigo blue and Prussian blue are the fastest to light among colours of this group. On *silk*, the above colouring matters show similar degrees of fastness. In some cases, however, the colours are somewhat faster on silk; for example, Catechu brown and the colours obtained with Brazilwood and its allies on the iron mordant. The fugitive character exhibited by nearly all the natural colouring matters when dyed on *cotton* is very marked. The exceptions are: the Madder colours, especially when fixed on oil-prepared cotton as in Turkey-red; the black produced by Logwood, tannin, and iron; a few mineral colours such Iron buff, Manganese brown, Chrome orange, and Prussian blue; Cochineal and its allies, which give excellent colours on wool and silk, give only fugitive colours on cotton; vat Indigo blue, again, is not so fast on this fibre as it is on wool and on silk.

A series of fast colours on wool, silk, and cotton, is afforded by the artificial "mordant-dyes." Among the yellow colouring matters of this class, Alizarin yellows R and GGW, although not true alizarin colours, are quite equal in fastness to any of the natural yellow dyes, probably faster; truer representatives of the natural dyes (giving olives on the iron mordant) exist in Gallotlavin and Alizarin yellows A and C, and these are of about the same degree of fastness as the natural yellows. In the group of red dyes, Alizarin and its allies yield fast colours; the only dyes of this group which are somewhat behind the rest in point of fastness are Purpurin and Alizarin-maroon. Fast blues and greens are furnished by Alizarin-blue, Alizarin-cyanin, Alizarin-indigo, Alizarin-green, and Cœrulein. Further, an excellent group of colouring matters giving fast browns and greens with copper and iron mordants respectively, is formed by Naphthol green, Resorcinol green, Gambin, and Dioxin. The only fugitive artificial dyes of this mordant-dyeing class are some of the yellows, Gallamine blue, and Gallocyanin.

The substantive or "direct" class of artificial dyes is composed in the main of fugitive dyes. Magdala red on silk appears tolerably fast, and on cotton Indophenin, Paraphenylene blue, Cinereine, and Meldola's blue, are a little faster than the rest. Biebrich scarlet, Brilliant crocein, and other azo scarlets, crimsons, and clarets show a considerable degree of fastness on wool and silk, as also do Crocein orange, Aurantia, Orange crystal, Tartrazin, Milling yellow, and Palatine orange on wool, and Acid yellow D, Brilliant yellow, Azo-acid yellow, Metanil yellow, Curcumin S, and others on silk. It is interesting to note the decidedly fugitive character on silk of Tartrazin, Aurantia, Orange crystal, &c. as compared with their great fastness on wool. All the "Acid" greens and blues are fugitive both on wool and on silk; Patent blue appears slightly better than the rest. Of the "Acid" blacks and violets, &c., a few colours are of medium fastness both on wool and on silk, namely, Naphthol black, Naphthylamine black, Resorcinol brown, Fast brown, and one or two others.

In the benzidine class of colours, amid a number of very fugitive dyes, there are a few of satisfactory fastness: Diamine fast red, for example, is quite remarkable for its fastness both on wool and on silk, and may certainly rank with Alizarin; but on cotton it is quite as fugitive as the rest. Of medium fastness on wool are Brilliant congo G and R, and Congo G R; and on silk, Diamine scarlet B, Deltapurpurin 5 B, and Brilliant congo R. On cotton the yellows of this class appear to be the fastest, but are only of medium fastness; Mikado orange R, 4 R, G, Hessian yellow, Curcumin S, Chrysophenin. On wool, Benzo orange, Congo orange R, Chrysophenin G, Chrysamine R, and Brilliant yellow, are moderately fast. On silk some of the fastest yellows and oranges obtainable from any source on this fibre are yielded by Congo orange R, Chrysophenin G, Diamine yellow N, Brilliant yellow, Curcumin W, Benzo orange, Hessian yellow, Chrysamin G and R, Cresotin yellow R and G, Cotton yellow G, and Carbazole yellow. Few colours among the "Congo" violets, blues, and purples, are found worthy of particular notice for fastness; Diamine violet N appears, perhaps, of medium fastness on wool and silk, whilst Sulphonazurin, Benzo black-blue, and Direct grey may claim the same distinction on silk.

The intensity or depth of a colour has considerable influence on its fastness. Dark full shades invariably appear faster than pale ones produced from the same

colouring matter, simply because of the greater body of pigment present. A pale shade of even a fast colour like Indigo will fade with comparative rapidity. The fugitive character of many of the coal-tar colours is, in the author's opinion, rendered more marked, because, owing to their intense colouring power there is often such an infinitesimal amount of colouring matter on the dyed fibre.

The author's opinion, based upon general observation, is that a fugitive colour is not rendered any faster to light by being applied along with a fast colour. When light acts upon a compound colour, the unstable colour fades, while the stable colour remains behind. A woaded colour, for example, is only fast in respect of the vat indigo it contains.

The Action of Milling on Colours.—Fast to milling, especially with respect to bleeding, are all those phenolic colouring matters of which alizarin may be taken as the type. These do not bleed because in the dyed fibres they form, in combination with the mordants, an insoluble precipitate which is largely enclosed within the substances of the fibres. That portion of the precipitate which lies on the surface is undoubtedly removed mechanically during the milling process; but even then, since the colouring matter is combined with the mordant and is not in the free state, it cannot combine with the mordants of neighbouring dyed fibres, nor can it be attracted by and stain unmordanted white fibres. Phenolic colouring matters, however, are liable to bleed if they be improperly applied.

Colouring matters of the triphenylmethane group, azo scarlets, nitro dyes, and some other basic and acid colouring matters, nearly all bleed during milling. The dyed colours themselves, perhaps, are not materially impoverished, so that a plain dyed fabric might be milled with impunity, provided the soap used be not too alkaline; nevertheless such colouring matters are practically useless for tweeds and the like, where variously-coloured fibres are interwoven. It is interesting to note, however, that many of the "direct" dyes are perfectly fast to milling. Even in the triphenylmethane group there are a few especially remarkable exceptions to the rule; for example, Victoria blue and Night blue. Members of the Eosin group are also generally characterised by their fastness to milling. Most noteworthy for fastness to milling is the whole group of "Congo" dyes. This fastness, however, only extends to wool; any white cotton fibres in the fabric milled would certainly be stained.

Many "direct" dyes, more particularly those of the "acid" class, have the defect of being greatly impoverished in colour during milling, even to the point of almost total extinction. Examples of this class are Acid magenta, Azo scarlets and oranges, Indigo carmine, &c. In the cases referred to the colour is partly or entirely restored by passing the milled piece through dilute sulphuric or acetic acid. The reason of this decolourising action is very evident. The alkali of the soap neutralises the "colour acid" on the dyed fibre, and produces a pale-coloured, or even colourless, alkali salt of the colour acid. The restoration of the colour during the subsequent passage through acid is due to the decomposition of the colourless alkaline salt, with the liberation of the original highly-coloured colour acid.

Some colours, both such as are dyed directly, or even with the aid of mordants, have the defect of being entirely altered in hue during milling; thus, Cochineal scarlet becomes crimson, Orchil purple becomes violet, Turmeric yellow becomes brown, and so on. Here, again, the alkali of the soap either dissolves or decomposes the lake, or it combines with the colouring matter to form a differently coloured compound.

The Action of Scouring on Colours.—When wool has been dyed in its loose, unspun condition, it is dried and impregnated with oil to facilitate the carding and spinning processes. The yarn or cloth made from such dyed fibre has therefore to be submitted to the operation of scouring, in order to remove the oil of the spinner. It consists in washing the material in a warm solution (50 —60° C.) of soap or carbonate of soda, or a mixture of the two, until the oil is entirely removed. The stronger alkali, and the higher temperature employed, cause the operation of scouring to be even still more searching on dyed colours than that of milling. Those colours which are altered in hue, decolourised, or impoverished in colour by milling are much more altered by scouring. Some—for example, Prussian blue—are entirely decomposed.

Very susceptible to the action of scouring are the sulphonic acid colours, and, indeed, for the same reasons as are explained above. Fast to scouring, as a rule, are the "mordant dyes," the Eosins, Congo colours, and some others.

All coloured goods should be washed or scoured at a low temperature, and with a soap which is as neutral as possible

Action of Stoving on Dyed Colours.—In some instances dyed colours must be fast to what is known as the operation of "stoving." Such is the case, for example, with those coloured yarns which form the striped headings of blankets, with many kinds of woollen hosiery, &c. In goods of this kind, white and dyed fibres are interwoven or even spun together, and the materials are submitted to a final bleaching with sulphurous acid, so that the white fibres, which have become soiled during the spinning and weaving operations, shall ultimately appear in all their original purity.

Many "acid" and "mordant" dyes withstand this stoving operation, but others are more or less altered in colour, or are entirely decolourised, either because the colouring matter is reduced or the colour-lake is decomposed, by reason of the acid vapours.

Action of Acids on Dyed Colours.—Fastness to acids is required from the colours on cotton yarn intended to be woven with white woollen or worsted weft, which is subsequently dyed with acid colours. Further, the colour of all materials intended to be worn next the skin should be fast to acids, since perspiration contains such organic acids as acetic acid, butyric acid, &c., and although the acidity of perspiration is slight—indeed it is sometimes alkaline—still it can exercise considerable influence on dyed colours, in consequence of the additional action of friction and heat, and by its concentration upon the fibre.

Fast to acids are many of the "mordant" dyes, and also those colours which are dyed in an acid bath, provided the acidity be not too great. Basic colours, and most of the "Congo" colours, are very sensitive to acids.

The Rubbing-off of Dyed Colours.—No colour can be considered fast if it have this defect, and yet, strange as it may appear, Indigo, one of our fastest dyes in other respects, is particularly unfortunate in this one.

Of defective coal-tar colours in this respect, Malachite green and Victoria blue may be mentioned; indeed, all the basic dyes show the defect more or less, especially if they be heavily dyed. Acid colours and Congo colours, as a rule, are free from the defect. On the other hand, even mordant dyes are liable to rub off if they be improperly applied.

Not unfrequently, in the case of wool, the fault is due to insufficient scouring, the employment of hard water, or from some similar cause, the fibre becoming permeated or coated with lime-soap or with grease in some form or other, which either fixes the dye on its surface or prevents the effectual penetration of the mordant or dye solution.—E. B.

Permanent and Fugitive Colours to Light on Wool T. Frusher. J. Soc. Dyers and Colourists, 1891, 82—84

The author has exposed to light for a period of 40 days samples of a number of dyed colours, with the following results:—Of the natural colouring matters, Camwood, the fastest of the red woods, and Fustic, the fastest of the yellow woods, both fade a little; Logwood, in pale shades, is considerably decolourised, the destruction of colour not being so apparent in dark shades; Logwood blacks "finished" with chrome, turn greener than unfinished blacks; vat-dyed Indigo gives the fastest of all blue colours. Amongst the artificial colouring matters tested, Alizarin blue and Anthracene brown, in pale shades, are only moderately fast; Gallocyanin is not quite so fast as Alizarin blue; Naphthol black, Diamond black, Anthracite black, and other wool-substantive azo-blacks are much faster to light than Logwood-black.—E. B.

Metallic Sulphites in Calico Printing. J. Mullerus. Chem. Zeit. 1891, **15**, 911.

Chromium bisulphite is largely used for mordanting dress-goods on which the fashionable grey, lilac, rose, olive, and other light self colours are to be produced. Better results are obtained by using mixtures of the sulphites of two or more metals, the dyeing bath being in this case more easily exhausted, the colour more equally distributed, and a larger variety of shades possible. The following are suitable mixtures:—

I.

500 c.c. of chromium bisulphite 16° B.
500 c.c. of aluminium bisulphite 16° B.
2 litres of gum tragacanth 100 : 1,000.
13 litres of water.

II.

500 c.c. of chromium bisulphite 16° B.
500 c.c. of iron bisulphite 16° B.
2 litres of gum tragacanth 100 : 1,000.
13 litres of water.

The goods are mordanted, dried in the hot flue, printed with a discharge consisting of—

700 grms. of citric acid.
600 c.c. of water.
600 c.c. of caustic soda 36° B.
800 grms. of burnt starch.
1,200 c.c. of gum water (Senegal).

Either sodium silicate or arseniate or cows' dung and chalk may be used for dunging. The chromium aluminium mordant gives a clear fawn (chamois) on dyeing with a mixture of 600 grms. of Anthracene brown (20 per cent.), 600 grms. of quercitron extract (30° B.), and 360 grms. of Persian berries extract (30° B.); a reddish bronze with 1,500 grms. yellow alizarin (20 per cent.), 1,500 grms. of Anthracene brown (20 per cent.), 4,000 grms. extract of Quercitron (30° B.), and 2,000 grms. extract of Persian berries (30° B.), 1 kilo. being used per 100 metres of cloth; and a bluish rose colour with 20 per cent. blue alizarin, using 500 grms. per 100 metres.

With the chromium iron mordants a sea-green is obtained by dyeing with Resorcinol green (300 grms. per 100 metres); a lilac with Gallocyanin, and all varieties of grey and olive shades by mixing Resorcinol green with Gallocyanin. Some of the shades may be improved by the addition of quercitron. These dyes are fast to light and soap, and are remarkable for their agreeable tints.—S. B. A. A.

Fast Black: a Preparation of Logwood. H. Gutknecht. Chem. Zeit. 1891, **15**, 919.

For some time past, a product obtained by the oxidation of logwood with potassium bichromate, has been largely employed in the black-dyeing of cotton goods. The following is a recipe for its preparation:—To a mixture of 100 kilos. of logwood extract at 25° B. and 25 kilos. of crude glycerin, there is gradually added, with constant stirring, an oxidising solution composed of 8 kilos. of potassium bichromate, 15 kilos. of chrome alum, 50 litres of water, and 12·6 kilos. of hydrochloric acid at 20° B. The logwood-glycerin mixture, whilst undergoing oxidation, is heated to 100°, and this temperature is maintained for ½—¾ hour after completing the addition of the oxidising solution. After cooling and allowing to stand for 12 hours, the product, which should be free from any sediment, is ready for use.

For use in cotton dyeing, 3—6 per cent. (of the weight of the cotton) of the above preparation is dissolved in water at 20°, the material to be dyed introduced, and the temperature of the bath raised to 40° in the course of 25—30 minutes.

To render it suitable for printing, the preparation is treated with 12 per cent. of its weight of sodium bisulphite at 40° B., and allowed to stand for about eight days. It yields a good black when printed on calico and steamed.

A cheap black ink may be prepared by diluting the oxidised logwood preparation (1 part) with water (10—15 parts), thickening with glucose, and neutralising with sodium carbonate (about ½ per cent.).

Glucose may be used instead of glycerin in the above recipe.—E. B.

Preparation of Catechol. H. Gutknecht. Chem. Zeit. 1891, **15**, 959.

See under XX., *page* 849.

The Tannin Matters of Algarobilla and Myrabolams. G. Zolffel. Arch. Pharm. 1891, **229**, 123.

Under the general name of Algarobilla (Algarobito, Algarobo, &c.), the pods of several species of *Cæsalpinia*, notably those of *Cæsalpinia brevifolia* (known also as *Balsamocarpum brevifolium*), are employed in Chili for tanning and dyeing. Attempts are now being made to find a suitable use for them in Europe.

Algarobilla contains two tannin matters, namely, a glucoside, gallotannin, to the extent of 8—10 per cent., and a tannic acid of the formula $C_{14}H_{10}O_{10}$, in comparatively larger amount. The latter substance is easily resolved into ellagic acid, and is consequently named by the author ellagotannic acid. It is identical with the acid isolated by Löwe from divi divi and myrabolams. It contains five hydroxyl groups replaceable by acetyl groups, and has the constitution $C_6H_2(OH)_3CO.O.O.C_6H_2(OH)_2COOH$.

According to Schiff, the formula of air-dried ellagic acid is $C_{14}H_6O_8.H_2O$, $C_{14}H_6O_8$ being obtained on drying at 100°, and $C_{14}H_6O_8$ at 180—200°. The author, on the other hand, finds that air-dried ellagic acid has the composition $C_{14}H_6O_8.2\,H_2O$, and that it loses 2 H_2O at 100°.

Myrabolams contain the same tannin principles as algarobilla, and in similar ratio.

A small quantity of gallic acid is present in both myrabolams and algarobilla, and the former contain, in addition, a little oxalic acid.—E. B.

Bleaching of Cotton by Means of Oxygenated Water. M. Prud'homme. Compt. Rend. 1891, **112**, 1374—1376.

The addition of calcined magnesia to oxygenated water when employed for bleaching cotton has been recognised as very advantageous. Its action is due to the formation of a peroxide of the formula $3\,Mg(OH)_2 + MgO(OH)_2$, which loses all its active oxygen at 300° C., but which is more stable than peroxide of hydrogen at 100° C. This peroxide has an alkaline reaction, and is formed when metallic magnesium is dissolved in oxygenated water. The oxides of zinc and cadmium behave similarly, the peroxide of the former having the composition $2\,ZnO + ZnO(OH)_2$.

In the bleaching of cotton oxygenated water does not act simply as a decolourising agent, but attacks both the fatty bodies present and the cellulose, directly. The saponification of oils and fats is effected in part by the magnesia, but the oxygenated water has also a direct action. On boiling a considerable amount of carbon dioxide is evolved, due to the oxidation of glycerol, whilst the neutral fatty bodies are also acted upon by acidulated oxygenated water with the formation of fatty acids and the evolution of carbon dioxide. The fatty acids themselves are still further oxidised both by the magnesia and by the oxygenated water, and the oleic acid formed is also partially converted into palmitic acid. The fatty bodies remain in the fibre as oleates and palmitates, &c. of magnesia, and are eliminated by treatment with dilute acid and alkali successively. Cellulose is transformed into oxycellulose by oxygenated water, an action which is much aided by the presence of metallic oxides, and also by mercerising the cellulose beforehand, that is by adding caustic soda to the bath used. A piece of cloth mordanted with iron, chromium, and alumina was considerably attacked

by the oxygenated water in the parts covered by the mordants in 1—2 hours; it is therefore advisable to place the cloth, previously to bleaching it, in a bath of dilute acid so as to remove any metallic salts or oxides that may be present. An ammoniacal copper solution acts upon cellulose very similarly to oxygenated water, and when employed in dilute solution, so as not to disentegrate the fibre, is found to act as a bleaching agent and to give rise to the formation of oxycellulose. Schweitzer's reagent therefore does really attack cellulose, a fact which is contrary to the generally accepted view of its action.

—C. A. K.

PATENTS.

Process and Appliances for Washing, Bleaching, and Dyeing Fibrous Materials. O. Hoffmann, Neugersdorf, Germany. Eng. Pat. 14,839, September 19, 1890. 11*d*.

In the washing, dyeing, and bleaching of fibrous materials the patentee ensures perfect penetration of the liquors used by enclosing the material in a vessel, which is subjected to "movements and shocks or concussion in the manner of the head of a hammer." To protect the vessel from injury there are provided "layers of caoutchouc, wood, springs, or equivalent substance or device." A special form of centrifugal machine by which the above object is attained, is also claimed. The mechanical details are explained in the original specification with the aid of drawings.—E. B.

Process for Dyeing Textile Materials of all Kinds in the Hyposulphite Vat. C. D. Abel, London. From M. M. Rotten, Berlin, Germany. Eng. Pat. 17,326, October 29, 1890. 6*d*.

Three claims are made: First, the employment of a bath of hydrogen dioxide for oxidising the indigo-white absorbed by textile fibres in the process of dyeing of the same with indigo, the materials being passed directly from the indigo-vat into the hydrogen dioxide bath; second, the addition of ammonia to the hydrogen dioxide bath "for the purpose of maintaining the indigo-white in a uniform solution suitable for oxidation, for the production of light tints;" and, third, the addition, at intervals, of acid sodium hyposulphite (crude) to the dye-vat, when in use, to remove excess of alkali therefrom.—E. B.

Improvements in the Method of and Apparatus for the Production of Plates for Colour Printing. J. Michaud, Paris, France. Eng. Pat. 17,382, October 30, 1890. 8*d*.

By means of this invention, which is described in the original specification with the aid of drawings, the position of each one of a number of printing plates, inserted in curved letter-press printing plates for the purpose of printing illustrations in several colours, is exactly indicated on the cylinder of the printing machine, thus enabling a perfect register to be at once obtained.—E. B.

Improvements in Machines for Dyeing Skeins or Hanks. P. J. Grandsire fils, Paris, France. Eng. Pat. 19,158, November 25, 1890. 8*d*.

The machine appears to be substantially the same as that patented by La Société Grandsire et Fils (Eng. Pat. 15,881 of 1889; this Journal, 1890, 174), an arrangement being, however, now added by means of which, when the machine is working, the hanks are alternately lifted out of, and lowered into the dye-vat, in addition to their being moved horizontally round the vat and vertically on the reels, as described in the specification referred to.—E. B.

Improvements in the Production of Black Azo-Colours upon Fibres. B. Willcox, London. From the "Farbenfabriken vormals F. Bayer and Co.," Elberfeld, Germany. Eng. Pat. 9636, June 6, 1891. 6*d*.

The *p*-amidonaphtholsulphonic acid, whose employment for the production on the fibre of black azo-colours has been claimed by the present patentee (Eng. Pat. 8530 of 1890; this Journal, 1891, 697), can be advantageously replaced for the same purpose by the amidonaphtholdisulphonic acid (Eng. Pat. 13,443 of 1890) obtained from naphthalenetrisulphonic acid (Ger. Pat. 38,281). Satisfactory results are obtained with the dyes formed (1) by combination of two mols. of this acid with one mol. of the tetrazo derivatives of benzidine, *o*-tolidine, *p*-diamidophenyl-*o*-tolyl, *p* diamidoalkoxydiphenyl, *p*-diamidoalkoxyphenyltolyl, diamido-*o*-diphenol ether, diamidodiphenoxylacetic acid, *p*-diamidostilbene, diamidofluorene, or α_1-α_3-diamidonaphthalene; or (2) by combination with the preceding tetrazo derivatives of one mol. of the above-mentioned acid and one mol. of another "dyestuff component;" or (3) by combination with these tetrazo derivatives of one or two mols. of α-naphthylamine or α-amidonaphthol ether, diazotisation of the resultant dyestuffs, and further combination with two mols. of amidonaphtholdisulphonic acid, or with one mol. of the same and one of another "dyestuff component." The following is an example of the application of this invention: About 10 kilos. of cotton are dyed (blue) with 0·6 kilo. of the colouring matter obtained from tetrazodiphenyl and amidonaphtholdisulphonic acid (2 mols.), then rinsed and passed into a cold solution of 0·2 kilo. of sodium nitrite in 200 litres of water, acidulated with 0·6 kilo. of hydrochloric acid at 20° B. After being rinsed again, the cotton is introduced into a solution of 0·5 kilo. of sodium β-naphtholate. A black is thus obtained, which is very fast to washing. When, instead of the dye obtained from tetrazodiphenyl and amidonaphtholdisulphonic acid, the above-mentioned analogous dyes are employed, or when, in place of β-naphthol, other "dyestuff components" are used, violet-black, brown-black, blue-black, and green-black shades are obtained.—E. B.

VII.—ACIDS, ALKALIS, AND SALTS.

Artificial Periclase; a By-Product of the Magnesium Chloride Industry. R. Otto and J. H. Kloos. Ber. 1891, **24**, 1480—1482.

Periclase is a crystalline variety of magnesia, in which the magnesia is partially replaced by ferrous oxide. It occurs naturally in the limestone found at Monte Somma, Vesuvius, and forms greenish, greasy crystals, which in hardness are about equal to felspar. The authors have discovered crystals resembling periclase in a furnace employed for the manufacture of chlorine and hydrochloric acid from magnesium oxychloride, which was being repaired. Large accumulations of heavy magnesia were removed from parts of the furnace usually inaccessible, and the artificial periclase was found on the interior surface of a number of cavities existing in this magnesia. The crystals were octahedral in shape, and varied in size, the largest having edges 4 mm. in length. They exhibited a brilliant diamond-like lustre, and showed signs of scalariform growth. The smaller crystals were colourless, but the larger ones had a yellowish tint. Their specific gravity was found to be 3·555—3·571, and hardness between that of felspar and quartz. The crystals gave the following results on analysis:

	I.	II.
MgO..	98·21	97·94
Fe_2O_3	1·57	1·70

—H. T. P.

Occurrence of Ammonium Chloride in Stassfurt Potassium Salts. F. Neinke. Chem. Zeit. 1891, **15**, 915.

The author has found as much as 0·8 per cent. of ammonium chloride in commercial carnallite. The crude potash salts and the salts and liquors obtained in the treatment of crude carnallite contain appreciable quantities of ammonia. Kieserite, however, and the calcined potassium chloride do not contain a trace.

These ammoniacal compounds are probably derived from nitrogenous organic matter present during the deposition of the potash beds, and converted into ammonium chloride by the action of the magnesium chloride.—S. B. A. A.

The Action exercised by Alkaline Bases on the Solubility of Alkaline Salts. M. Engel. Compt. Rend. 1891, **112**, 1130—1132.

In continuation of a series of experiments on the solubility of salts of the alkalis in presence of acids, bases, or other salts, the author has determined the solubility of sodium chloride in presence of sodium hydroxide, and the following table contains the results, the figures of the first three columns representing molecules in a saturated solution at 0°. The specific gravity is at the temperature of the laboratory.

NaCl.	Na_2O.	Sum Total.	Sp. Gr.
5M·7	0	5M·7	1·207
49·375	4·8	54·175	1·221
47·212	6·725	53·937	1·225
42·375	10·1[illegible]	52·781	1·236
39·55	14·78	54·33	1·249
24·95	30·5	55·45	1·295
19·3	37·875	57·175	1·311
9·08	53·25	62·66	1·362

Sodium hydroxide precipitates sodium nitrate in a similar manner from its saturated solution, and potash acts also similarly on saturated solutions of the chloride, bromide, iodide, and nitrate of potassium.

Ammonia, however, acts differently, and does not precipitate ammonium chloride from its solution. This the author refers to the formation of a double salt of ammonia and ammonium chloride.—J. W. L.

On the Persulphates. Berthelot. Compt. Rend. 1891, **112**, 1481—1483.

Owing to the recent publication of researches by Traube on the same subject, the author gives an instalment of his results. A solution containing a mixture of sulphuric and persulphuric acids, as obtained by electrolysis, is carefully neutralised by baryta or potash, and the solution will then contain a certain quantity of a neutral persulphate, which decomposes rapidly, especially on heating. The solution then again becomes acid under evolution of oxygen gas, the dissolved persulphate breaking up according to the equation $S_2O_8K_2 + H_2O = SO_4K_2 + SO_4H_2 + O$.

If baryta is used for neutralisation, the solution containing the persulphate, S_2O_8Ba, can be filtered from the precipitated barium sulphate, and its composition can be more satisfactorily determined. It becomes decomposed on boiling in the same way as the potash salt. The solution often contains hydrogen peroxide, so that the active oxygen, as determined by titration with ferrous sulphate or potassium iodide, will often exceed that required by the formula $S_2O_8H_2$.—G. H. B.

PATENTS.

Process for Utilising the Silicic Fluoride obtained by the Treatment of Certain Phosphates with Sulphuric Acid. E. Richters, Saaran, Germany. Eng. Pat. 15,394, September 29, 1890. 6*d*.

It is proposed to condense the escaping gases resulting from the treatment of certain phosphates with sulphuric acid in wooden or stoneware receivers, with or without the admission of steam or water (the object of the water being the decomposition of any silicon fluoride), whereby fluosilicic acid and silicic acid are formed. On treatment with water fluosilicic acid dissolves, and the solution (preferably of a strength of 15—20 per cent. by volume) is treated with aluminium hydrate and caustic alkalis; the product is a double fluoride of the alkali and aluminium (artificial cryolite) mixed with silicic acid. Pure cryolite may be obtained when using a weak solution of an alkaline aluminate and alkaline carbonate, in which silicic acid is soluble.—H. A.

Improvements in the Manufacture of Chlorate of Soda. D. Gamble, St. Helens. From A. R. Pechiney, Salindres, France. Eng. Pat. 16,460, October 16, 1890. 4*d*.

Weldon's process (Eng. Pat. 424 of 1881) for manufacturing sodium chlorate (see also this Journal, 1882, 40—41) consists in treating milk of lime with chlorine, and decomposing the calcium chlorate so formed with sodium sulphate. It is proposed to unite the two operations in one by treating with chlorine a mixture of equivalent quantities of milk of lime and, preferably solid, sodium sulphate. The liquor so obtained has the advantage of being more concentrated than that obtained in the usual way.—H. A.

Method of Utilising the "Weldon" Plant for the Manufacture of Precipitated Phosphates. P. de Wilde, Brussels. Eng. Pat. 11,965, July 14, 1891. 4*d*.

The stills and neutralising wells may be used for dissolving phosphatic rock in hydrochloric acid. The acid solution is then pumped into the top settlers, the clear liquor run into the oxidiser, and a current of air blown in, to effect an intimate mixture with the milk of lime, which is simultaneously added. The mass is then run into the mud-settlers and, after undergoing a series of washing operations, is filter-pressed and dried.

The settlers and oxidisers are lined with lead. "The pump and its pipes should also be constructed of acid-resisting material."—H. A.

X.—METALLURGY.

On Nickel Carbon Oxide and its Application in Arts and Manufactures. Ludwig Mond, F.R.S. British Association, Annual Meeting, Section B., 1891.

The fact that under ordinary circumstances nickel alone is acted on when a mixture of this metal with any other metallic or mineral substances is treated by carbonic oxide gas, led the author to institute experiments to ascertain whether it would not be possible by means of carbonic oxide to extract nickel direct from its ores, and such metallurgical products as nickel speiss and nickel matte. As the nickel is volatilised at the ordinary temperature in the form of a vapour disseminated through other gases from which it can be deposited without first condensing the nickel compound, by simply heating these gases to the moderate temperature of 200° C., as it is thus obtained in the form of

bright coherent masses of great purity, as the carbonic oxide used is completely liberated and can be employed over and over again, and as small quantities of the poisonous nickel compound which may escape decomposition would thus never leave the closed apparatus in which the process would be carried out, it seemed probable that such a process might be capable of industrial application, and might prove more economical than the very complicated operations metallurgists have now to resort to to produce tolerably pure nickel.

Experiments carried out in conjunction with Langer, with a great variety of nickel ores from all parts of the world, containing from 4 to 40 per cent. of nickel, as well as a number of samples of nickel speiss and nickel matte, have proved that as long as the nickel is combined with arsenic or sulphur the process is entirely successful on a laboratory scale. In the majority of cases the author was able to extract the nickel almost completely in three or four days. Such ores or matte or speiss have in the first instance to be calcined, so as to convert the nickel completely into oxide. The mass is then reduced in a current of hydrogenous gases, in practice water-gas at a temperature of 450° C. It is cooled down to ordinary temperature and treated with carbonic oxide in a suitable apparatus. For this purpose any good apparatus for treating solids by gases, of which a great number are in common use, will answer. Methodical apparatus moving the reduced ore in opposite directions to the current of carbonic oxide, at the same time exposing fresh surfaces, facilitate the operation. After a certain time the action of the carbonic oxide upon the nickel becomes sluggish. The mass is then heated to about 350° C. in a current of carbonic oxide, which regenerates the activity of the nickel. This may be done in the same apparatus, but it is preferable to use a separate apparatus connected with the first, and from which it is returned to the first by mechanical means, so that each apparatus can be kept at the same temperature. The carbonic oxide gas can be employed dilute, as it is obtained from gas producers; but since it is continuously recovered, a purer gas such as can be cheaply prepared by passing carbonic acid through incandescent coke is more advantageous, as it extracts the nickel more quickly and requires smaller apparatus. The gas charged with the nickel compound leaving the apparatus is passed through tubes or chambers heated to about 200° C., in which the nickel is deposited. The gas leaving these tubes is returned to the first apparatus, and circulates continuously. From time to time the nickel is removed from the tubes in which it has been deposited. To facilitate this operation thin nickel sheets bent to fit the tubes, are inserted, on which the nickel deposits, and which are easily taken out. The metal so obtained is almost chemically pure; only very rarely in the case of certain ores it is slightly contaminated with iron. Its density is equal to that of ordinary sheet nickel. Its mechanical properties still await investigation. As the nickel is deposited in perfectly coherent films upon heated surfaces exposed to the gas containing the nickel carbon oxide, it was found possible to produce direct from such gas articles of solid nickel or goods plated with nickel resembling in every way those obtained by galvanic deposition of metals, and reproducing with the same exactitude and fineness any design upon such articles. This result can also be obtained by immersing heated articles in a solution of nickel carbon oxide in such solvents as benzole, petroleum, tar oils, &c., or by applying such solution to the heated articles with a brush or otherwise. These processes open up a wide perspective of useful application, considering the many valuable properties of nickel, especially its power of resisting atmospheric and other chemical influences. (See also this Journal, 1891, 644, and 1890, 808—809. See following abstract.)

Compounds of the Metals with Carbon Monoxide. V. Wartha. Chem. Zeit. 1891, **15**, 915.

The author has repeated some of the work of Mond, Langer, and Quincke (this Journal, 1890, 808; 1891, 644; also previous abstract) on the compound of nickel with carbon monoxide, using however some impure ferriferous nickel oxide as the source of the metal. Under these circumstances the condensed nickel compound has always a yellow tinge, and contains iron, as do also the nickel films obtained by heating the conducting tube. The liquid after standing for a few hours, even in a sealed tube, deposits a brown compound containing iron, which often explodes with great violence when the liquid is poured off, the sides of the tube being simultaneously covered with a film of nickel. An apple-green precipitate containing nickel is occasionally deposited, together with the brown iron compound, and adheres strongly to the sides of the tube. The vapour of the liquid compound exploded upon one occasion very violently, either owing to the presence of a particle of the iron compound or to its own explosive properties.

—S. B. A. A.

Antimony Mining in Portugal. J. H. Vogel. Zeits. f. angew. Chem. 1891, **11**, 326—328.

Deposits of antimony are met with in all parts of Portugal. The chief of these occur in the northern part of the country. Besides the mines of Braganza, those that lie in the district around Oporto are the most notable. Northwards from the Douro, within an area of 10 kilometres wide and 60 kilometres long, through which flow the Sousa and the Ferreira, tributaries of the Douro, lie immense deposits of antimony and lead ores, together with tin and wolfram ores. The district is also rich in brown coal. The ores of antimony in these deposits are nearly all rich in gold and silver. The mines are mostly worked with Portuguese and English capital, under German engineers. The gold sometimes occurs in particles the size of linseed in the ore, as in the mines of Ribeiro da Serra and Fontinha. The ore, which is almost all sulphide of antimony, is washed and separated into four qualities. The first three products are shipped to England, where the ores are smelted, scarcely any of the minerals of Portugal being smelted in Portugal. Samples of these three qualities analysed by the author gave — 1st product, 65 per cent. antimony sulphide; 2nd product, 54·5 per cent.; and third product, 49 per cent. The fourth quality contains between 30 and 45 per cent. of sulphide, and will not bear the cost of exportation. English buyers declare that they cannot profitably extract the gold and silver as well as the antimony, and the ore is valued only upon its yield of antimony. The author is not in a position to give the maximum contents of gold and silver found in Portuguese antimony ores, but the three samples above mentioned, were said to be especially poor in gold and silver. They yielded on assaying as follows per ton (metrical) of ore:—2nd product, 15 grms. of silver and 5 grms. of gold; 3rd product, 30 grms. of silver and 16 grms. of gold. These amounts of silver and gold may be considered as minimum quantities, for the ores of this class. An attempt was made by an English company at Lixa, near Oporto, in 1889, to extract the antimony electrolytically, and at the same time recover the gold and silver, but the work was abandoned as being too costly. A practical method of recovering these three metals has yet to be discovered. Another question to be solved is the utilisation of the fourth product, containing between 30 and 45 per cent. of antimony sulphide, and the solution can only be arrived at by smelting the material on the spot. Unsuccessful attempts have been made in the neighbourhood of Coimbra to smelt the ores. The author states that he has succeeded in treating these poorer products so as to obtain nearly their whole contents of antimony, and also that he has devised another method by which the antimony is recovered as oxide, and by which the sulphur is made available.

The deposits of antimony ore next in importance occur near Coimbra, and in this district the rarer oxide of antimony is found in ores containing as much as 70 per cent.

In the south and south-east of Portugal, in the province of Alemtejo, considerable deposits of antimony are found which some 25 years ago were worked very profitably.

—H. S. P.

PATENTS.

Process for Obtaining a New Metallic Alloy. T. Held, Menden, Germany. Eng. Pat. 13,413, August 26, 1890. 4*d.*

An alloy resembling gold in appearance is produced by adding 6 per cent. by weight of antimony to molten copper. When the metals have become alloyed with each other, 10 grms. of "ashes or dust from charcoal" and 25 grms. of calcspar are added to the melting-pot for every kilo. of alloy. The alloy produced as described can be rolled, hammered, and soldered; it has the appearance of gold when polished, and is considerably tougher and harder. According to the patentee it may be exposed to the action of acid or ammoniacal fumes for a long time without losing its brilliancy.—S. B. A. A.

Improvements in the Treatment and Reduction of Metallic Ores or Compounds and the Recovery of Metals and Products therefrom. A. J. Campion, Margate, and J. E. Tenison-Woods, London. Eng. Pat. 15,806, October 6, 1890. 6*d.*

According to this invention, metallic oxides, chlorides, &c., are reduced by hydrogen gas, and sulphides by successive treatment with steam and hydrocarbon gas. The necessary hydrogen is obtained by passing superheated steam through molten iron in a closed vessel, the iron when fully oxidised being subsequently reduced to the metallic state for use over again by passing a current of hydrocarbon gas over it. For the reduction of the oxides, &c., of the metals crucibles are preferably used shaped like ordinary glass-pots, and made of fireclay or plumbago in the case of antimony, barium, strontium, bismuth, cadmium, cobalt, copper, nickel, and metals of the platinum group, of powdered emery and gelatinous alumina for the reduction of compounds of aluminium, chromium, manganese, molybdenum, titanium, tungsten, vanadium, &c., and of the respective oxides agglutinated in some instances by the addition of gelatinous alumina in the case of compounds of magnesium, iron, tin, and zinc. Lead, thallium, and the alkali metals are reduced in brasqued iron crucibles; boron and silicon in crucibles of nearly pure silica.

Sulphides of iron, copper, and lead present together in iron pyrites are first treated with superheated steam in a closed vessel, a current of the gas being passed through the molten mass until it is free from sulphur, and the resulting oxide treated first with the quantity of hydrocarbon gas required to reduce the lead and copper only, the heat being maintained at about 2,000° F.; the temperature is then raised, and the ferric oxide reduced at a temperature of 2,500° to 3,000° F. Other sulphides are treated in an analogous manner.—S. B. A. A.

Improvements in the Manufacture of Steel and Ingot Iron. E. Smith Cassen, Emerley Hill. Eng. Pat. 16,344, October 14, 1890. 4*d.*

The inventor carburises ingot iron by strewing charcoal on the bottom of the ladle, running the metal in directly from the converter, and subsequently adding a little more than the usual proportion of ferromanganese. About 5 lb. of charcoal is used per ton of metal to produce a high-grade steel capable of standing a tensile strain of from 26 to 31 tons.—S. B. A. A.

Improvements in Machinery or Apparatus to be used for the Extraction of Gold and Silver from their Ores by the Amalgamation Process. J. Harris, Sydenham. Eng. Pat. 16,694, October 20, 1890. 8*d.*

According to this invention, gold or silver ores are crushed by stamps or otherwise and charged into a trough containing mercury and fitted with a series of longitudinally-corrugated rollers, which successively carry the ore down into the mercury and finally pass it on to the discharge end of the trough. A rake is placed before this end, and serves to open up the tailings before discharge, allowing any entangled mercury to separate. The bed of the trough is depressed under the centre of each roller, and suitable mercury traps, &c., are adjusted in convenient positions.—S. B. A. A.

Improvements in and Means or Apparatus for the Extraction of Metals from Metallic Ores or Matters containing Metals. N. Lébédeff, St. Petersburg, Russia. Eng. Pat. 17,935, November 7, 1890. 8*d.*

According to this invention, metallic oxides melted or fluxed in a vessel with porous walls are reduced by the action of gases which are allowed to diffuse through the walls of the vessel. It is essential that the mixture of ore, flux, &c., be reduced to a state of perfect fluidity before treatment. The process may be conducted either in plumbago crucibles or in a reverberatory furnace the hearth of which is formed of thin slabs of plumbago or other porous material, below which the reducing gases can circulate. It is alleged that aluminium may in this way be reduced from a solution of the oxide in calcium fluoride.—S. B. A. A.

Improvements in Extracting Iron and Steel or other Metals from Ores or other Metalliferous Materials. N. Lébédeff, St. Petersburg, Russia. Eng. Pat. 946, January 19, 1891. 6*d.*

Iron or other ore is mixed with limestone or dolomite in the proportions required by the equations—

$$2\,RO + nSiO_2 + CaCO_3 + C = (2\,RO, CaO)n\,SiO_2 + 2\,CO =$$
$$2\,R + CaO.nSiO_2 + 2\,CO_2,$$

placed preferably on the hearth of a basic-lined open-hearth furnace, and when the mixture commences to melt a thin layer of pulverised coke, anthracite, &c. is placed on the surface of the mixture. Under these circumstances it is stated that the carbon reduces the carbonic anhydride given off by the decomposing limestone into carbonic oxide, which in turn reduces the ore. The reduction may also be effected by melting the ore on a bed composed of a mixture of limestone and carbon.—S. B. A. A.

Improvements in the Methods of Treating Blue Billy or Purple Iron Ore, Iron Sand, and Similar Substances for the Purpose of Preparing them for the Reducing Furnace. J. Bowring, Tilbury. Eng. Pat. 11,083, June 30, 1891. 4*d.*

For purposes of reduction "Blue Billy" or finely divided iron ore is well mixed with an equal weight of powdered rich coking coal, or with two parts of refractory coal, wetted with water, tar being added in a proportion determined by experiment, and the mixture coked. A hard coherent mass is said to be obtained fit for treatment in the blast furnace.—S. B. A. A.

An Improved Converter for the Manufacture of Iron and Steel. J. Wilmotte, Chénée, Belgium. Eng. Pat. 12,165, July 17, 1891. 6*d.*

This apparatus consists of an ordinary casting ladle into which may be lowered to various depths a fire-proof block pierced by inclined pipes located in a circle and communicating with an air reservoir surmounting the block. This reservoir is connected with an adjustable slide pipe attached to the blowing apparatus. Air can thus be blown into the steel from above, and it is possible to treat small quantities of metal in the ladle by suitably adjusting the block.—S. B. A. A.

Improvements in the Manufacture of Galvanised Iron. J. W. Richards, Philadelphia, U.S.A. Eng. Pat. 12,405, July 21, 1891. 4*d.*

The inventor finds that the presence of small quantities of aluminium in the galvanising bath leads to the deposition of a highly crystalline as well as a permanently brilliant and adhesive coating of zinc. The aluminium is best added to the bath in the form of a zinc alloy containing two per cent. of aluminium, 4 oz. of this alloy being added to the galvanising bath for every ton of zinc.—S. B. A. A.

XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

PATENTS.

Improvements in Electrical Storage Batteries. E. Frankland, Reigate Hill. Eng. Pat. 4303, September 9, 1882. (Second Edition.) 6*d.*

This patent relates to methods of hardening the lead oxide used in pasting the plates of storage cells. This result is brought about by the use of some acid, generally sulphuric, which is capable of forming an insoluble or sparingly soluble salt with the oxide. In one method described the oxide is mixed with water and spread over the plate, and after drying is hardened by repeated moistenings with dilute sulphuric acid. In a second method the acids and oxides are mixed at once to form the paste. In a third method the oxide, mixed with sulphuric acid, is cast round a conductor in a suitable mould. In a fourth method the metal supports are coated with oxide by repeated dipping into the oxide-acid paste. In a fifth method solid plates are formed by casting the oxide-acid paste in a mould without any metallic conductor. In all cases the plates, after drying, are to be saturated with dilute sulphuric acid, to further harden them. Where perforated plates are used, the inventor prefers to make small holes through the pellets of active material, so as to induce better circulation of the electrolyte.—E. T.

Improvements in Thermo-Electric Batteries. G. E. Gouraud. Beulah Hill. Eng. Pat. 12,330, August 6, 1890. 6*d.*

A small block, composed of three parts of antimony, two parts of zinc, has a small wire or strip of nickel or nickeline embedded in it near each end. The wires project in a vertical direction from the horizontal top face of the block. The end to be heated is protected against fusion by a casing, usually of iron. As many of these blocks with electrodes are joined in series as are desired, and arrangements are made for heating the cased ends to a higher temperature than would be practical without protection.

—E. T.

Improvements in Electrical Smelting. E. Taussig, Bahrenfeld, Germany. Eng. Pat. 12,475, August 9, 1890. 6*d.*

The electric current is led into and out of the furnace by electrodes of considerable surface and made of plates preferably of the same metal as that to be smelted out. On first passing current the points of bad contact of the separate parts of the ore are heated. As these points soften and the area of contact becomes larger, more current passes and the operation goes on till the whole is melted. According to the patentee if the cross section of the furnace be one square metre, that that of the copper conductor and of the electrodes should also be one square metre.—E. T.

Improvements in Apparatus for Use in Electro-Metallurgical Operations. C. Hoepfner, Giessen, Germany. Eng. Pat. 13,735, September 1, 1890. 8*d.*

The apparatus somewhat resembles a filter-press and consists of a number of frames separated by porous diaphragms, the frames containing alternately positive and negative electrodes. The stream of liquid enters the first frame at one side, passes to the other, and then through channels in the walls of No. 2 into No. 3, from the opposite side of No. 3 into No. 5, and so on. Similarly, a second stream of liquor enters No. 2 and passes successively into Nos. 4, 6, &c. Thus all the anode cells communicate, and all the cathode cells. The diaphragms are of parchment paper strengthened on one or both sides with a strong fabric. For use with chlorides, bromides, &c., diaphragms of asbestos or other organic substances may be used

The inventor proposes to use the same general arrangements for battery cells, insulating india-rubber diaphragms being used to separate the various cells of the battery from one another. He appears to allow compartments of different cells to communicate, however, by the liquid filling the channels.—E. T.

Improvements in Secondary Batteries. J. T. Niblett, Greenwich. Eng. Pat. 14,411, September 12, 1890. 8*d.*

To make thoroughly compact cells, adapted for portability, &c., an outer cell and porous pot, both containing electrodes, are used. Both pot and cell are packed with flaky and spongy lead, produced by pouring melted lead from a suitable height into hot water. The electrolyte is poured into both cells and fills all interstices. Formation may be hastened by depositing spongy lead on the negative electrode. For this purpose the cell is heated and filled with water slightly acidified by nitric or acetic acid, and a strong current passed for some time. The cell is then filled with its usual electrolyte, and formation in the ordinary manner proceeded with.—E. T.

Improvements in Incandescent Electric Lamps and Leading-in-Wires therefor. B. J. B. Mills, London. From T. A. Edison, Llewellyn Park, New Jersey, U.S.A. Eng. Pat. 15,792, October 6, 1890. 8*d.*

Leading-in-wires of other materials than platinum have larger coefficients of expansion than glass, and during cooling after the operation of sealing in, shrink away from the glass and allow air to leak into the lamps. The platinum wires are thicker than mere electrical reasons require since they must be sufficiently rigid to support the filament. To economise platinum and yet obtain a safe seal, the inventor supports the filament on sufficiently stout copper wires, which are sealed into the glass. These wires do not, however, pass right through the glass to the outside of the lamp, but are each attached to a short piece of very fine platinum wire, round which the glass makes a perfect seal. These short platinum wires, wholly imbedded in the glass, are attached to other copper wires which finally pass out of the lamp for making connections. The platinum required for each lamp (for half ampère lamp) is thus reduced to two short pieces, each about $\frac{1}{8}$ inch long and $\frac{1}{2000}$ inch diameter, while, if anything, a more perfect seal is obtained than by the usual plan. A second, but less perfect method on the same principle is described, whereby the amount of platinum is reduced to one half that of an ordinary lamp.

—E. T.

Improvements in and relating to Electric Batteries. E. Ortelli, Cadenabbia, Italy. Eng. Pat. 20,712, December 18, 1890. 8*d.*

A narrow flat cell of wood or other light material rendered waterproof contains a second, and necessarily still narrower cell of carbon, which again contains a zinc plate, insulated from it, in solution of ammonium chloride. Chlorine is supplied from a suitable generator to the space between the wooden and carbon cells. As the result of electrolytic action, zinc chloride and ammonia formed by the action

of the zinc on the ammonium chloride, which is, however, reformed by the absorption of the chlorine which passes through the porous carbon from the outside. In a battery of such cells chlorine is to be supplied to each independently of the others.—E. T.

An Improved Method of Producing a Hermetical Seal for the Connecting Wires of the Filaments of Incandescent Lamps. F. Walter, Vienna, Austria. Eng. Pat. 7160, April 25, 1891. *6d.*

The terminal end of the lamp is provided with two small tubes, and the filament, attached to stout wires of copper or other suitable metal, is inserted from the opposite end of the lamp till the ends of the supporting wires have entered and traversed the small tubes. The end of each tube is then filled with a metallic alloy, making good electrical contact with the wire, and a small metal capsule is fitted over the tube with more alloy between it and the latter. The alloy to be employed is described in Eng. Pat. 7159 of 1891, and is such that an air-tight joint can be made between it and glass. The terminals of the lamp are the two metal capsules.—E. T.

Improvements in Secondary or Storage Batteries. S. C. C. Currie, Philadelphia, U.S.A. Eng. Pat. 9762, June 9, 1891. *8d.*

The electrodes, preferably in the shape of wires or rods, are protected with a covering of braided asbestos or other suitable material. They are then immersed in some such solution as that of zinc chloride, and converted to a greater or less depth by electrolysis into lead chloride. This lead chloride is afterwards reduced by reversal of the current into [illegible] coat, when the electrodes are in a state for rapid [illegible].—E. T.

Improvements in Galvanic Batteries. G. A. Schoth, London. Eng. Pat. 9928, June 11, 1891. *4d.*

As an absorbent material for dry batteries, the inventor uses the dried compressed moss known as "Sphagnum." The cell is made up of a zinc tube closed at the bottom by a paraffined wood stopper, and covered on the outside with calico or canvas varnished or japanned. The zinc cell contains the moss, which surrounds the carbon with its depolarising materials, and is saturated with the electrolyte.—E. T.

Improvements in Electric Batteries. W. A. Crowdus, Memphis, U.S.A. Eng. Pat. 5638, August 1, 1891. (Internat. Conv. October 7, 1890.) *8d.*

In order to avoid the high electrical resistance introduced by a thick porous pot and the large diffusion or osmotic action with a thin one, the inventor employs the latter with the *porous* carbon electrode in close contact with it. The contact need not be perfect, as grooves, channels, or perforations may be added to allow a limited circulation of the liquid between the carbon and the porous diaphragm.—E. T.

XII.—FATS, OILS, AND SOAP MANUFACTURE.

On New Derivatives of Stearic Acid. C. Hell and J. Sadomsky. Ber. 1891, **24**, 2388—2396.

The authors obtained pure stearic acid from oil of Bassia-seed (Illipe oil), which contains much stearic acid, as well as palmitic and oleic acid, by saponification, treatment of the isolated fatty acids with alcohol, repeated distillation under vacuum, and, lastly, by fractional precipitation with magnesium acetate (Heintz' method). This acid melts at 69·2° C.—K. E. M.

PATENTS.

Treatment of Linseed and other Oils Employed in Varnishes. A. F. St. George, Redhill. Eng. Pat. 10,753, July 11, 1890. *8d.*

The linseed or other oil is floated in a thin layer on the surface of water containing hydrogen peroxide or other oxidising agent, and kept at a suitably elevated temperature, whereby it becomes bleached. The process is carried on preferably with the assistance of daylight or the electric light to further the oxidising action. A sketch of a heating chamber for conducting the process accompanies the specification.—G. H. B.

Improvements in or Appertaining to Bars, Blocks, or Tablets of Soap, or other like Soluble Substances. W. H. Thew, Liverpool. Eng. Pat. 11,358, July 21, 1890. *6d.*

A block of soap is divided into sections by having a series of marks impressed on it; on each section is marked the amount of water required for the section. Drawings accompany the specification.—K. E. M.

Improvements in the Preparation of Paint Oils. J. Baptista, Philadelphia, U.S.A. Eng. Pat. 11,359, July 21, 1890. *6d.*

Mineral oil, rosin, borate of manganese, and linseed oil are incorporated together in specified proportions for the preparation of a drying oil termed by the inventor "Linosene." A small addition of sulphur to the oil is also included.—G. H. B.

Improved Plant or Apparatus for Extracting Oil or Grease from Granular or Pulverulent Material. W. H. Lever, J. D. Lever, and E. G. Scott, Port Sunlight. Eng. Pat. 16,025, October 9, 1890. *11d.*

The apparatus is for the purpose of using volatile solvents in the treatment of oleaginous materials, the extractions being carried on systematically in a series of closed vessels, but the fully extracted material is removed to another vessel for the recovery of the adhering solvent, the vapours from which are removed in a partial vacuum and condensed under considerable pressure. These means are specially adapted to working with such volatile liquids as tetrachloride of carbon, carbon disulphide, and chloroform. The apparatus is described in considerable detail, for the comprehension of which a reference to the accompanying drawings is essential.—G. H. B.

Improvements in the Manufacture of Soap. C. A. O. Rosell and J. C. Pennie, Washington, U.S.A. Eng. Pat. 16,059, October 9, 1890. *6d.*

The specification refers to the production of a hard potash soap, for which the harder fats and fatty acids are to be used. Any greater degree of hardness desired is to be

attained by using soda along with the potash for saponification; or a potash salt such as the sulphate, bicarbonate or sulphite may be added to the soap. The operations described are those ordinarily in use, except that potassium salts, especially the chloride, are used instead of sodium salts for salting out, &c. There are 19 claims.—G. H. B.

Improvements in the Manufacture of Iodine Soaps. A. Seibels, Berlin, Germany. Eng. Pat. 9991, June 12, 1891. 4*d*.

With a view to ensure the presence of iodine in a soap uncombined with the alkalis used in the saponification, the fatty matter to be used for the manufacture of the soap is heated with iodine to about 266° F.—K. E. M.

Improvements in and relating to Lubricants for Machinery. C. Fink, Washington, U.S.A. Eng. Pat. 10,132, June 15, 1891. 4*d*.

A mixture composed of pulverised lime, pulverised French chalk, and carbonate of potash and water is added to various oils to give these more body for lubricating purposes.—K. E. M.

XIII.—PAINTS, PIGMENTS, VARNISHES, RESINS, INDIA-RUBBER, Etc.

Studies upon Resins. L. H. Friedburg. J. Amer. Chem. Soc. 1890, **12**, 392—394.

In order to determine simultaneously the temperatures of melting kauri (copal) gum and of its vapours, 222 grms. of pale but soft kauri gum, coarsely powdered, were put into a tubulated retort, into the tube of which two thermometers were inserted, one to ascertain the melting point and the other the temperatures of the vapours.

The following temperatures were observed:—

	Vapour.	Gum.
	°C.	°C.
After 55 minutes	181	351
After 60 minutes	178	341
After 65 minutes	175	337
After 70 minutes	175	335

For the first 18 minutes the retort became filled with visible fumes which then disappeared, the upper half of the retort remaining transparent to the end. The liquid distillate obtained weighed only 36 grms., at a temperature of 21° C. it consisted of two layers of 0·86 and 1·01 sp. gr. respectively. The residue, when cold, was transparent, clear and of a brilliant dark amber colour. It was completely soluble in cold spirits of turpentine. (Compare J. Amer. Chem. Soc. 1890, **12**, 285—291, and this Journal, 1891, 149.)—H. S.

PATENT.

A Process for Manufacture of White Lead. G. Bischof, London. Eng. Pat. 11,602, July 24, 1890. 6*d*.

In manufacturing white lead by acting with carbon dioxide on a lead oxide in the presence of suitable reagents such as acetic acid or its compounds, great difficulty is experienced in obtaining for this purpose an oxide such as will produce white lead of a clear white colour. One cause of this difficulty seems to be that lead oxides of commerce, such, for instance, as litharge, are mixtures of several compounds of lead with oxygen which are differently acted upon by the reagents employed, so that some of these oxides become converted before others of them; and when the reaction is continued in order to convert those others, those first converted are apt to be rendered crystalline, thus greatly impairing the value of the product.

The patentee overcomes the above difficulty by partially deoxidising the crude lead oxides by exposing them at a temperature of 250°—300° C. to the action of gas rich in hydrogen, *e.g.* water-gas, in suitable vessels. The partially deoxidised but uniform product (suboxide of lead) is allowed to cool in the reducing atmosphere of the apparatus, then afterwards exposed, after moistening with water, to the oxygen of the air; the suboxide is thereby converted into a hydrated higher oxide, $Pb(OH)_2$. This is then treated with acetic acid and carbon dioxide in the usual way, with or without admixture of sugar; the sugar having been found "useful in promoting the reaction."

XIV.—TANNING, LEATHER, GLUE, AND SIZE.

The Tannin Matters of Algarobilla and Myrabolams. G. Zolffel. Arch. Pharm. 1891, 123.

See under VI., *page* 834.

XV.—MANURES, Etc.

The Position of the Artificial Manure Industry. Chem. Ind. 1891, **14**, 230—232.

The stopping of various phosphate beds, the reduced imports from Curaçao, and the low price of crude products, accompanied with such high charge for carriage as to hinder their importation, led to a want of good crude products and a consequent rise of prices. This rise of prices was largely to the advantage of the manure industry, because, owing to the conventions, the factory prices were not able to follow the prices of crude material without increasing the enmity of a portion of the agriculturists towards the conventions.

The good harvest prospects early in 1890 and the contemporaneous want of straw, together with the ever-increasing conviction that the use of phosphoric acid was a necessity, even in moderately good farming, caused a considerably increased use of phosphatic manures; so that the factories were fully occupied in spite of the pressing offers of foreign superphosphate. The German manure trade is not only not protected by a tax, but is encumbered by the high protective tax on, for instance, the jute industry. The German manufacturers have always striven not only to produce a dry and well-powdered material, but one as perfect as possible with regard to chemical composition. The distribution of the soluble phosphates in the soil is of the greatest importance, and this can only take place when the manure contains but little iron and alumina; otherwise there will be a return of the phosphoric acid to the insoluble form. The value of phosphates when more or less free from iron and alumina is most apparent after slight rainfalls, which are able to distribute the whole of the phosphoric acid in the soil and so render it available to the crops.

If the agricultural bodies which are unwilling to co-operate with the manufacturers still continue in this course, the latter will be obliged, to the disadvantage of both, to use

inferior crude products. The manufacture, which was formerly one of the simplest, is now very difficult. The continual discovery of new phosphate beds and their rapid exhaustion, causes the manufacturer to be frequently having to deal with a new material. The lately-found Liège-, Somme-, and Florida-phosphate materials, however, seem to promise a greater stability.

Attention is drawn to the importance of statistics relating to phosphates being given in more detail, and not merely under the two headings of superphosphate and bone-ash, as is done at present.

It was the activity of manufacturers of Thomas slag, supported by the good results obtained with the manure, that led to a quite unforeseen increase in the use of phosphates; and as it was soon found that the two manures were not in opposition to, but rather supplement one another (each being suited for different soils) the two industries can only be a help to each other when recommending the use of phosphates.

The view held in some districts where phosphoric acid has been in use for 10 years, that its employment has been excessive, is not generally accepted, and has even been disputed by important authorities; and its adoption, without consideration, would probably lead to serious losses.

—N. H. J. M.

Alkaline Sulphides as Insecticides. Dubois. Compt. Rend. 1891, **112**, 1526.

Solutions of potassium or sodium monosulphide are destructive to all stages of insect life. Solutions ranging from 10 to 35 B effected the destruction of eggs and insects respectively, and the hatching of the eggs was prevented by a slight sprinkling with the solution. Even the vigorous stag-beetle succumbs to the action of the solution. These experiments point to the use of soluble sulphides for manuring with a view to the destruction of the Acridians, which devastate the crops of Algiers.—G. H. B.

The Formation of Nitrates in the Soil. A. Müntz. Compt. Rend. 1891, **112**, 1142—1144.

Recognising the result of the recent researches on the formation of nitrous acid by the action of organisms present in the soil, the author has made a series of experiments with the object of determining the conditions under which the calcium nitrite so formed is oxidised to nitrate.

In the first series, a dilute solution of pure calcium nitrite, prepared from calcium chloride and silver nitrite, was allowed to remain exposed to the air for six months, at the end of which time it was found that no oxidation had taken place. In the next place, the action of carbonic anhydride on a similar dilute solution of calcium nitrite was studied, and it was found that the nitrous acid was liberated rapidly in the case of the gas being pure, whilst if the carbonic anhydride was diluted with an inert gas, the liberation took place more slowly. Recognising how readily free nitrous acid is oxidised by free oxygen to nitric acid the author next passed a mixture of carbonic anhydride and air through the solution of calcium nitrite, which resulted in the rapid oxidation of the nitrite to nitrate. In another experiment, soil was sterilised by heating it for half an hour to 100°, a solution of calcium nitrite was then added to it, after which it was allowed to lie exposed to the air. At the end of several days the oxidation was found to be complete. The author considers that these experiments explain how it is that the nitrite, which is formed in the soil by the agency of the nitrifying organism, becomes oxidised so readily, the soil containing, as is well known, considerable quantities of carbonic anhydride formed by the decomposition of organic matter.—J. W. L.

Thomas versus Martin Slag. Iron, October 2, 1891, 298.

The Agricultural Experiment Bureau, of Bonn, draws attention to the fact that in the Rhine provinces Martin slag is often falsely sold as Thomas slag. In some iron-works the Martin process for eliminating sulphur has recently been used, which method is materially different from the Thomas process. The Martin slag thus obtained does not, in the crushed state, differ in appearance from the Thomas slag; it contains, however, according to recent tests, only 12 per cent. of phosphoric acid. A sample of Martin slag analysed at the above-mentioned experimental station gave the following results:—

	Per Cent.
Phosphoric acid	11·11
Lime	40·86
Silicic acid	14·31
Sesquioxide of iron	17·85
Magnesia	9·98
Manganese	5·56
	100·00

in addition to alumina and other elements which were not specifically investigated.

XVI.—SUGAR, STARCH, GUM, Etc.

Note on Ost's Communication on "The Rotatory Power of Levulose and Invert-sugar." B. Tollens. Ber. 1891, **24**, 2000.

A claim to priority. (See page 859.)—H. T. P.

Analysis of Shoe Blacking. J. Pinette. Chem. Zeit. 1891, **15**, 917.

See under XXIII., *page* 861.

PATENTS.

Improvements in the Manufacture of Lactose or Milk Sugar. J. Y. Johnson, London. From A. L. L. Peck, Burlington, U.S.A. Eng. Pat. 13,444, August 26, 1890. *6d.*

This invention provides a method for the extraction of milk sugar from whey, whereby the yield is increased, and the melassigenic action of the acid produced in the older and more lengthy processes is obviated, as is also the loss involved in the successive recrystallisations of the sugar which are necessary in these processes to free it from nitrogenous and other impurities.

The whey is neutralised either with slaked lime or chalk, heated to boiling and filtered from the partially precipitated nitrogenous constituents (proteids). The greenish, somewhat turbid liquid is evaporated to half its volume and then treated while hot with the requisite quantity (varying with different samples) of a hot concentrated solution of washing soda and alum (equal parts); any acid except nitric acid, also any one of the known precipitants of proteids "together with a solution of rennet" may be used instead of the washing soda and alum. The filtrate thus freed from proteids is again neutralised with slaked lime or chalk, passed through animal-charcoal filters, and evaporated *in vacuo* to the crystallising point. The resulting sugar forms "white fine crystals," and after washing from salts with a small quantity of ice-cold water, drying and powdering, is a marketable article.—A. R. L.

Process of Utilising the Waste of Distilleries, Breweries, Glucose and Starch Works and the like for the Preparation of Fuel. A. Parks, Martinsburg, U.S.A. Eng. Pat. 8893, May 26, 1891. *6d.*

See under XVII., *page* 844.

Improvements in Apparatus for Automatically Manufacturing Cold Syrups of a Determined Density. H. Klein and G. Dethan, Paris, France. Eng. Pat. 12,054, July 15, 1891. 6*d*.

THE object of this invention is to manufacture pure syrups at the ordinary temperature of a determinate density in any desired quantity, the latter depending upon the dimensions of the apparatus. The apparatus consists of a cylindrical vessel of silvered copper or other material not acted upon by the ingredients employed, and of a smaller perforated cylinder, which fits into the first and is supported by its rim. It is somewhat less than half the depth of the large cylinder. Two sieves of perforated sheet iron or gauze, surrounded by felt, cloth, flannel, or the like are placed below the smaller cylinder; these are packed with a filtering medium such as paper pulp. The larger cylinder may be constructed of glass, and in this case the smaller one is of earthenware, open at the bottom, and provided with an internal rib to support the two sieves. Air is admitted by a tube to the lower portion of the larger cylinder, but above the surface of the syrup which it contains. A gauge glass, to indicate the quantity of syrup contained in the apparatus, is attached to the side of the larger cylinder and is provided at the bottom with a three-way cock, so that its contents may be run off independently of the cylinder itself; it also contains a float, by means of which the density is determined.—A. R. L.

Improvements in Apparatus for Defecating and Evaporating Saccharine Juices. R. F. Cordero, Tachira, Venezuela. Eng. Pat. 12,058. July 15, 1891. 8*d*.

THE patentee describes, with the aid of drawings, an apparatus for defecating and evaporating saccharine juices, together with a furnace adapted to the same. The juice as it comes from the mill is run into pans, and thence into a series of three defecating tanks, separated from one another by partitions of unequal height, and previously charged with the defecating material. The tanks are provided with adjustable pipes reaching to the bottom, which serve to discharge the juice from one tank into the succeeding one, the last tank discharging, by a similar arrangement, into an open evaporating pan having an arrangement which causes the juice to circulate freely; this discharges into another evaporating pan, and the "molasses" ultimately passes into a crystallising tank. The defecating tanks and evaporating pans are placed over the above-mentioned furnace. The juice may be fed continuously.—A. R. L.

XVII.—BREWING, WINES, SPIRITS, Etc.

The Calculation of the Alcoholic Yield from Starchy Materials. E. Donath. Chem. Zeit. 1891, **15**, 597—599.

THIS is a communication from the laboratory of the technical school at Brünn.

The calculation may be based either on the amount of starch contained in the raw material, or on the amount of saccharine matter yielded after conversion of the starch.

The yield of alcohol (Σ) may be calculated by the formula—

$$\Sigma = a\frac{Mm}{100} + a'\frac{Pp}{100}$$

where M is the weight of potatoes or other similar material containing m per cent. of starch; P the weight of malt yielding p per cent. of dry extract; a the alcoholic yield from 1 kilo. of starch; and a' the alcoholic yield from 1 kilo. of dry extract.

The numbers given by various observers for the values of a and a' vary slightly; the best values are $a = 0{\cdot}53889$ and $a' = 0{\cdot}4942$.

In actual practice the amount indicated by the above formula is never reached, owing to the following causes:—

1. Insufficient crushing of the material, in consequence of which and other causes undissolved starch remains behind in the grains. 2. A portion of the fermentable matter escapes fermentation and remains in the spent wash. 3. A portion of the fermentable matter undergoes a fermentation other than the alcoholic one. 4. A portion of the alcohol produced is oxidised to aldehyde or acetic acid, or is volatilised.—A. L. S.

The Use of Saccharine in Wine.

THE *Handels Museum* of September 3rd says:—

"The *Deutsche Wein Zeitung* has taken some pains to collect the opinions of various experts as regards the use of saccharine in wine or must, and in doing so has attached particular weight to such chemical laboratories as have experience in the matter of wines. The Grand Ducal Agricultural Experimental Institution of Karlsruhe considers the addition of saccharine to wine as an adulteration if the purchaser be not informed of the circumstance. The chemical laboratory of Dr. Fresenius in Wiesbaden condemns wine containing saccharine when the presence of the latter is not declared, a sentiment also expressed by the Institution for Chemical Analyses in Mainz. The district experimental station at Speyer gives its opinion in an exhaustive paper on the use of saccharine. In every case where it has been found possible to establish clearly the fact that saccharine has been added to wine, the liquor has been unhesitatingly condemned as spurious and as contravening the laws dealing with food products. Regarding the contention that saccharine is used as a preservative, it is the opinion of Dr. Halenke that to attain this purpose it would have to be used in such quantities as would render the beverage all but undrinkable, and consequently that no expert could accept such an explanation when proffered by individuals who have added saccharine to wine. The experimental stations of Alsace-Lorraine hold similar views on the subject."

PATENTS.

Improvements in the Treatment of Grain and Malt, and the Production therefrom of a New Product, more especially intended for Use in Brewing and Distilling or as a Food. B. E. R. Newlands, London. Eng. Pat. 13,862, September 3, 1890. 4*d*.

THIS product is made by soaking rice, maize, barley, wheat, malt, black malt, or the like in a solution of glucose, cane sugar, caramel, or other saccharine substances of a strength of about 28° B., and either cold or hot, as may be most suitable, until the grain has become impregnated with the solution (about eight hours). The grain is then drained and dried.—A. L. S.

Improved Method of and Apparatus for Maturing Wines and like Beverages. E. R. Budden, London. Eng. Pat. 15,790, October 6, 1890. 6*d*.

THE wine to be matured is led through a coil placed in a vessel containing water heated to say 190° F.; from this it passes through a second coil immersed in a vessel of cold water and thence to a receiving vat, in which it may be kept from exposure to the atmosphere. By this process of employing a variable temperature the wine is said to be matured.—A. L. S.

Improvements relating to Brewers' and Distillers' Fermenting Vessels and Yeast Receivers. R. H. Leaker and J. H. Howell, Bristol. Eng. Pat. 17,646, November 4, 1890. 8*d*.

THE yeast receiver is in the form of an inverted funnel with a turned-back edge, and is suspended in the fermenting square by chains. The yeast works through

the central throat and over the sides of the receiver into the same. The barrel of the wort-circulating pump is supported in the throat of the receiver by stays, and when in action pumps the fermenting wort into the yeast receiver. The wort may be allowed to flow back into the fermenting vessel by raising the receiver a little and opening a valve at the bottom of it. The yeast is removed by a door in the side of the receiver.—A. L. S.

Improvements in Producing and Refining Spirits from Oils, and Apparatus therefor. W. S. Somers, Liverpool. Eng. Pat. 2241, February 7, 1891. *6d.*

THE apparatus consists of a steam-jacketed vessel with an interior steam coil; the steam from the jacket passes into the interior of the vessel. The alcohol to be purified is placed in the vessel, and the vapours which are evolved are condensed in the usual way.—A. L. S.

Process of Utilising the Waste of Distilleries, Breweries, Glucose and Starch Works, and the like, for the Preparation of Fuel. A. Parks, Martinsburg, U.S.A. Eng. Pat. 8893, May 26, 1891. *6d.*

THE hot waste (slop hot) from the still is discharged into a tank, whereby the solid portion in suspension settles, and the supernatant liquid to the extent of 60—70 *per cent.* of the total liquid is run off. The residuum, which is a semi-solid mass of nitrogenous material is then run into another receptacle having on the bottom, which is slatted or provided with suitable openings, a thin layer (3—12 ins. deep according to circumstances) composed preferably of fine coal, cinders, sawdust or other combustible material so that 40—50 *per cent.* of the remaining liquid drains off. After a few hours (when cracks appear on the surface) the *waste* and porous layer of fuel are thrown upon a slightly inclined slatted floor to further drain, or if desired they may be burned without having recourse to the last-mentioned operation. When the lower stratum of filtering substance is not mixed with the *waste*, it may consist of gravel or other loose material which must, however, be placed in pockets formed on the bottom of the tank: it is desirable to mix the *waste* with a certain proportion of other fuel before using. It is necessary to operate on the *waste* before the acetic fermentation sets in, as soon after this it undergoes putrefaction, and passes into a slimy mass from which it is impossible to separate the liquid portion, and it is desirable to work up the waste each day as it is produced, in order to avoid accumulation.—A. R. L.

Improvements in Malting Apparatus. F. Bollmann, Landsberg, Germany. Eng. Pat. 11,183, July 1, 1891. *6d.*

THE perforated malting-floor rests on angular perforated air distribution channels, which are supplied with moist air through branch channels communicating with a main channel in which is placed a blower for supplying the air. Each branch channel is furnished with an air-tight door so that any section of the floor may be thrown out of use and cleaned without interfering with the rest.

—A. L. S.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

(*A.*)—CHEMISTRY OF FOODS.

Formulæ for Detecting the Adulteration of Milk. T. Günther. Chem. Zeit. 1891, **15**, 960—961.

THESE formulæ are to be used in comparing the results of testing samples of milk taken at the stables and samples of the milk exposed for sale. If t_1, f_1 and t_2, f_2 are the percentages of the total solids and fat in these samples respectively,

$$\text{percentage of fat abstracted} = \phi = \frac{t_2 f_1 - t_1 f_2}{t_2 - f_2}$$

$$\text{percentage of water added} = W = \frac{10{,}000\,(t_1 - \phi)}{t_2\,(100 - \phi)} - 100$$

$$\text{or when } \phi = 0,\ W = \frac{100\,t_1}{t_2} - 100.$$

—S. B. A. A.

PATENTS

Improvements in the Treatment of Grain and Malt, and the Production therefrom of a New Product more specially intended for Use in Brewing and Distilling, or as a Food. B. E. R. Newlands, London. Eng. Pat. 13,862, September 3, 1890. *4d.*

See under XVII., *page* 843.

Improved Malted Food Preparations. W. Geddes, Oldham. Eng. Pat. 15,981, October 8, 1890. *4d.*

THE inventor claims the preparation of "malted marmalade," "malted preserves," "malted jellies,"—adapted for dyspeptic persons. The food materials are mixed with an extract of malted barley, wheat, &c. prepared preferably *in vacuo*, a small quantity of gelatin together with the "desired flavouring or colouring" being added to the finished product.—A. R. L.

Improvements in the Method of Treating Bananas for Use in the Preparation of Food and Drink. M. A. E. Schneider, Baden-Baden, Germany, and R. H. Coall, London. Eng. Pat. 16,857, October 22, 1890. *6d.*

THIS specification relates to the preparation of meal from banana fruit to be used either alone or in admixture with other "nutritious or medicinal materials" in the preparation of food and drink for infants, invalids, &c. The banana fruits are peeled and heated on "wire grills or gratings" in an oven or hot chamber at about 35° C. for about eight hours; they are next transferred to a dry room and kept there for at least 24 hours, and then again heated in the aforesaid manner for 5 hours at 55—60 C.; after which they are cut into pieces, one centimetre in length, and carefully heated in a coffee roaster or other suitable apparatus over a quick fire until they are of a uniform dark brown colour. When cool the pieces are bruised and ground in a mill to a fine brown flour. The latter forms an "excellent substitute for coffee," and an "excellent food for children and invalids" may be prepared by mixing the banana flour with maize corn flour.—A. R. L.

Method of Preserving Grain Fodder. R. R. von Gunesch and C. Beurle, Vienna, Austria. Eng. Pat. 3498, February 26, 1891. *4d.*

GRAIN fodder, such as oats, maize, and barley, is freed from dust and foreign seeds in a cleaning machine, crushed (not

ground) between smooth rolls, and mixed with solutions of sugar, molasses, dextrin, maize-gluten, gelatin, or gum arabic, suitable proportion being usually 100 kilos. of grain fodder to 1—10 kilos. of the binding material. It is then subjected to a pressure of 500—600 atmospheres in a hyuraulic press, whereby it is reduced to about one-third of its original volume, and the cakes thus formed are dried in a chamber through which air circulates. It is claimed that the invention not only secures the preservation of the grain fodder but also facilitates its packing and transport by reducing its bulk.—A. R. L.

Improved Method of and Process for the Preparation of Condensed Milk. C. Lesser, Warsaw, Russia. Eng. Pat. 5196, March 24, 1891. 4*d*.

Milk is freed in a centrifugal machine from impurities and separated into cream and skimmed milk. The caseïne is carefully precipitated from the latter by means of rennet or other suitable precipitant, or by means of a centrifugal machine; it is then condensed at a temperature not exceeding 75° C in a vacuum apparatus, having a sight of yellow or red glass "which admits red or yellow light," as the inventor finds that the more refrangible rays have a deleterious action on the miscibility with water of the "condensed product." Care must be taken that during "condensation" the acidity does not exceed a limit of 5·5 (Soxhlet-Henkel), and to this end a certain quantity of caustic or carbonated alkalis or of alkaline earths are added to the milk. The "condensed product" is now remixed with the cream and with milk sugar. It is urged that by this process the complete miscibility of the finished product with water is ensured.—A. R. L.

Improvements in Centrifugal Apparatus for Testing Relative Volumes of Mixtures of Liquids of Different Specific Gravities. J. Laidlaw, Glasgow. Eng. Pat. 10,492, June 20, 1891. 6*d*.

See under I., *page* 822.

(*B.*)—SANITARY CHEMISTRY.

Action of Water on Lead Pipe. E. Waller. J. Amer. Chem. Soc. 1891, **13**, 176—178.

Two waters from the mountain region of Kentucky were examined, and, since the intention was to use the waters for drinking purposes, their action on lead pipe was tried.

Total solids are thus stated in parts per 100,000.

—	I.	II.
NaCl	0·051	0·092
K_2SO_4	0·284	0·263
Na_2SO_4	0·157	0·093
Na_2CO_3	0·032	0·017
$CaCO_3$	0·556	0·404
$MgCO_3$	0·501	0·346
Fe_2O_3 and Al_2O_3	0·107	0·180
SiO_2	0·912	0·957
Organic matter (by difference)	0·800	0·548
Total	3·400	2·900

Samples of the waters were placed along with pieces of filed and scraped lead pipe in bottles of about 300 cc. capacity. After standing for about 20 hours, both bottles showed a slight white precipitate, which was proved to contain lead. The bright surfaces became dull. No lead was detected in solution. The waters and precipitates were poured off and the pieces of lead rinsed, after which they were treated with fresh portions of the waters; at the end of 24 hours very little separation had taken place in the No. I. water, but a considerable separation in No. II. After a second removal of the sediment and water, another 24 hours with fresh samples of the waters produced scarcely any result in the case of No. I., whilst No. II. showed as much sediment as before; on continued standing a little separation took place in the case of No. I., but the sediment in No. II. bottle continued to increase very considerably. The action corresponds almost exactly to the action of Loch Katrine water on lead in open vessels. Water No. I. in the closed bottle acts in very much the same way as the Loch Katrine water in closed vessels. The analysis of Loch Katrine water shows about the same proportion of solids, though the salts are different in their respective amounts; in Loch Katrine water they are, in parts per 100,000, as follows:—

Organic matter	1·285
$CaSO_4$	0·544
$CaCl_2$	0·206
Alkaline chlorides	0·619
$MgCO_3$	0·309
SiO_2 and phosphates	0·243
Fe_2O_3	Traces
Total	3·206

—T. L. B.

PATENTS.

Manufacture of Illuminating Gas and other Useful Products from Refuse of the Kind known as Town's Refuse. F. Scudder, London. Eng. Pat. 10,313, July 3, 1890. 4*d*.

The refuse, after being screened and hand picked to remove non-combustible material, is charged, together with an admixture of about 10 per cent. of coal or coke to ensure proper combustion, into a gas producer of any suitable construction designed to produce either ordinary producer-gas or water-gas, and it is burnt with air or air and steam. It is also usually advantageous to mix with the refuse a suitable proportion (from 1 to 2½ per cent.) of lime or an alkali to act as a flux and to facilitate the production of ammonia from the nitrogenous matter in the refuse. For the latter purpose a producer constructed to make water-gas is the most suitable kind. In carrying out the process it is advisable to use a combination of two producers, the water-gas formed by the steam descending through the incandescent charge of the first producer being then passed through the second producer, which is preferably charged with coke. In this way any steam and hydrocarbons carried forward by the water-gas from the first producer become decomposed.

The gases after leaving the second producer are then cooled to a temperature of about 300° F. by passing through a cooler or condenser preferably cooled by air, and they are then led through strong sulphuric acid of about 140° Tw., which absorbs the ammonia contained in the gases, whilst the carbonic oxide, hydrogen, and other unabsorbed gases are passed finally into a suitable reservoir or conduit for use for illuminating or heating purposes. The temperature to which the gases are cooled, viz., about 300° F., is such that the sulphuric acid is not volatilised, but is sufficient to prevent the condensation of water in the sulphuric acid. The sulphate of ammonia crystals that are formed are removed from time to time, and a corresponding quantity of fresh sulphuric acid is run into the saturator to maintain the strength of the acid.—H. S. P.

Improvements in Sterilising Water and other Liquids, and Apparatus therefor. H. Rouart, Paris, France. Eng. Pat. 14,051, September 6, 1890. 8*d.*

The process consists in heating the liquid to be sterilised in a strong closed vessel to 120° C., and subsequently cooling it. By this means the dissolved gases in the liquid under treatment are retained, subsequent aeration is rendered unnecessary, and thus the danger of fresh infection is minimised. Several forms of apparatus in which the operation can be most conveniently carried out are described. For drawings and details of these, the original specification must be consulted.—H. T. P.

Improvements in the Treatment of Sewage. A. O. Jones, Harrogate, and S. Fox, New Wortley. Eng. Pat. 14,253, September 10, 1890. 6*d.*

The solid portion of the sewage to be treated is separated from the liquid portion and charged, either alone or in admixture with from one-fourth to four times its own weight of some carbonaceous material, such as coal, coal-dust, or smudge, coke, town's refuse, sawdust, or soot, into an ordinary furnace for the production of water- or producer-gas. The furnace is manipulated in the usual way, air and steam being admitted alternately; only, when the sludge is to be used alone, the furnace is first heated by a preliminary charge of coke or coal. The liquid portion of the sewage is heated in a boiler, the steam and noxious gases given off being employed to feed the gas-producing furnace. The water or producer-gas obtained is purified as usual by means of scrubbers and purifiers.—H. T. P.

Improvements in the Preparation of Agents for Use in the Purification of Sewage and other Polluted Water, by Precipitation; and Improvements in the Treatment of Sewage and other Polluted Water in order to Effect the Purification thereof. J. W. Slater and "The Native Guano Company (Limited)," London. Eng. Pat. 17,153, October 31, 1890. 6*d.*

The following preparations are employed for the purpose of purifying sewage, &c.:—

A.—Clay, loam, or non-calcareous earth, 100 parts by weight; semi-peat, 100 parts; basic iron slag, Redonda phosphate or other phosphate, 10 parts; carbon (if used), 10 parts; and water in sufficient quantity to produce a thin paste.

B.—A saturated solution of crude aluminium chloride, or an equivalent quantity of a solution of aluminium sulphate, 100 parts by weight; solution of copper slag in crude hydrochloric acid, "in such quantity as to introduce into the mixture copper, one part by weight." Instead of the copper slag, any other waste, containing an equivalent amount of copper, may be used. Or, in place of the copper solution, a solution of manganous sulphate or chloride, 80 parts by weight; water, 10 parts, also by weight.

In treating sewage, &c., a quantity of A. is added thereto, and well stirred in; a quantity of B. is then added, by which means the impurities are precipitated. For average sewage, 3 lb. of A. and 1½ lb. of B. per 10,000 gallons, are about the right amounts to use. In other cases the quantities to be employed are easily found by a small trial experiment.

In regard to the above mixtures the following remarks must be made. By "semi-peat" is meant a naturally occurring deposit of vegetable matter in course of conversion into peat, but which still retains, to some extent, its vegetable structure, and contains only traces of arsenic and aspercnic acids. Semi-peat is found overlying the clay along the banks of the Lower Thames and Medway (for instance, at East Greenwich). Carbon is only added to the mixture A. when the liquid to be treated is stronger than average sewage, or contains much tan liquor.—H. T. P.

A Method of and Apparatus for the Treatment and Disposal of Sewage. C. W. Chancellor, Baltimore, U.S.A. Eng. Pat. 4243, March 10, 1891. 8*d.*

This apparatus is more particularly suitable for the treatment and disposal of household sewage. It consists of a cylindrical strainer, a receiving tank, a settling or precipitating tank, and a filter. The vessels are all air-tight, and are connected together in series, the last three being placed on the same level; whilst the strainer is fixed on the top of the receiving vessel. The soil pipe from closets, &c., is connected directly to the strainer. The solid portion of the sewage discharged into the latter finds its way through a trap at the bottom into the receiving vessel, which is filled with water, where it settles. The liquid portion of the sewage passing through the walls of the strainer flows through a pipe into the settling tank. Before entering the settling tank a small quantity of the fluid is made to pass through a box containing some solid disinfectant, such as quicklime, sulphate of iron, or alum. The inlet and outlet tubes of the precipitating vessel are so arranged that the suspended matters have time to settle before the liquid passes on to the filter. The filter simply consists of a cast or wrought iron vessel fitted with a perforated false bottom, between which and a perforated shelf fixed some distance higher up, the filtering medium is disposed. The filtered liquid finally leaves the filter through a pipe near the top. For drawings and details of the apparatus the original specification must be consulted.—H. T. P.

(*C.*)—DISINFECTANTS.

The Employment of Carbon Disulphide against the Ravages of the Phylloxera. A. F. Marion and G. Gastine. Compt. Rend. 1891, **112**, 1113—1117.

The authors have made further experiments on the value of carbon disulphide as an insecticide, especially in the case of the phylloxera of the vine. Different quantities of carbon disulphide, both pure and also mixed with some non-volatile ingredient, have been injected into different descriptions of soil and determinations made of the extent of the diffusion, as measured from the point of injection. Also in another series of experiments the toxical effect of the carbon disulphide vapour on the phylloxera has been experimented on. 100 tubes, each containing fragments of the vine roots, which were attacked by the insect, were placed in series of 25 in different kinds of earth and subjected to the action of carbon disulphide vapour. At the end of a certain period the root fragments were withdrawn and examined. From the relation which the still living phylloxera bore to those which had been killed, the authors found, what they term, the "*insecticide coefficient.*" In the opinion of the authors, mixtures of such substances as gas-tar or rosin oil, and carbon disulphide, made with the object of reducing the rate of volatilisation of the latter in the earth, are a false economy, since a considerable proportion of the carbon disulphide is retained permanently by the tar or oil.

In the employment of vaselin for this purpose, the case is just the same, and it is only during the first short period after the injection that the vapour of the carbon disulphide is present in sufficient amount to act as an insecticide.

The authors consider that the disulphide should be employed by itself, the quantity being varied for different classes of soil, from 220—250 kilos. per hectare for light and readily permeable soils, whilst for heavy clays the quantity must be increased to 300—350 kilos. They also consider it economical to apply the carbon disulphide in two portions, a few days being allowed to elapse between the injections. It is an excellent practice to inject 5 or 6 cc. of the disulphide at a distance of some 10 cm. from the vine stock and at a nearly equal depth.—J. W. L.

The Employment of Carbon Bisulphide for the Destruction of Atmospheric Germs. H. Quantin. Compt. Rend. 1891, **112**, 1283—1284.

Carbon bisulphide when dissolved in a vegetable oil is immediately precipitated as an emulsion by the addition of

water (free from calcium salts) made slightly alkaline by sodium carbonate. A milk is thus obtained, the toxic properties of which are in direct proportion to the quantity of carbon bisulphide present, and which can be brought up to 60—80 grms. per litre. On standing, some of the carbon bisulphide separates from the emulsion, but it is readily taken up again on stirring the mixture. The oil, beyond serving as a solvent for the carbon bisulphide, also is advantageous in restricting its rate of evaporation. This method of obtaining an emulsion can be employed in many ways for antiseptic purposes. The carbon bisulphide can be saturated with sulphur, of which it will take up one-third of its own weight, before making the emulsion; or solutions of sulphur in heavy oils, boiling below 200° C., can be similarly prepared. Further, an emulsion of such a mixture as carbon bisulphide and carbonate of copper can be employed as an antiseptic. The experiments tried with the carbon bisulphide, an emulsion containing 50 grms. to a litre of oil being employed, were in every way satisfactory.
—C. A. K.

The Employment of Carbon Bisulphide dissolved in Water against Phylloxera. A. Rommier. Compt. Rend. 1891, **112**, 1330—1333.

The paper contains a short summary of the experiments made in France since 1875 on the use of aqueous solutions of carbon bisulphide for exterminating phylloxera. The solubility of carbon bisulphide is a little more than 2 grms. per litre at the ordinary temperature according to the author, whilst Chancel and Parmentier found it to vary from 2 grms. per litre at 3·4° C. to 1·05 grms. per litre at 40° C. These aqueous solutions of carbon bisulphide have in all cases been most successful in combating the phylloxera pest.
—C. A. K.

Alkaline Sulphides as Insecticides. Dubois, Compt. Rend. 1891, **112**, 1526.

See under XV., *page* 842.

XIX.—PAPER, PASTEBOARD, Etc.

On Sizing Paper with Ammonium Albumen. Dingl. Polyt. J. **279**, 298—300.

Ammonium albumen (compare Dingl. Polyt. J. **275**, 71, and this Journal, 1890, 320) obtained from milk, is soluble in water, and this liquid may be mixed with rosin-size solutions, starch, colouring matters, &c. in varying proportions. In many respects its properties are similar to rosin-size, the albuminates being precipitated by treating the solutions with aluminium sulphate. The chief advantages of ammonium albumen as a sizing material consist in its being absorbed in large quantities by the fibres and in its imparting to the paper increased strength and durability in addition to gloss and smoothness. It yields better results than animal size, because all albuminates are precipitated by treatment with aluminium sulphate, and what is not absorbed by the fibres coats their surface, whilst animal size is less effective and much more expensive. In many instances it is advisable to mix ammonium albumen with rosin-size (in varying proportions), and so combine the good qualities of both these sizing materials.—H. S.

PATENT.

Improvements in Apparatus for Separating Iron from Paper Stock. H. H. Lake, London. From B. D. Rising, Mittineaque, and C. H. Atkins, Palmer, U.S.A. Eng. Pat. 10,696, June 23, 1891. 6*d*.

In the bottom of the trough through which the pulp has to travel from the vats to the paper-making machine, is mounted an electro-magnet, whose poles project through into the trough and extend from side to side across it. The poles thus form two successive ridges across the bottom, over which the pulp must flow, and attract and retain any magnetisable particles in the latter. Ripples and depressions, with the use of mercury, are dispensed with. The poles may form simple ridges or may be of any desired shape and number, and may be excited by more than one electro-magnet if desired.—E. T.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES AND EXTRACTS.

Quinine and its Manufacture. C. Zebel. Chem. Zeit. 1891, **15**, 735—736.

After an historical sketch of the quinine industry, the author turns to the method of extraction of the bark, for which purpose paraffin oil is now employed. The finely-powdered bark is ground to a thin paste with lime, caustic soda, or sodium carbonate, and extracted with warm paraffin oil. On standing the oil separates, when it is run off and shaken with sulphuric acid; this solution is boiled, and whilst boiling is neutralised with sodium carbonate and allowed to cool. Quinine sulphate crystallises out on cooling, whilst cinchonidine, cinchonine, and quinidine remain in solution as sulphates. The quinine sulphate is purified by recrystallisation after treatment with animal charcoal. The mother-liquor containing the other alkaloids is treated with caustic soda, and extracted with weak alcohol, when of the three bases precipitated by the alkali, quinidine and cinchonidine are dissolved, whilst cinchonine is left behind; the two former can then be separated by means of their neutral tartrates, that of quinidine being considerably the more soluble.

Chemically pure quinine is manufactured by preparing the acid sulphate, which after undergoing sufficient purification is reconverted into the neutral salt. The consumption of quinine amounts to 200,000 kilos. annually. The Ceylon bark contains from 2·4 per cent. of quinine sulphate; Java bark 4—9 per cent. and even up to 13 per cent. The more recent cultivations of cinchona bark in Peru and Bolivia are of special importance; such bark yields about 4—5 per cent. of sulphate of quinine.—C. A. K.

Amarylline and Belamarine; two New Alkaloids. K. Fragner. Ber. 1891. **24**, 1498—1500.

It is well known that the plants belonging to the family Amaryllideæ are poisonous; the tubers both of *Amaryllis formasissima* and of *A. Belladonna* produce vomiting and even death.

The former, which is a native of South America, contains a new alkaloid, *Amarylline*, which can be extracted from the tubers by means of alcohol. After distilling off the solvent the residue is washed with water, the resulting solution precipitated with sodium carbonate, and the precipitate extracted successively with ether and with chloroform.

After evaporation a brown-red residue remains, which is purified by dissolving in acidulated water, neutralisation, extraction with chloroform, and crystallisation from strong

alcohol, from which last the alkaloid separates in small clusters of needle-shaped crystals. It is slightly soluble in water, readily in ether, alcohol and chloroform, and gives characteristic precipitates with most of the general reagents for the alkaloids. Concentrated sulphuric acid gives a dark red-brown colouration, which turns gradually brown; this brown solution becomes green on the addition of three drops of water. When heated, the amarylline begins to discolour at 190° C. and melts at 196° C.

The tubers of *Amaryllis belladonna*, which is a native of the islands in the Caribbean Sea, contain the alkaloid *Belamarine*, which can be extracted by means of hot alcohol. The residue, after evaporating off the alcohol, is taken up with water, and the aqueous solution precipitated by sodium carbonate, when a voluminous yellow-brown precipitate is obtained, which is purified by repeated crystallisation. The alkaloid forms long, colourless needles, readily soluble in chloroform, ether, and alcohol, and which melt at 181° C. The salts give characteristic precipitates with the usual reagents for the alkaloids, and also with other reagents. The author intends to continue the study, both chemical and physiological, of the two new alkaloids.—C. A. K.

Synthesis of Oxygenated Pyridine and Piperidine Bases. A. Ladenburg. Ber. 1891, **24**, 1619—1628.

The author has already shown that the aldehydes react with picoline to form alkines with the separation of water (Ber. 1889, **22**, 2583).

α-Picoline, when heated to 120° for 10 hours with paraform aldehyde in molecular proportions, water being added to the mixture, yields α-picolylalkine—

$$C_5H_4.(CH_2.CH_2.OH)N$$

a liquid boiling at 114°—116° C. under a pressure of 9 mm. That it is an alkine is shown by its forming a benzoic ester, $C_5H_4(CH_2.CH_2.O.C_7H_5O)N$, a weak base, platinic and auric double chlorides of which were prepared and analysed. The free base could not be obtained in a crystalline state. On oxidation α picolylalkine forms picolinic acid; a pyridyl acetic acid could not be obtained. Pipecolylalkine results when the picolyl compound is treated with sodium and absolute alcohol. It is a liquid boiling at 234·5° C. (corr.). The hydrochloride is hygroscopic, whilst the benzoyl compound forms a hydrochloride which crystallises in colourless plates. In this latter it is not the hydrogen of the imido-group that has been substituted, since it forms a nitrosamine. The substitution of the hydrogen of the imido-group by methyl is attended with considerable difficulties, and it cannot be effected by any of the ordinary methods. It can, however, be carried out successfully by heating the α-pipecolylalkine in aqueous solution with a large excess of the potassium salt of methyl sulphuric ester on the water-bath for 12—24 hours. The product thus obtained possesses a constant boiling point, but nevertheless still contains some unchanged α pipecolylalkine, from which the methyl compound is separated by converting the latter into the mercuric chloride double salt, which is with difficulty soluble and readily purified by recrystallisation from hot water. This salt melts without decomposition at 214° C., and has the composition $C_8H_{17}NO.HCl.5\,HgCl_2$. From it the free base is readily obtained as a colourless syrupy liquid, possessing a slight smell and boiling at 223·5° C. (corr.). It is readily soluble in water and alcohol, less readily in ether, and only solubilies slowly in the cold. The gold double chloride of the base is fairly soluble and forms small crystals resembling those of sal-ammoniac, and melts at 169—170°. Further, this *n*-methyl-α-pipecolylalkine—

$$C_5H_9.(CH_2.CH_2.OH)N.CH$$

reacts with methyl iodide to form an ammonium iodide from which the corresponding chloride and its gold and platinic double chlorides were prepared. Since the base resembles tropine closely both constitutionally and in its properties, differing, however, in having two additional hydrogen atoms in the ring, the name *Hydrotropine* is proposed for it. When warmed with tropic acid and hydrochloric acid an alkeine results which, like atropine, has a mydriatic action on the eye. Since the above relationship of hydrotropine to tropine exists, the author attempted to prepare the latter from the former by oxidation. The resulting body, called *Paratropine*, has the formula $C_8H_{13}NO$, but is not identical with the base obtained from atropine, in fact does not resemble it very closely in physical properties. An alkaline solution of potassium ferricyanide was employed as the oxidising agent, the resulting base being isolated by means of its gold double chloride. The free base is a colourless liquid boiling at 200°—203° C. (almost 30° C. lower than the boiling point of tropine), and which shows no tendency to crystallise at a low temperature. It has strongly alkaline properties, and forms characteristic double chlorides with platinic, aurie, and mercuric chlorides, which melt at 195°—197° C., 181°—182° C., and 225° C. respectively. Analyses of all these salts are given. A small quantity of a difficultly soluble base was obtained by heating paratropine with tropic acid and hydrochloric acid, and which has a similar mydriatic action to atropine.

These experiments are being continued with the view of preparing tropine and atropine synthetically.—C. A. K.

Tropine. A. Ladenburg. Ber. 1891, **24**, 1628—1633.

The synthetical experiments conducted by the author with the view of preparing tropine and atropine (see previous abstract) have led to the desirability of studying the properties of tropine and of its salts more minutely. Full crystallographic measurements of the gold and platinic double chlorides of tropine are given. The mercuric double chloride melts at 246° C., and blackens before melting; it has the composition $C_8H_{15}NO.HCl.6\,HgCl_2$. A short discussion of the proposed constitutional formulæ for tropine follows, in which the author shows that the di-basicity of tropinic acid does not overthrow the formula suggested by him, as stated by Liebermann (Ber. 1891, **24**, 515).

—C. A. K.

A New Alkaloid from Conium Maculatum, its Constitution and Attempts to Synthesise it. A. Ladenburg and G. Adam. Ber. 1891, **24**, 1671—1676.

The authors have investigated the nature of the new alkaloid isolated by Merck from *Conium maculatum* (this Journal, 1891, 481).

It is a strong base having an alkaline reaction and forming readily soluble salts with acids. It melts at 100°—102° C., but sublimes before melting in fine needles; the base boils at 229°—231° C., and solidifies to a crystalline mass at once on distillation. Analysis points to the formula $C_8H_{17}NO$, whence the alkaloid is isomeric with conhydrine, with which it shows a marked analogy; for this reason the name of *Pseudo-conhydrine* is proposed for the new base. It dissolves readily in water, alcohol, ether, and benzene, and is optically active, having a rotatory power $\alpha_D = 4{\cdot}30°$. It is a secondary base and forms an oily nitrosamine. The hydrochloride forms colourless hygroscopic crystals, having the composition $C_8H_{17}NO.HCl$; the hydrobromide is stable in the air. Pseudo-conhydrine heated with amorphous phosphorus and hydriodic acid in a closed tube to 150° C., forms an iodide $C_8H_{16}NI.HI$ which when treated with hydrochloric or sulphuric acid yields a base, which was obtained however in too small a quantity to be identified. Nevertheless this reaction is considered by the authors to point to the fact that pseudo-conhydrine, like conhydrine and tropine, contains a hydroxy-group and belongs to the class called "alkines." Ladenburg has shown that the analogy of pipecolylmethylalkine to conhydrine points to one of the two following formulæ for the latter:—

$$C_5H_9\{CH(OH)CH_2.CH_3\}NH$$

or

$$C_5H_9.(CH_2.CH_2.CH_2.OH)NH$$

Since pseudo-conhydrine is isomeric with conhydrine it is not unnatural to suppose that it possesses one of the above

two formulæ. To put this supposition to the test the authors prepared the second of the above bodies synthetically, viz.: —α-lupetidylalkine starting from α-latidylalkine

$$C_5H_6(CH_2.CH_2.CH_2.OH)NH$$

which was obtained by the action of formaldehyde on α-ethylpyridine. This body is a liquid boiling at 128°—130° C. and forms characteristic platinic and auric double chlorides. When reduced by sodium in absolute alcohol solution it is converted into the α-lupetidylalkine—

$$C_5H_9(CH_2.CH_2.CH_2.OH)NH$$

which although resembling pseudo-conhydrine in smell, boiling point, and solubility, differs from it markedly in its much lower melting point, considerably below 0° C., and in its not forming crystalline salts. It boils at 232°—234° C. The action of phosphorus and hydriodic acid is also different, and no crystalline iodide results, but a body which when distilled with alkali yields a base having the formula $C_8H_{15}N$—an allylpyridine or coniceine. It is evident that lupetidylalkine is identical with neither conhydrine nor with pseudo-conhydrine; the constitutional formulæ of the two latter therefore still remained undetermined, and the two formulæ suggested above are insufficient unless one of the three isomers contains an isopropyl group.—C. A. K.

The Formation of Inactive Tartaric Acid by the Oxidation of Phenol with Potassium Permanganate. O. Doebner. Ber. 1891, **24**, 1753—1757.

A solution of phenol, neutralised by caustic soda when oxidised in the cold by potassium permanganate yields oxalic acid, inactive tartaric acid, a large quantity of carbon dioxide, and a yellow-brown amorphous body, the composition of which could not be ascertained. From 90 grms. of phenol, 9 grms. of the calcium salt of inactive tartaric acid, 24 grms. of calcium oxalate, and 5 grms. of the amorphous substance result.

The formation of the two acids may be expressed according to the following equation:—

$$CH\begin{cases}CH{=}CH\\CH{-}COH\end{cases}CH + H_2O + O_8 = \begin{matrix}CH.OH{-}CH.OH\\ \diagup\quad\diagdown\\ CO.OH\quad CO.OH\end{matrix} + CO.OH.CO.OH$$

a decomposition which, in the opinion of the author, is entirely in accordance with Kekulé's benzene formula, but opposed to the prism and to the diagonal formulæ.

The bearing of this on the double linkages in the benzene ring is discussed. Further experiments on similar lines are in progress.—C. A. K.

The Constitution of 5-membered Ring Systems. E. Bamberger. Ber. 1891, **24**, 1758—1764.

See under IV., *page* 828.

The Action of Acid Alkaline Sulphites on Cinnamic Aldehyde. F. Hensler. Ber. 1891, **24**, 1805—1807.

When cinnamic aldehyde is shaken with acid sodium or potassium sulphite, the addition product separates out, which when boiled with water is decomposed according to the following equation:—

$$2\,C_6H_5.CH{:}CH.CH\begin{cases}OH\\SO_2.ONa\end{cases} = C_6H_5.CH{:}CH.COH +$$

$$C_6H_5.C_2H_3(SO_2.ONa)CH\begin{cases}OH\\SO_2.ONa\end{cases}$$

The acid sulphite of sulpho-cinnamic aldehyde thus formed is more readily obtained by treating 1 molecule of the aldehyde with 2 molecules of a hot concentrated solution of the acid sulphite; on evaporation a crystalline residue results, which is purified by recrystallisation from water. These salts regenerate the aldehyde on dry distillation or when boiled with caustic soda; boiled with dilute sulphuric acid, sulphur dioxide is evolved, whilst the sulphonic acid of cinnamic aldehyde remains in solution. This latter body, which has the formula $C_6H_5.C_2H_3(SO_2.OH)COH$, is isolated by converting it into the hydrazone which crystallises from alcohol in yellow plates, melting with decomposition at 165°—166°. The hydrazone when treated with caustic soda is converted into the hydrazone of cinnamic aldehyde.

From these reactions the close analogy in the behaviour of cinnamic aldehyde and of acrolein with acid sulphites is apparent.—C. A. K.

Morrenine and Morrenol. P. Arata and C. Gelzer. Ber. 1891, **24**, 1849—1853.

Morrenia brachystephana is one of the American *Asclepiæ* which grows throughout the Argentine Republic, where it is known under the name of "*Tasis.*" It is largely grown by the Indians and Gauchos for the sake of the silk hairs which the fruit contains and which is used as vegetable silk. The rich sap of the rhizoma and of the fruit is made use of in medicine, especially as an aid for the flow of milk in the case of women lacking a milk supply. The daily dose is 30 grms. The infusion is yellow and thick and has a sweetish taste with a bitter after-taste. It is not unpleasant to take, but at first produces slight vomiting and a little headache; afterwards increased perspiration is noted, but otherwise the system is unaffected.

The authors have investigated the chemical nature of the root and fruit of this plant. The root is of a dark yellow colour and has a specific gravity of 0·631, contains 9·06 per cent. of water, and 9·30 per cent. of ash. Ether extracts an aromatic smelling mixture of chlorophyll, resin, fatty acids, and wax-like bodies, but the extract contains no alkaloid. The residue after extraction with ether, when extracted with alcohol yields a yellow solution which contains an alkaloid, which latter is best isolated by macerating the finely divided root for 3—4 days with 2 per cent. hydrochloric acid and treating the resulting solution after concentration with a slight excess of calcined magnesia and evaporating the whole to dryness. The residue thus obtained is exhausted with alcohol, the solvent evaporated off and the residue again taken up with either chloroform or amyl alcohol. A dark red gelatinous mass having a sharp smell and a very bitter taste remains after distilling off the solvent. It is soluble in water, melts at 106° C., and gives all the general reactions for the alkaloids. The name "*Morrenine*" is proposed for the new alkaloid. No analytical data were obtained, owing to lack of material.

The sap of the fruit of *Morrenia brachystephana* consists of a yellow-white milk, having an aromatic smell and which coagulates on standing. The liquid separated from the coagulated mass contains the alkaloid morrenine, whilst the residue dissolves in warm alcohol to a pale yellow-coloured solution from which a white crystalline substance separates on standing. This product is insoluble in water, soluble in cold sulphuric acid with a red colour and melts at 168°. Analyses point to the formula $C_{14}H_{22}O$ or to $C_{15}H_{24}O$. The name "*Morrenol*" is proposed for this substance, which is being further investigated.—C. A. K.

Preparation of Catechol. H. Gutknecht. Chem. Zeit. 1891, **15**, 959.

Catechol has for a long time been neglected by manufacturers of dyestuffs on account of supposed difficulties in its preparation. A useful product may however readily be obtained from catechu if the use of unnecessary heat and reagents is avoided. Commercial catechu is cut into large pieces with wet knives or axes, softened in cold water, well kneaded, filtered cold through woollen cloths and the residue washed with cold water. The catechu-tannin passes into solution, the residue containing the catechol is dissolved a little at a time in hot water, filtered through

woollen cloths, and the solution cooled as speedily as possible. The catechol is thus precipitated in yellowish white needles. The filtration of the hot solution presents some difficulties on account of the slimy consistency of the residue. The catechol may be purified by recrystallisation or decolourised by adding lead acetate drop by drop to the warm solution. If the catechu is directly treated with hot water and filtered, the cold mass loses its sliminess and can more easily be worked; the yield of catechol is however about 20 per cent. less. The catechu-tannin should be useful in cotton dyeing as it yields clearer shades than ordinary catechu. Catechol is useless as a dye for cotton, but when treated with weak acids, preferably boric acid, or with small amounts of acid salts at 100°, it is converted into an unerystallisable product which yields a clear green colour with cotton tissues.—S. B. A. A.

Bismuth Salicylate. H. Causse. Compt. Rend. 1891, **112**, 1220—1223.

In order to prepare bismuth salicylate by the double decomposition of a bismuth salt and an alkaline salicylate, it is necessary to dissolve the former in acid, with the result that a mixture of the salicylate with salicylic acid is obtained. In order to avoid this, the author prepares the salt in the presence of ammonium chloride, which has the power of keeping the bismuth salt in solution without any fear of dissociation and precipitation of a basic salt taking place. 100 grms. of sub-nitrate of bismuth are dissolved in hydrochloric acid (concentrated) and the solution treated in the cold with 1 litre of a saturated solution of ammonium chloride; to this is then added a mixture of 120 grms. of sodium salicylate and 500 grms. of a saturated solution of ammonium chloride. On standing, the bismuth salicylate separates out in the form of a voluminous crystalline powder, closely resembling dehydrated quinine sulphate in appearance. It is filtered off, washed, and dried at the ordinary temperature. Analysis points to the formula $Bi(C_7H_5O_3)_3 + 4\,H_2O$; it is insoluble in and unacted upon by cold water, whilst boiling water, acids, and alkalis decompose it with the separation of salicylic acid or of a salicylate. It is also readily decomposed by absolute alcohol, and on heating when the decomposition begins at 50° C.—C. A. K.

Quinethyline, a Homologue of Quinine. E. Grimaux and A. Arnaud. Compt. Rend. 1891, **112**, 1364—1367.

The authors have shown in a previous communication (this Journal, 1891, 723 and 790) that quinine is the methyl ether of cupreine, and the name of "*quinines*" is proposed for all derivatives of cupreine having the general formula $C_{19}H_{21}N_2O.OR$ where R is a substituting group. Thus ordinary quinine is the first member of this series, and the body described in the present memoir the second member, viz., the ethyl ether of cupreine or quinethyline. The salts of cupreine previously prepared were found to contain small quantities of quinine salts, and in order to obtain the former in a pure state the acid sulphate is first converted into the neutral sulphate in aqueous solution, the latter separated by crystallisation, redissolved in boiling water, and the solution treated with an excess of caustic soda. The cupreine is first precipitated, and then redissolved by the alkali, whilst the quinine remains suspended in the solution and may be extracted either by means of ether or of chloroform. The residual alkaline solution is then treated with sufficient dilute sulphuric acid to redissolve the precipitated base, and the alkaloid finally obtained in the free state by pouring the acid solution into ammonium hydrate. The precipitate is collected, washed and dried at 100° C. To prepare the quinethyline, the cupreine is treated with ethyl chloride or bromide at 120°—130° C., or preferably with ethyl nitrate. One molecule of cupreine dissolved in alcohol, 1½ mols. of sodium, and 1½ mols. of ethyl nitrate are heated in a sealed tube to 95°—100° C. for 12—15 hours. The alcohol is then distilled off, the residue taken up with acidulated water, and an excess of sodium hydrate added, which redissolves any cupreine that has been unacted upon. The new base is then extracted from the alkaline liquid with ether, the ether distilled off and the basic sulphate and then the neutral sulphate of quinethyline prepared, which latter is purified by repeated recrystallisation from hot water.

Quinethyline, $C_{19}H_{21}N_2O.OC_2H_5$, is prepared by treating the neutral sulphate with a slight excess of ammonia in the cold. It is precipitated as a white amorphous powder closely resembling quinine. This precipitate is hydrated, and melts at 60° C., but by careful drying first in the air and finally at 125° C., it is obtained in a pulverulent form, when it melts at 160° C. It is very soluble in ether, alcohol, &c.; the sulphuric acid solution of the base is strongly fluorescent. Quinethyline could not be obtained in a crystalline condition, but it forms a crystalline hydrate; like both quinine and cupreine it is lævo-rotatory, $[\alpha]_D = -169{\cdot}4°$. The acid sulphate of the base, $(C_{21}H_{26}N_2O_2)_2.H_2SO_4H_2O$, is only slightly soluble in cold water, whilst the neutral sulphate is considerably more soluble, and forms large prisms, which effloresce in the air and have the composition $C_{21}H_{26}N_2O_2.H_2SO_4.8\,H_2O$.—C. A. K.

The Volatility of Creosote: Pharmaceutical Preparations. A. Reismann. Pharm. C. H. N. F. 1891. **12**, 203.

Officinal creosote, a mixture of guaiacol and creosol, only commences to boil at 205°—220°, but is volatile even at ordinary temperatures; thus, a sample which was exposed on a watch-glass to the air inside the case of a chemical balance for less than four weeks, lost 65·6 per cent. of its weight. Creosote pills coated with cocoa, under similar conditions, lost 22·1 per cent. of the creosote they contained; sugar-coated pills kept better, losing, during the same time, only 5·6 per cent. The author considers enclosure in gelatin capsules the best method of making up pharmaceutical preparations of creosote.—E. B.

Terpenes and Camphor. O. Wallach. Ber. **24**, 1525—1579.

In the following paper the author gives a summary of the more recent literature on the subject of the terpenes; many of the original papers to which he refers have been previously abstracted. (Compare this Journal, 1888, 517, 586, 587; 1889, 635; 1890, 963, 964, 1147.)

The terpene-like hydrocarbons may be classed into three groups, according to their molecular formulæ:—(1.) Hemiterpenes or pentenes, C_5H_8. (2.) True terpenes, $C_{10}H_{16}$. (3.) Polyterpenes $(C_5H_8)_n$.

The true terpenes undergo decomposition at a moderately high temperature, being partially converted into unsaturated hydrocarbons of the valerylene series, the best known member of which is isoprene; isoprene, and the ordinary terpenes undergo polymerisation at a high temperature and are transformed into polyterpenes of the molecular formula $C_{15}H_{24}$, $C_{20}H_{32}$, &c.; of these polyterpenes, to which class belong, amongst others, caoutchouc and colophony, the sesquiterpenes, $C_{15}H_{24}$, are most commonly found in ethereal oils.

At the present time there are nine terpenes which have been characterised with certainty as distinct substances, namely, pinene, camphene, fenchene, limonene, dipentene, sylvestrene, phellandrene, terpinene and terpinolene.

Pinene is the fundamental constituent of the ordinary varieties of oil of turpentine; it is the principal constituent of the ethereal oils of most pines, and also occurs in larger or smaller quantities in numerous ethereal oils from other sources.

Camphene is important on account of its close relationship with camphor (see below), but whether it occurs in nature has not yet been determined.

Fenchene has only recently been discovered; it is very closely related to camphene, as will be shown later on.

Limonene is one of the most commonly occurring terpenes; it is present in the ethereal oil of the aurantiaceæ, in the largest quantity in oil of Orange-peel, and also in oil of Lemon and oil of Bergamot; it is also found in con-

siderable quantities in Cumin oil, Dill oil, and oil of Fleabane, and is a never-failing constitutent of oil of Pine-needles (this Journal, 1888, 587).

Dipentene occurs in oil of elemi (this Journal, 1889, 635), oil of Camphor, and in Russian and Swedish oil of turpentine; it is formed in particularly large quantities, together with isoprene, by the dry distillation of caoutchouc, and can also be obtained from certain terpene derivatives containing oxygen, for example, from cineol, terpin hydrate, and terpineol.

Sylvestrene has only hitherto been found, together with pinene, in Swedish and Russian oil of turpentine; the American oil of turpentine contains pinene but not sylvestrene, although it is obtained from the same species of pine.

Phellandrene, until lately, had been found only in the oils of Bitter-fennel and Water-fennel, but it seems to be somewhat widely diffused, and is now known to occur in oil of elemi, eucalyptus oil, &c. (this Journal, 1888, 587.)

Terpinene occurs in nature in oil of cardamom, and can be obtained artificially from other terpenes.

Terpinolene has been obtained artificially by various reactions, but has not yet been much investigated.

The terpenes exist in physically different modifications: Pinene, from American oil of turpentine, for example, is dextro-rotatory, whilst that obtained from the French oil (formerly called terebenthene) is levo-rotatory. Limonene, from the oil of the *Aurantiaceæ* and from oil of Cumin, is dextro-rotatory, that from Pine-needle oil is levo-rotatory. Phellandrene, from oil of Fennel and from oil of Elemi, is dextro-rotatory, but that obtained from eucalyptus oil is levo-rotatory.

Most active terpenes can be converted into inactive modifications by heat and by various chemical agents, such as mineral acids; the inactive products are also formed by mixing equal quantities of the two active modifications of opposite rotatory power. The active terpenes give, as a rule, active derivatives; occasionally, however, the derivative has a rotatory power of opposite sign to that of the compound from which it has been obtained.

In some cases the inactive form of the terpene, or its derivative, is identical with the corresponding active modification in all respects except as regards optical properties; this is so with pinene, camphene, and phellandrene. Inactive limonene is, however, totally different from the active terpene in its whole behaviour; the derivatives of the two modifications have also so little resemblance that inactive limonene was formerly thought to be a distinct hydrocarbon, and named dipentene; it will be found convenient to retain this name for inactive limonene.

Although most active terpenes can be readily rendered inactive, some, such as dextro-rotatory sylvestrene (and the levo-rotatory sesquiterpene) cannot be converted into inactive modifications; others, such as fenchene, terpinene, and terpinolene are at present only known in the inactive forms.

As regards other physical properties it may be stated that pinene, camphene (melting point 50°) and fenchene boil at about 160° and have a specific gravity of about 0·86; limonene, dipentene, and sylvestrene boil at about 175 and have a specific gravity of 0·846 at 20° (see table, p. 852).

That the terpenes are unsaturated compounds is clearly shown by various reactions. They combine directly with the halogen acids yielding hydrochlorides and hydrobromides, but they do not all behave in the same way, as is shown by the following examples:—When perfectly dry hydrogen chloride is passed into dry pinene, a saturated crystalline compound $C_{10}H_{16}.HCl$ ("artificial camphor") is formed; camphene also combines with one molecule of hydrogen chloride under similar conditions, and the product is a saturated compound. Limonene shows a totally different behaviour; when it is treated with hydrogen chloride in absence of water it combines with one molecule of the acid yielding an unsaturated, optically active liquid having the composition $C_{10}H_{16}.HCl$; this compound combines with a second molecule of hydrogen chloride in presence of moisture, being converted into an inactive compound (dipentene dihydrochloride) of the composition $C_{10}H_{16}.2HCl$. Dipentene and sylvestrene resemble limonene in their behaviour with hydrogen chloride. The melting points of the mono- and dihydrochlorides of the terpenes are given in the table (see page 852). From both these classes of compounds the terpenes can be regenerated by heating with aniline or sodium acetate.

The terpenes also behave differently towards bromine:—Some, as for example pinene and fenchene, combine with only one molecule of bromine-yielding saturated compounds, whilst others, such as limonene, dipentene, sylvestrene and terpinolene combine directly with two molecules of the halogen. Most of these compounds are crystalline (see table, p. 852) and like the hydrochlorides and hydrobromides are of great service in identifying the terpenes.

Some of the best defined terpene derivatives are those obtained by treating the terpenes with oxides of nitrogen or with nitrosyl chloride. Phellandrene, for example, can be readily detected by pouring a mixture of the sample and light petroleum on an aqueous solution of sodium nitrite, and then gradually adding acetic acid, with frequent shaking; if phellandrene is present a voluminous, unstable, crystalline compound of the composition, $C_{10}H_{16}.N_2O_3$, is quickly deposited. Terpinene also combines with nitrous acid, but much more slowly, yielding a very stable nitrosite, $C_{10}H_{16}.N_2O_3$, which crystallises in prisms and melts at 155°.

The other terpenes do not yield crystalline derivatives with oxides of nitrogen, but combine with nitrosyl chloride forming nitrosochlorides of the general formula—

$$C_{10}H_{16}\begin{cases}NO\\Cl\end{cases}$$ (see table, p. 852.)

These compounds can be easily prepared by treating a solution of the terpene in glacial acetic acid, or alcohol, with amyl or ethyl nitrite, and then adding hydrochloric acid to the well-cooled mixture (this Journal, 1888, 517). If in the above reaction nitric acid is used in the place of hydrochloric acid, nitrosates of the general formula—

$$C_{10}H_{16}\begin{cases}NO\\ONO_2\end{cases}$$

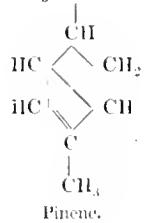
are produced (this Journal, 1888, 517); the nitrosates are sometimes very serviceable for the isolation of particular compounds, but they are frequently more soluble than the nitrosochlorides or else do not crystallise.

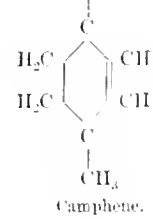
The unsaturated terpene hydrochlorides, such as limonene and dipentene hydrochloride, also yield crystalline, very sparingly soluble nitrosochlorides and nitrosates.

The nitrolamines (this Journal, 1888, 517) have also proved of great value for the identification of the terpenes. These compounds are easily obtained by treating the nitrosochlorides, nitrosates, nitrosites, or hydrochloronitrosates of the terpenes with organic bases such as piperidine, benzylamine, &c.; they crystallise very readily, are very stable, and have well-defined melting points (*see* table, p. 852).

When the nitrosochlorides are treated with reagents which eliminate hydrogen chloride, they are converted into nitroso-compounds of the general formula $C_{10}H_{15}NO$; in the case of pinene, limonene, and dipentene, these nitroso-derivatives crystallise well.

The author then proceeds to explain, with the aid of the following diagram and table (p. 852), some of the most important reactions of pinene. He considers that the behaviour of this terpene is best explained by assigning to it the constitution represented by the formula given below, and by assuming that in some reactions the para-binding is broken, and a second ethylenic binding formed between two other carbon atoms by intramolecular change.


Pinene.

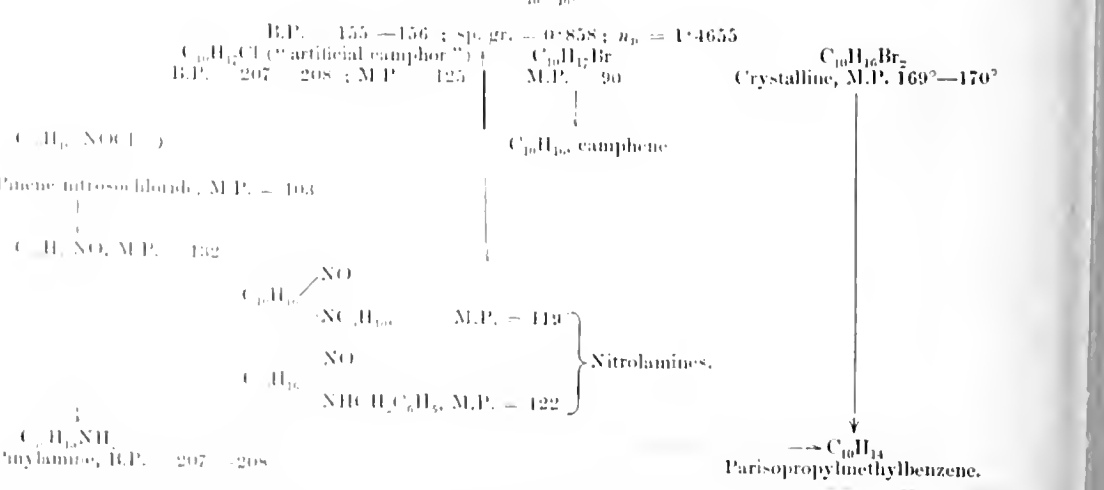

Camphene.

As examples of some of the reactions of pinene, it may be mentioned that it is converted into dipentene by heating it at a high temperature; when treated with moist hydrogen chloride it is converted into dipentene dihydrochloride, $C_{10}H_{16}.2\,HCl$, but with dilute nitric acid it gives terpin $C_{10}H_{16}.2\,H_2O$. Dipentene and its derivatives are not the only products of the action of moist acids on pinene; the formation of terpinene, terpinolene, terpineol, and cineol has also been observed, but these compounds are doubtless formed from terpin by secondary reactions. Pinene nitrosochloride is readily converted into crystalline nitrolamines by compounds such as piperidine and benzylamine, which have the nature of fatty bases; when, on the other hand, it is treated with true amido-compounds it is reconverted into pinene. By means of the last reaction it is possible to prepare chemically pure, inactive pinene (this Journal, 1890, 964). When pinene nitrosochloride is treated with alcoholic potash it loses one molecule of hydrogen chloride, and is converted into nitrosopinene, which, on reduction with zinc-dust and acetic acid, is transformed into pinylamine. Pinylamine hydrochloride, when heated above its melting point, gives parisopropylmethylbenzene (cymene).

The two terpenes, camphene and fenchene, are probably very similarly constituted. The former can be obtained artificially from camphor, and has probably the constitution given above; the latter is formed in exactly the same manner from fenchon, a substance isomeric with camphor, and which has recently been isolated from Fennel oil (this Journal, 1890, 1147). The close relationship between camphor and fenchon is clearly shown by the remarkable similarity in the chemical behaviour of the two compounds. As will be seen from an examination of the following table, (p. 853), the two substances form strictly analogous derivatives.

The constitution of limonene and dipentene is then discussed, and it is shown that the two compounds are structurally identical, dipentene being produced when equal quantities of dextro- and levo-rotatory limonene are mixed. Although this is the case, the physical properties of the derivatives of the two substances differ very considerably.

Pinene.	Camphene.	Fenchene.	Limonene.	Dipentene.	Sylvestrene.	Phellandrene.	Terpinene.	Terpinolene
155°—156°	160°—161° Solid: M.P. 50°	158°—160°		175°—176°	175°	About 170°	About 180°	About 18
d 0·858	d 0·850 at 50°	d 0·863		d 0·846	d 0·848	..	.. ..	..
$C_{10}H_{16}<^{H}_{Cl}$ Saturated. M.P. 125°	$C_{10}H_{16}<^{H}_{Cl}$ Solid	$C_{10}H_{16}<^{H}_{Cl}$ ..	$C_{10}H_{16}<^{H}_{Cl}$ Liquid	$C_{10}H_{16}<^{H}_{Cl}$ Solid Unsaturated.	$C_{10}H_{16}<^{H}_{Cl}$	..	.. ..	..
.. ..	.. ..	..	.. ..	$C_{10}H_{16}<^{HCl}_{HCl}$ 50°	$C_{10}H_{16}<^{HCl}_{HCl}$ 72°	..	.. ..	..
$C_{10}H_{16}Br_4$ 170°	.. ..	$C_{10}H_{16}Br_2$ Liquid	$C_{10}H_{16}Br_4$ 104°	$C_{10}H_{16}Br_4$ 124°	$C_{10}H_{16}Br_4$ 135°	..	.. ..	$C_{10}H_{16}Br_4$ 116°
$C_{10}H_{16}.NOCl$	.. ..	..	$C_{10}H_{16}.NOCl$	$C_{10}H_{16}.NOCl$	$C_{10}H_{16}.NOCl$	$C_{10}H_{16}.N_2O_3$ 102°	$C_{10}H_{16}NO.NO_2$ 155°	..
$C_{10}H_{15}<^{NO}_{NHC_7H_7}$ 122°	.. ..	..	$C_{10}H_{15}<^{NO}_{NHC_7H_7}$ 93°–94°	$C_{10}H_{15}<^{NO}_{NHC_7H_7}$ 109°–110° (a)	$C_{10}H_{15}<^{NO}_{NHC_7H_7}$ 71°	..	$C_{10}H_{15}<^{NO}_{NHC_7H_7}$ 137°	..
$C_{10}H_{16}NO$ 152	.. ..	..	$C_{10}H_{15}NO$ 72°	$C_{10}H_{15}NO$ 93°	.. ..	..	.. ..	..



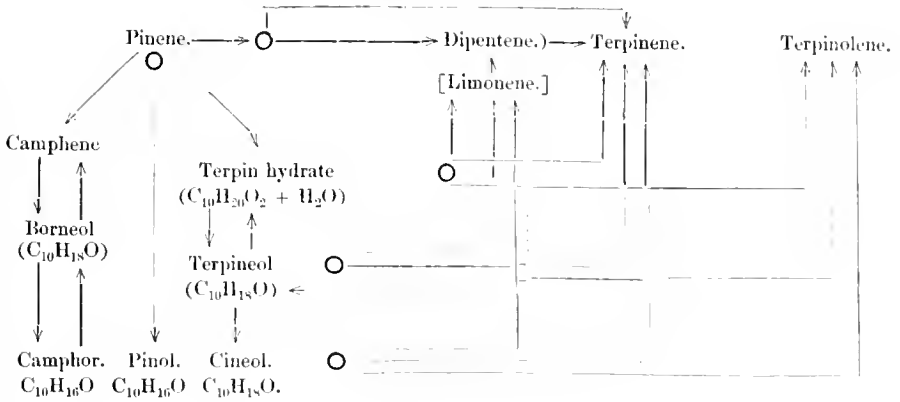
Transformations of Pinene.

(a.) *On heating*: Dipentene, Polyterpenes, Isoprene (C_5H_8).

(b.) *With acids*: Terpineol ($C_{10}H_{18}O$), Terpin hydrate ($C_{10}H_{20}O_2 + H_2O$), Cineol ($C_{10}H_{18}O$). Dipentene, terpinene, camphene.

(c.) *On oxidation*: Pinol ($C_{10}H_{16}O$), Pinol hydrate ($C_{10}H_{18}O_2$). Terebic acid ($C_7H_{10}O_4$), Terpenylic acid ($C_8H_{12}O_4$).

Transformations in the Terpene Series.



—	Fenchon Series.	Camphor Series.
$C_{10}H_{16}O$.....	Fenchon { Specific gravity = 0·9465 at 15° ; Melting point.. = 6° ; Boiling point... = 192° }	Camphor { Melting point = 175° ; Boiling point = 204 }
$C_{10}H_{16}H.OH$...	Alcohol { Specific gravity = 0·933 at 50° ; Melting point.. = 40° ; Boiling point... = 201° }	Borneol { Melting point = 206° ; Boiling point = 212 }
$C_{10}H_{16}H.Cl$.....	Fenchyl chloride....Liquid, boiling point = 84° (11 mm.)	Bornyl chloride..... Solid
$C_{10}H_{16}$	Fenchene { Liquid, Specific gravity = 0·864 at 20° ; Boiling point... = 158°—160° }	Camphene { Solid, Melting point = 50° ; Sp. gr. = 0·85 at 50° ; Boiling point = 160° }
$C_{10}H_{16}.H.NH_2$	Fenchylamine..... Liquid, Boiling point.... = 195°	Bornylamine ..... { Melting point = 159° ; Boiling point = 199°—200° }
$C_{10}H_{17}NH.COH$	Formylfenchylamine .. Melting point ..... = 87°	Formylbornylamine.... Melting point = 60°—61°
$C_{10}H_{17}NH.CO.CH_3$ ..	Acetylfenchylamine... Melting point ..... = 92°	Acetylbornylamine .... Melting point = 141°
$C_{10}H_{17}NH.CO.C_6H_5$.	Benzoylfenchylamine.. Melting point ..... = 89·5°	Benzoylbornylamine... Melting point = 131
$C_{10}H_{16}:NOH$	Oxime { Melting point above 150 ; Boiling point about 240 }	Oxime... Melting point = 118
$C_9H_{15}.CN$	Boiling point = 217°—218°	216 —217°
$C_9H_{15}.CH_2.NH_2$	Boiling point about 240 (?)	194 —196°
$C_9H_{15}.CO.NH_2$	Melting point = 113°—114	124 —125
$C_9H_{15}.COOH$	Boiling point = 257 —260	251°—255°
C_9H_{16}	....	130°—140°

The two series of compounds also differ in solubility and in the facility with which they crystallise. Dipentene dihydrochloride, $C_{10}H_{18}Cl_2$, and the dihydrobromide, $C_{10}H_{18}Br_2$, can be converted into crystalline halogen substitution products; the hydrochloride yields the compounds $C_{10}H_{17}Cl_3$ (melting point 85°—86°) and $C_{10}H_{16}Cl_2$ (melting point 105°), and the hydrobromide gives a tribromide $C_{10}H_{17}Br_3$ (melting point 110°). When this tribromide is boiled with alcoholic potash it is converted into an unsaturated hydrocarbon (boiling point 182°) which is isomeric with cymene, and which forms a crystalline tetrabromide, $C_{10}H_{14}Br_4$, melting at 154°. A satisfactory constitutional formula for limonene cannot yet be put forward.

A substance closely related to dipentene is *Cineol* (eucalptol, cajeputol), $C_{10}H_{18}O$ (this Journal, 1888, 586), a compound which forms the principal constituent of the oils of Cina, Eucalyptus globul, and Cajeput, and which also occurs in the oils of Rosemary, Laurel, Sage, Spike, Myrtle, Camphor, Lavender, and Australian eucalyptus. Cineol has the same boiling point as limonene, dipentene, and sylvestrene, but a much higher specific gravity and refractive power; when limonene or pinene contains a small quantity of cineol its properties are altered to such an extent that it may be easily mistaken for a distinct compound. It is, however, very easy to identify cineol owing to the readiness with which it combines with bromine and with hydrogen bromide. Cineol can be readily converted into dipentene by the action of dehydrating agents, and it is transformed quantitatively into dipentene derivatives in various reactions.

As regards the constitution of sylvestrene, terpinolene, terpinene, and phellandrene, nothing definite is known.

—F. S. K.

PATENTS.

Manufacture of Iso Eugenol and of certain of its Derivatives and their Application to the Manufacture of Vanillin. G. de Laire, Paris, France. Eng. Pat. 17,547, November 1, 1890. *6d.*

ISO-EUGENOL, which has the formula—

$$C_6H_3 \begin{cases} CH=CH.CH_3 \\ OCH_3 \\ OH \end{cases}$$

is prepared from eugenol, or the Essence of Cloves, by heating it with caustic potash in amyl alcohol solution for 16—24 hours. After distilling off the amyl alcohol with steam, the residual liquid is treated with dilute sulphuric or hydrochloric acid, when the iso-eugenol separates and is decanted, washed, and purified by distillation; it boils at 258—262° C. By replacing the hydrogen of the hydroxyl group in iso-eugenol by an acid radicle, acetyl, propionyl, butyryl, valeryl, and benzoyl derivatives may be obtained, all of which yield vanillin on oxidation. In the preparation of these compounds, both mono-molecular and polymerised bodies may result; the latter only give small yields of vanillin when oxidised, and therefore the conditions favourable to the preparation of the former must be maintained. These conditions consist in heating the iso-eugenol with anhydrous acids, or in treating slightly alkaline solutions of the alkali salts of iso-eugenol with the acid chlorides.

Details for the preparation of the acetyl and benzoyl compounds are given; they are crystalline bodies, the former melting at 79°—80° C., the latter at 103°—104° C.

—C. A. K.

Improvements in the Manufacture of Methyl and Ethyl Phenacetine. B. Willcox, London. From the "Fabriken vormals F. Bayer and Co," Elberfeld, Germany. Eng. Pat. 18,022, November 8, 1890. *6d.*

THIS is an improvement on the patent previously taken out for the preparation of methyl and ethyl phenacetine (Eng. Pat. 5723 of 1890; this Journal, 1891, 384).

To prepare the ethyl compound, phenacetine is first converted into the acetyl compound by treating it at the ordinary temperature with acetic anhydride in molecular proportions, the temperature being gradually raised to 100° C. during the addition. The whole is allowed to cool, alcohol added, and then distilled, when any excess of acetic anhydride is removed as acetic ether. The residue is distilled in vacuum, when it comes over as a clear liquid, which solidifies on standing, and consists of pure ethyl phenacetine. The methyl compound is prepared similarly. The acetic anhydride may be replaced by acetyl chloride, or less advantageously by acetic acid.—C. A. K.

Process for the Production of Anthranilic Acid. O. Imray, London. From "Amsterdamsche Chininefabrik," Amsterdam, Holland. Eng. Pat. 18,246, November 12, 1890. *6d.*

See under IV., *page* 831.

A New Process for Producing Oxygen Gas. F. Fanta, London. Eng. Pat. 3031, February 19, 1891. (Under Internat. Conv. October 22, 1890.) *6d.*

THE process is based on that of Tessié du Motay, in which manganates of soda are treated in a current of steam, when oxygen is evolved and the manganates reduced to sesquioxides of manganese, which are re-oxidised by heating in a current of air. Two special precautions are taken in order to obviate the melting and caking together of the material in the retort. In the first place, the manganate of sodium or potassium is prepared in a porous condition; full details for producing it in this form are given. And secondly, the air and steam employed in the operation are heated in the same furnace as the retorts or tubes in which the material is placed previously to their entering the tubes, by which means any deposition of moisture which would render the material soft and liable to cake is obviated. The apparatus consists of a furnace in which a heating appliance for the air, a superheater for the steam and two independent series of tubes or retorts for the manganate, are fixed. In one of these series the manganate is treated with the superheated steam, and in the other the reduced manganate is re-oxidised by the hot air, this order of things being reversed at the end of each operation. Without any change of temperature, therefore, a continuous supply of oxygen is drawn off, which, after passing through a cooling apparatus and a washer, is collected in a gas-holder. The process may be repeated indefinitely. The superheating of the steam has the additional advantage of facilitating the reduction of the manganate, owing to the decomposition of the steam into hydrogen and oxygen that takes place. No details of plant are given.—C. A. K.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

Action of Sulphuric Acid on Quinol (Hydroquinone) and Effect of the Resulting Quinol Monosulphonic Acid on Gelatino-Bromide Plates. J. H. Stebbins, jun. J. Amer. Chem. Soc. 1891, **13**, 155—159.

WHEN quinol (hydroquinone) is heated at 100° with twice its weight of sulphuric acid of 66°, it is converted into a mass of yellowish acicular crystals of quinol monosulphonic acid, $C_6H_3(OH)_2SO_3H$, which can be freed from excess of acid by draining, and crystallised directly from alcohol. It can also be obtained in the usual way by decomposition of the barium salt. From alcohol it crystallises in brownish transparent rhombic prisms of the composition—

$$2\,C_6H_3(OH)_2SO_3H + C_2H_6O$$

They lose the greater part of their alcohol over sulphuric acid at the ordinary temperature and the remainder at 120°. The barium salt crystallises with 1 mol. H_2O in concretionary stellate groups of acicular crystals. The potassium salt is obtained from the barium salt by double decomposition; it crystallises in small yellowish-white needles when the concentrated solution is mixed with three or four times its volume of alcohol and allowed to evaporate in a vacuum.

A solution of the barium salt made slightly alkaline with sodium carbonate, slowly develops a reddish-brown image on an exposed gelatino-bromide plate.—C. H. B.

XXII.—EXPLOSIVES, MATCHES, Etc.

Action of Nitric Acid upon Plant Fibres. C. F. Cross and E. J. Bevan. Ber. 1891, **24**, 1772—1776.

See under V., *page* 831.

PATENTS.

Improvements in Presses for Producing Gunpowder Cake. J. S. Taylor and S. W. Cullen, Birmingham. Eng. Pat. 16,002, October 9, 1890. *8d.*

THIS specification describes a "special arrangement of former, or head cake compressor" which is fitted to the ordinary hydraulic press and permits the more ready manipulation and filling of the platten or ram cake mould.

—W. M.

Improvements in the Manufacture of Explosives. H. H. Lake, London. From S. T. G. Thorn, G. R. O. Westendarp, and G. L. C. Pieper, Hamburg, Germany. Eng. Pat. 16,189, October 11, 1890. 6*d*.

About 48 parts of trinitrocresol are mixed with 20 parts of barium or strontium carbonate or hydrate, 33 parts of barium nitrate and all worked up together with a solution of solt resin, wax, &c., in alcohol into a dough-like mass, which is then dried and granulated.—W. M.

Improvements in the Manufacture of Lucifer and other Matches made of Wood, Cotton, or other Combustible or suitable Material. J. B. Searlett, Newhaven. Eng. Pat. 9196, June 1, 1891. 4*d*.

This invention consists in tipping both ends of each match with an igniting compound.—W. M.

Improvements in the Manufacture of Gunpowder. C. H. Curtis, London, and G. G. André, Dorking. Eng. Pat. 11,383, July 4, 1891. 4*d*.

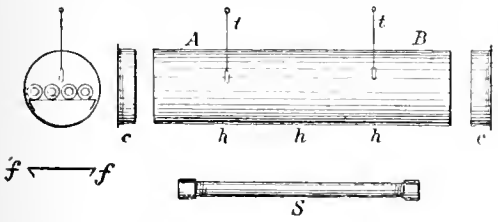
The inventors produce a smokeless powder by incorporating a mixture of soluble and insoluble nitrocellulose with nitroglycerin, preferably in the cold, the most suitable proportions being 40—47 parts of insoluble nitrocellulose, 20—23 parts of soluble nitrocellulose, and 30—40 parts of nitroglycerin, together with about 50—60 parts of acetone or acetic ether as a solvent.—W. M.

XXIII.—ANALYTICAL CHEMISTRY.

APPARATUS.

An Apparatus for Heating Sealed Tubes. D. Woodman. J. Amer. Chem. Soc. 1891, **13**, 182—184.

The apparatus, which is cheap, light, and convenient of use, and which is represented in the accompanying figure, is thus described:—



An Apparatus for Heating Sealed Tubes.

A length of 5-inch stove-pipe, A B, is provided with sheet iron caps, C C, so made as to be easily removable. Into A B is fixed, by means of four rivets, a piece of sheet-iron of the same length as the oven, and bent down at the edges (*f f* represents a section of this); two holes are bored at suitable places in the top of the oven for thermometers, *t t*, and three half-inch holes, *h h h*, for direct admission of heat, Bunsen burners being placed directly underneath them. The thermometers should not, however, be placed directly over the burners as wrongly indicated in the figure. A piece of heavy asbestos paper is fastened round the oven by means of copper wire, and discs of asbestos are fitted into the caps C C. The tubes are heated on the shelf in wrought-iron tubes S, of 1-inch internal diameter; these tubes are fitted with screw caps, which must screw on with the fingers, and which should not be steam-tight. Any convenient support may be used for the oven. The breaking of a tube is evidenced by the gases escaping with a hissing noise from the leaky cap.

—T. L. B.

Conversion of Cartier and Baumé Degrees. J. A. Mandel and A. Bourgougnon. J. Amer. Chem. Soc. **13**, 169—170.

Taking the specific gravity of the salt solution used for graduating Baumé's instrument as 1·073 (*Chevallier. Art de l'Ingénieur, &c., Paris*, 1819), and adopting the same notation as in a former paper (Proc. Amer. Chem. Soc. **1**, 53)—

$$\frac{V}{v} = \frac{1{\cdot}073}{1} \text{ and } \frac{v + 10}{v} = 1{\cdot}073$$

whence $v = 136{\cdot}9$.

Gay Lussac observed that 30° Cartier corresponds to 32° B., and 28° Cartier corresponds to sp. gr. 0·8791.

$$1^\circ \text{ Cartier} = \frac{32}{30} = 1{\cdot}066 \text{ B.}$$

$$28^\circ \text{ Cartier} \times 1{\cdot}066 = 29{\cdot}848 \text{ B.}$$

$$\frac{144{\cdot}329}{134{\cdot}329 + 29{\cdot}848} = 0{\cdot}8791$$

and, further, absolute alcohol at 15° has a sp. gr. = 0·795 and gives 44° Cartier.

$$44 \times 1{\cdot}066 = 46{\cdot}904 \text{ B.}$$

The tables give 47° B. = 0·795 sp. gr.—C. H. B.

INORGANIC CHEMISTRY.—QUALITATIVE.

On the Influence of Ammonium Hydrate on Arsenic Pentasulphide. Le Roy W. McCay. Chem. Zeit. 1891, **15**, 476.

Ammonium hydrate completely dissolves freshly-prepared arsenic pentasulphide precipitated from sulpharsenates of alkalis by hydrochloric acid, and well washed with water and absolute alcohol. The same is the case with arsenic pentasulphide freshly prepared by treating an acidified solution of arsenates of alkalis under pressure with sulphuretted hydrogen, and afterwards washing well with water and absolute alcohol. The solution appears first yellow and then almost colourless. No sulphur is precipitated, and the solution does not contain any arsenates. This solution contains sulphoxyarsenic acid after it has been treated in the following way:—First, highly diluted and cooled with ice, then acidified by a mineral acid, shaken and filtered, and the filtrate finally subjected to a current of air driven through it until the sulphuretted hydrogen is entirely expelled.

The author thinks it possible that the reaction is indicated by one of the following formulæ:—

I.

$$As_2S_5 + 6\,(NH_4OH) = (NH_4)_3AsS_4 + (NH_4)_3AsO_3S + 3\,H_2O$$

or

II.

$$2\,As_2S_5 + 6\,(NH_4OH) = 3\,(NH_4AsS_3) + (NH_4)_3AsO_3S + 3\,H_2O$$

—H. S.

INORGANIC CHEMISTRY—QUANTITATIVE.

The Estimation of Small Quantities of Alkali; and the Recognition of the Neutrality of Water. F. Mylius and F. Foerster. Ber. 1891, **24**, 1482—1498.

In the course of a research on the solvent action of water on glass, the authors endeavoured to directly estimate the dissolved alkali by means of a very weak solution of acid. An indicator suitable for the purpose was found in the shape of iodo-eosin or Erythrosin ($C_{20}H_6I_4O_5$), which, when used in the manner to be described is of extraordinary sensitiveness. Commercial Erythrosin requires to be purified for analytical purposes, and this may be done in the following way. A solution in aqueous ether is shaken out with a weak solution of caustic soda. A stronger solution of caustic soda is then added, by which means the brick-red sodium salt of Erythrosin is precipitated. The precipitate is washed with spirit and recrystallised from hot alcohol. From an aqueous solution of the purified salt, the Erythrosin is precipitated by the addition of hydrochloric acid, and thoroughly washed with water. For the estimation of traces of alkali, a milli-normal solution of acid is required. It must be prepared with absolutely pure water, and may be preserved unchanged for some time in a bottle of good glass. Titration is conducted as follows:—50—100 cc. of the water to be tested are placed in a stoppered bottle, and 10—20 cc. of an ethereal solution of erythrosin, containing not more than 2 mgrms. of the indicator per litre are added, and the whole is well shaken. If alkali be present the aqueous layer will assume a pink tint. Milli-normal acid is then added, the mixture being well agitated after each addition, until the pink colour disappears. Finally, milli-normal soda is run in until the colour just reappears. The amount required to do this (about 0·2 cc.) is subtracted from the volume of acid used. The method is capable of the most varied application. For instance, the carbonates in water may be estimated by its means (CO_2 does not sensibly affect the indicator). The decomposition of ammonium sulphate in boiling aqueous solution may be distinctly traced; and the presence of a minute excess of base or acid in salts of the alkalis, and of zinc, magnesium, cadmium, manganese, nickel and cobalt may be readily detected. The salts of iron (ferric) chromium and aluminium have an acid reaction. Silver and lead yield coloured salts with erythrosin, but as they are insoluble the process cannot be here applied. For the estimation of organic acids the method is altogether unsuitable.

For determining very small quantities of alkali (below 0·1 mgrm. Na_2O per 100 cc.) the process is preferably used colorimetrically. When a very dilute alkaline solution is shaken with an excess of ethereal erythrosin solution, the water is coloured more or less pink, according to the amount of alkali present. The intensity of the colouration is not proportionate to the amount of alkali, because, firstly, the water takes up a little free erythrosin from the ether; and, secondly, the alkaline erythrosate formed, is decomposed in very dilute solution into alkali and erythrosin.

The reagents required are:—

1. *Pure Neutral Ether.* Ordinary ether is shaken with soda solution, then washed once with water, and preserved in contact with water.

2. *An Ethereal Solution of Erythrosin.*—0·1 grm. is dissolved in one litre of aqueous ether (neutral).

3. *A Solution of Sodium Erythrosate.*—0·01 grm. of erythrosin is dissolved by the aid of 0·4 cc. of deci-normal soda and diluted to one litre with pure water.

4. *Neutral Water.* This the authors prepared by redistilling distilled water, acidified with sulphuric acid, in an apparatus completely made of platinum. The authors define such water as neutral, 100 cc. of which take up from an ethereal solution of erythrosin a quantity of that substance equal in colour to 5·65 cc. of the standard solution of sodium erythrosate, diluted to 100 cc. In practice, ordinary distilled water may be neutralised with sulphuric acid, until its "erythrosin equivalent" is 5·6—5·7 cc. The following is the method of working:—100 cc. of the liquid to be examined are placed in a cylindrical separator, 20 cc. of the ethereal erythrosin solution are added, and the whole is well shaken. The red aqueous layer, which will measure 110 cc., owing to absorption of ether, is transferred to a second separator and shaken with 10 cc. of aqueous ether to remove the excess of free erythrosin. Finally, the colour of the liquid is determined by comparison with water containing a known volume of the standard sodium erythrosate solution, 5—20 cc. of the latter diluted to 100 cc. being a suitable quantity. Experiments were made to determine the exact relation existing between the amount of alkali present and the colour intensity produced. The results are given in the table below:—

Quantity of Soda (Na_2O) per 100 cc. in $\frac{1}{1000}$ Mgrms.	Volume of Sodium Erythrosate required to match the Colour observed.	Corresponding Amount of Soda in $\frac{1}{1000}$ Mgrms.
	Cc.	
0	5·6	.. ..
10	14·5	6·6
15	20·5	11·0
20	25	14·3
25	31	18·8
40	45	29·1
60	66	44·7
80	86	59·5
100	104	72·8

The numbers in the last column are calculated on the assumption that the colourations observed are due to neutral sodium erythrosate, and that therefore 1 cc. of standard solution corresponds to 0·00074 mgrm. Na_2O. Allowance is of course made for the "erythrosin equivalent." It will be seen that the quantities of soda found average 72·1 per cent. of the amounts actually present. Taking this number, it appears that 1 cc. of erythrosate solution corresponds in reality to—

Mgrm.	
0·00102	Na_2O
0·00151	K_2O
0·00056	NH_3
0·00092	CaO

Employing these values the following results were obtained:—

K_2O

Taken.	Found.
15·16	14·2
30·32	32·1
60·64	58·9
90·96	88·3
151·6	160·1

NH_3

10·98	11·4
21·92	20·4
54·84	55·4

The above numbers represent $\frac{1}{1000}$ mgrms. per 100 cc. Carbonic acid somewhat affects the accuracy of the method, but unless present in large excess, the error introduced is not serious.—H. T. P.

Separation and Estimation of Antimony. J. Thiele. Annalen, 1891, **263**, 361—376.

The method devised by Tookey (Chem. Soc. J. **15**, 462) for the separation of antimony and tin, has been more exactly studied, and to some extent modified by Attfield and Clasen, without these chemists observing that oxidation of the metallic antimony precipitate takes place during the washing of the same, and that in consequence some of the antimony finds its way into the filtrate. The author has, therefore, considered it desirable to again test the accuracy of the method. Pure antimony trioxide, dried by heating in a current of carbon dioxide, was dissolved in hydrochloric acid and precipitated by electrolytic iron, as recommended by Clasen (J. prakt. Chem. **92**, 477). Previously to washing the precipitate on the filter, antimony could not be detected in the filtrate, but on commencing the washing (with pure boiled water) antimony made its appearance therein. Moreover, when the precipitate was washed for a long time with very dilute hydrochloric acid, its weight continuously increased. It thus appears that part of the antimony oxide formed remains on the filter, and that part passes into the filtrate. The following amounts of antimony precipitate were obtained from the weights of antimony oxide stated:—

No. of Experiment.	Wt. of Sb_2O_3 taken.	= Sb.	Sb. found.	Error.	
	Grms.	Grms.	Grms.	Grms.	Per Cent.
1	0·3742	0·3118	0·3112	0·0006	0·19
2	0·3267	0·2722	0·2720	0·0002	0·07
3	0·3106	0·2588	0·2591	0·0003	0·12

The percentages of oxygen contained in these precipitates were determined by carefully heating the same in weighed pieces of combustion tubing in a very slow current of hydrogen, the tubes being first heated beyond the precipitate in order to intercept any oxide which volatilised, mirrors of antimony being deposited on the red-hot glass. The following percentages were thus found: in precipitate (1) 2·31; in (2) 2·02; in (3) 2·28.

The antimony in the filtrates was estimated as pentasulphide by Bunsen's method, the following being the results:—

No. of Experiment.	Sb_2S_5 Found	= Sb.	
	Grms.	Grms.	Per Cent.
1	0·0077	0·0046	1·48
2	0·0081	0·0049	1·79
3	0·0089	0·0053	2·05

making the total percentages of antimony found—

—	1.	2.	3.
In the precipitate	97·40	97·96	97·84
In the filtrate.....	1·48	1·79	2·05
Total.....	98·88	99·75	99·89

The cause of the lowness of the above results was traced to the presence of antimony trisulphide in the precipitate obtained by Bunsen's method, the precipitate containing, on an average, 63 per cent. of metal, instead of 60 per cent., as it should do, did it consist entirely of pentasulphide.

In effecting the separation of antimony and tin, the author found unexpected difficulties: electrolytic iron precipitates tin as well as antimony; after heating in hydrogen, electrolytic iron dissolves very slowly in hydrochloric acid, leaving a residue of carbon (the iron was precipitated from a solution containing acetic acid), and still precipitates a trace of tin. This trace was detected by dissolving the precipitate in hydrochloric acid by the aid of potassium chlorate, expelling the excess of chlorine by boiling, precipitating the antimony with iron, and testing the filtrate with mercuric chloride. Pure iron wire possesses the advantages over heated electrolytic iron of dissolving readily and completely, but like the latter precipitates a little tin.

The only method which enabled the author to obtain a filtrate free from antimony, consisted in precipitating the antimony with a large excess of heated electrolytic iron, at once transferring the precipitate to a filter and washing in an atmosphere of hydrogen. This method, however, possesses the disadvantage of entailing a separation of the antimony from the undissolved iron, which is effected by dissolving the antimony in a concentrated solution of sulphur in potassium hydrate, filtering, treating the solution with chlorine, and estimating the antimony by Bunsen's method. It is necessary to use a concentrated solution of potassium sulphide, as otherwise finely-divided ferrous sulphide passes through the asbestos filter and vitiates the results.—E. B.

The Estimation of Silica in Presence of Iron. Leclerc. Compt. Rend. 1891, **112**, 1132—1133.

Owing to the difficulty, in the presence of much ferric chloride, of evaporating the residue of a solution to dryness for the purpose of rendering the silica insoluble, the author takes advantage of the fact that the double chloride of iron and potassium dries readily. The method which he recommends is as follows:—For the determination of the silica in cast iron, 1 grm. of the metal is dissolved by the aid of 20 cc. of nitric acid and 10 cc. of hydrochloric acid; the greater part of the acid is boiled off, two quantities of 30 cc. of hydrochloric acid are added to expel the nitric acid, and finally 3 grms. of ammonium chloride are added and the residue heated gently to expel the last traces of nitric acid. The residue is dissolved in hydrochloric acid, and then 3 grms. of potassium chloride are added and the evaporation carried to dryness. These salts are soluble in cold water, but a little hydrochloric acid is added in order to bring other bases which may be present into solution. The silica remains insoluble with the carbon. They are filtered off, and after ignition the silica may be weighed. The presence of ammonium chloride prevents the silica from carrying down manganese. When chromium is present this is best reduced by means of a little zinc. The results obtained are satisfactory.—J. W. L.

ORGANIC CHEMISTRY.—QUALITATIVE.

The Use of Ammonium Selenite as a Test for the Alkaloids. A. J. Ferreira da Silva. Compt. Rend. 1891, **112**, 1266—1268.

Lafon has employed ammonium selenite as a test for morphine and for codeine; the reagent consists of a solution of 1 grm. of the salt in 20 cc. of concentrated sulphuric acid, and gives a green colouration with the above two alkaloids. The author has examined the action of this reagent with other alkaloids with the following results:—Aconitine, no immediate colouration, slight rose colour after 20 minutes. Berberine, yellow to brown and finely wine-red colouration. Brucine, rose to pale orange, and then amber colouration. Caffeine and cocaine, slight rose colouration on standing. Curarine, slight violet to red colouration. Delphine, slight violet colouration, turning red on standing. Digitaline, no immediate colouration, then yellowish and reddish precipitate on standing. Eserine, yellow to orange colouration. Morphine, greenish-blue colouration, which turns chestnut brown on standing; no precipitation. Narcotine, blue colouration, turning first violet and then reddish; slight precipitate of a reddish colour after three hours standing. Narceïne, yellowish-green colouration turning to brown and then to red; red precipitate on standing. Papaverine, blue colouration passing to bottle-green, violet, and finally red; on standing a slight bluish precipitate is deposited. Solanine, yellow colouration passing to brown,

red, and finally violet. Saponine, yellow colouration turning red; a very delicate test. Senegine, pale yellow colouration, which becomes reddish on standing. Veratrine, yellowish colouration, which after standing three hours deposits a red precipitate, whilst the solution remains yellow. Cinchonine, cinchonidine, atropine, and pilocarpine do not give any reaction with ammonium selenite. The author is of opinion that these reactions are not entirely due to the reducing powers of the alkaloids, causing a separation of metallic selenium which dissolves in the sulphuric acid of the reagent, but that some special action takes place in the case of each of the alkaloids.—C. A. K.

ORGANIC CHEMISTRY—QUANTITATIVE.

The Estimation of Sugars with Copper Potassium Carbonate Solution. No. III. H. Ost. Ber. 1891, **24**, 1634—1636. (Compare this Journal, 1890, 1160.)

This communication deals with the estimation of maltose; the preparations employed were crystallised 3—5 times from dilute alcohol. After remaining for a week over concentrated sulphuric acid the compound is constant in weight, but does not lose its water of crystallisation, the latter being only slowly removed at 100—110°, and not without decomposition. Maltose exhibits a similar behaviour towards copper potassium carbonate solution as towards Fehling's solution, less copper being reduced than by the monosaccharides (monoses). The amount of reduction is less influenced by the presence of an excess of dissolved copper.

In carrying out the experiments 50 cc. of the copper solution were diluted to 75 cc. and gently boiled for 10 minutes with various weights of maltose hydrate, and the remainder of the operation conducted as previously described (Zeits. f. anal. Chem. 1890, 637; this Journal, *loc. cit.*). 50 cc. of the copper solution are exactly precipitated by 195 mgrms. of maltose hydrate. Single determinations are in better agreement than those formerly cited in the case of milk sugar, but are not so close as those obtained with dextrose and galactose (this Journal, *loc. cit.*). For example, 100 mgrms. of maltose hydrate gave on boiling as above described for 10 minutes, 165, 167, 169, 169, 167·7, 168, 169, and 165·4 mgrms. of copper; mean = 167·5 mgrms. of copper; on boiling for 15 minutes, 169·3 mgrms. of copper; and on boiling for 20 minutes, 173·2 mgrms. of copper. The conditions of the experiments were such that they can easily be attained by other chemists. The following table is constructed from the mean results obtained when the boiling was maintained for 10 minutes:—

Copper.	Maltose Hydrate, $C_{12}H_{22}O_{11}+H_2O$.	Anhydrous Maltose.
Mgrms.	Mgrms.	Mgrms.
100	50·6	29·1
[illegible]	[illegible]	31·9
120	56	34·7
125	59·4	37·5
130	61·4	38·3
135	65·4	43·1
140	68·5	45·9
145	71·2	48·6
150	74	51·4
155	77·0	54·2
160	79·9	57·0
165	82·9	59·8
170	85·8	62·6
175	88·8	65·4
180	91·7	68·2
185	94·6	71·0
190	97·6	73·8

Copper.	Maltose Hydrate, $C_{12}H_{22}O_{11}+H_2O$.	Anhydrous Maltose.
Mgrms.	Mgrms.	Mgrms.
135	89·6	76·6
140	83·6	79·4
145	86·5	82·2
150	89·5	85·0
155	92·5	87·9
160	95·5	90·7
165	98·5	93·6
170	101·5	95·5
175	101·6	93·4
180	107·7	102·3
185	110·8	105·3
190	114·0	108·3
195	117·1	111·3
200	120·3	114·3
205	123·5	117·3
210	126·7	120·3
215	129·9	123·3
220	133·1	126·4
225	136·4	129·6
230	139·8	132·8
235	143·2	136·0
240	146·7	139·3
245	150·2	142·6
250	153·7	146·0
255	157·3	149·4
260	161·0	152·9
265	164·8	156·6
270	168·7	160·3
275	172·7	164·1
280	176·7	167·9
285	180·7	171·7
290	184·9	175·7
295	189·3	180·0
298·6	195·0	185·2

—A. R. L.

The Rotatory Power of Levulose and Invert Sugar. H. Ost. Ber. 1891, **24**, 1636—1645.

The author undertook the experiments described below in view of the contradictory results of other chemists as to the rotatory power of levulose. The levulose employed was prepared from inulin, and after being crystallised three or four times from absolute alcohol, resembled to outward appearance that of Honig and Schubert (this Journal 1888, 445). It formed compact mammillated aggregates of prisms, and when dried over concentrated sulphuric acid was generally anhydrous; whilst Jungfleisch and Grimbert's preparation (this Journal, 1888, 761) contained 2·5 per cent. of water. The author's preparation was not hygroscopic, and when heated in a stream of hydrogen at 100° in a Liebig's drying tube it melted and slowly lost weight (0·75 per cent. in 10 hours), without becoming constant. He cannot confirm Jungfleisch and Grimbert's observation that a solution of levulose is decomposed when heated at 50°, or that the rotatory power is affected even when heated at 100°. To determine the specific rotatory power of levulose all the

weighings were reduced to a vacuum. The results obtained for solutions containing 3—30 per cent. by weight of levulose are represented by the formula—

$$[\alpha]_{D\,20} = -(91{\cdot}90 + 0{\cdot}111\,p)$$

where p is the weight in grms. of levulose in 100 grms. of the solution. Like those of dextrose, more dilute solutions of levulose have a much lower specific rotatory power. The values are plotted side by side with those of Hönig and Jesser (Zeits. f. Rübenzuck. Ind. 1888, 1027), and also with those of Jungfleisch and Grimbert. It is found that they are higher than the former for solutions containing less than 25 per cent. and lower for concentrations above this; whilst they are about 3 per cent. higher throughout than the latter; this may perhaps be due to the presence of an optically inactive impurity in the levulose employed by Jungfleisch and Grimbert. The specific rotatory power of a mixture of levulose and dextrose (equal parts) was next determined for different concentrations. The dextrose was carefully dried at 100°, crystallised from absolute methyl alcohol and dried over concentrated sulphuric acid. The results agree well with the calculated values, taking the author's numbers for levulose and those of Tollens (Ber. **17**, 2234; this Journal 1885, 132); the agreement is however still better if 0·1—0·2 be deducted from Tollens' numbers, and the fact that Tollens dehydrated his dextrose by heating it at 60—70°, whereby it may have undergone slight change, appears to justify this deduction. The author has obtained the following results with his dextrose dried over concentrated sulphuric acid (see above); for $p = 10$, $[\alpha]_{D20}^{\circ} = 51{\cdot}54$ (52·74 Tollens); for $p = 2$, $[\alpha]_{D20}^{\circ} = 52{\cdot}15$. The mean of three determinations of the rotatory power of invert sugar produced by the Clerget-Herzfeld inversion method gave $[\alpha]_{D20}^{\circ} = -20{\cdot}71$ ($p = 13{\cdot}035$), whereas the rotatory of pure invert sugar for the same concentration is $[\alpha]_{D20}^{\circ} = -20{\cdot}28$. 13 per cent. solutions of pure invert sugar and of levulose were treated at different temperatures and for various lengths of time with aqueous solutions of oxalic and acetic acids; the results are in agreement with those of Gubbe (Ber. **18**, 2214; this Journal, 1885, 747) and show that a 0·1 per cent. solution of oxalic acid at 50°—53° has no influence on the specific rotatory power of invert sugar even after several hours; the specific rotatory power of levulose is however lowered from —

$$[\alpha]_{D20}^{\circ} = -93{\cdot}34 \text{ to } [\alpha]_{D20}^{\circ} = -92{\cdot}02 \text{ and } -92{\cdot}19$$

on heating with a 0·25 per cent. solution of oxalic acid and a 0·25 per cent. solution of hydrochloric acid respectively for 15 minutes at 100°. Contrary to the statement of Jungfleisch and Grimbert, however, a 5 per cent. solution of acetic acid lowers the rotatory power of invert sugar, even at the ordinary temperature from—

$$[\alpha]_{D20}^{\circ} = -20{\cdot}3 \text{ to } [\alpha]_{D20}^{\circ} = -19{\cdot}77.$$

The inversion of cane sugar is best effected by heating it with a 2 per cent. solution of oxalic acid for 1·5 hours or with a 1 per cent. solution for 4 hours at 60°; this method gives a specific rotatory power $[\alpha]_{D20}^{\circ} = -20{\cdot}16$ ($p = 13$). A solution of invert sugar prepared according to Soxhlet's method by heating cane sugar with 0·1 per cent. hydrochloric acid is not quite identical with that obtained by the Clerget-Herzfeld method. The former has a specific rotatory power $[\alpha]_{D20}^{\circ} = -19{\cdot}25$—$19{\cdot}50$, whereas $\frac{-90{\cdot}5 + 52{\cdot}1}{2} = 19{\cdot}2$, and as furthermore it has the same reducing power as a solution of a mixture of pure dextrose and levulose (equal parts), it is to be recommended for standardising the copper solution.

Note on Ost's Communication on "The Rotatory Power of Levulose and Invert Sugar." B. Tollens. Ber. 1891, **24**, 2000.

The author draws attention to his work in conjunction with Parcus (Annalen, **257**, 165; this Journal, 1890, 748) in which similar views to those of Ost (preceding abstract) are expressed, viz. that the specific rotatory power of levulose is higher than it has hitherto been considered to be. In one experiment, for example, the value of $[\alpha]_{D20}^{\circ} = -93{\cdot}03$ was obtained for a 10 per cent. solution which agrees closely with that of Ost. Referring to the observations of the latter on the specific rotatory power of dextrose, Tollens does not consider it finally established that the differences between his results and Ost's are due to his own preparation having undergone slight decomposition on drying at 50°—60°, an alternative view being that Ost's preparation contained 0·2 per cent. of water.—A. R. L.

Action of Nitric Acid upon Plant Fibres. C. F. Cross and E. J. Bevan. Ber. 1891, **24**, 1772—1776.

See under V., *page* 831.

On the Cryoscopic Behaviour of Aqueous Solutions of Cane Sugar. J. F. Eykman. Ber. 1891, **24**, 1783—1785.

The author has repeated Traube's experiments (this Journal, 1891, 660); his results, which are shown in the following table, contrary to those of Traube, are perfectly normal:—

Percentages of Cane Sugar.	Mgrm. Mols. per Kilo.	Depression Observed.	Molecular Depression.
0·4473	13·08	0·026	19·9
0·8218	24·03	0·047	19·5
1·115	32·6	0·066	20·2
1·613	47·16	0·102	21·6
3·073	89·9	0·193	21·5
5·64	164·9	0·367	22·3
11·72	347·2	0·797	23·3

—A. R. L.

The Influence of Inactive Bodies on the Rotatory Power of Dilute Solutions of Dextrose. N. Wender. Ber. 1891, **24**, 2200—2203.

It is known that the inactive constituents of diabetic urine affect the rotatory power of fairly strong solutions of dextrose. Urea, and to some extent, ammonium salts, exert a depressing influence; and it is therefore quite possible that the dextro reading of any small amount of dextrose existing in normal urine might be completely masked and thus overlooked. To settle the point, solutions of dextrose were prepared, with and without the addition of urea, and the rotatory powers were carefully taken. The following results were obtained:—

Dextrose taken.	Urea Taken.	Solvent.	Length of Tube.	Temperature.	Rotatory Power Observed.	Difference.
Grms.	Grms.		Decim.	°C.	°	
0·3976	.. ..	Water up to 100 cc.	2	22·5	+ 0·424	− 0·003
0·3976	1·028		2	22·5	+ 0·421	
0·106	.. ..		2	20·5	+ 0·103	+ 0·0075
0·106	2·030		2	20·5	+ 0·1105	
0·102	.. ..		2	20·5	+ 0·2052	+ 0·0038
0·102	2·095		2	20·5	+ 0·2090	

Next, a sample of normal urine was decolourised by means of animal charcoal and used as solvent for the dextrose.

Length of tube = 2 decim. Temperature 20° C.

Dextrose taken.	Solvent.	Rotatory Power.	Difference.
Grms. 0·1143	100 cc. Water	+ 0°116	−0°008
0·1110	Urine	+ 0°108	

It is evident, therefore, that the constituents of urine exert no influence whatever on the rotatory power of dilute dextrose solutions.—H. T. P.

On Hubl's Method for the Examination of Wax. R. Benedikt and K. Mangold. Chem. Zeit. 1891, **15**, 474—475.

This method, although of great value, has the drawback that certain kinds of wax are saponified by it only with difficulty when treated with alcoholic lye. For instance, if a wax contains ceresin, the saponification numbers obtained are nearly always too low. To avoid these inaccuracies the following modifications are recommended by the authors:—

1. The acid number is ascertained in the way indicated by Hubl, and it is advisable to use a considerable quantity of the substance (7 to 10 grms.) for the test.

2. Instead of the saponification number the "total acid number" is determined, by which is understood the quantity of caustic potash necessary for neutralising a mixture of fatty acids and fatty alcohols, obtained after previously decomposing the saponified wax by dilute hydrochloric acid. To obtain this mixture 20 grms. of caustic potash are dissolved in 15 cc. of water and boiled, to this during continuous stirring are added 20 grms. of the wax which has been melted on the water-bath. The mixture is heated and stirred for 10 minutes more, then diluted with 200 cc. of water; heated again and acidified with 10 cc. of hydrochloric acid slightly diluted with water. It is then boiled until the upper part appears clear, then allowed to stand, and the wax cake boiled, first with water containing some hydrochloric acid, and subsequently twice with water alone. Then the wax cake is dried with filter-paper, and melted in the drying oven and the liquid filtered. The filtrate solidifies as it cools. Six to 8 grms. of the substance thus obtained are treated with alcohol free from acids, heated on the water-bath, and titrated after phenolphthalein has been added. The total acid number thus obtained is somewhat lower than Hubl's saponification number. If s be the acid number, S the total acid number, and a the ether number, we have Hubl's saponification number $a + s$ and—

$$a = \frac{56100\,(S - s)}{56100 - 18\,S}$$

$$S = \frac{56100\,(a + s)}{56100 + 18\,a}$$

The total acid numbers of various kinds of yellow beeswax of different origin varied from 88 to 93; as an average figure 92·8 is given, corresponding to the saponification number 95. The amount of wax W contained in ceresin is then determined by the formula—

$$W = \frac{100\,S}{92\cdot8}$$

or, more accurately—

$$W = \frac{97\cdot72\,S}{92\cdot75 - 0{\cdot}0228\,S}$$

If, however, small quantities (6 per cent. or less) are mixed with beeswax, this test is no longer applicable, and Buisine's method must be used instead. When stearic acid or resin is present, the acid number is higher; if σ be the average acid number of such additions, these additions are calculated by the formula—

$$K = \frac{100\,(s - 20)}{\sigma - 20}$$

Stearic acid, as used for technical purposes, has $\sigma = 200$, hence we have in this case—

$$K = \frac{10\,(s - 20)}{18}.$$

When fats or tallows are present, the following formula has to be used—

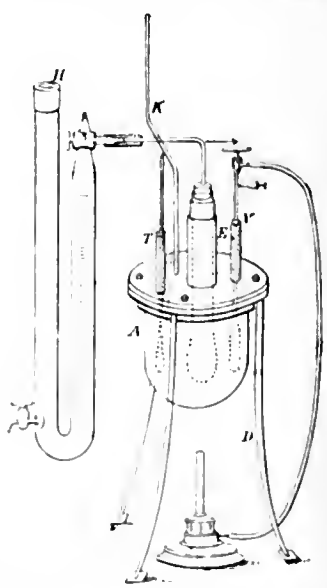
$$W = \frac{100\,(Sf - S)a}{(Sf - S)a + (S - S_{ic})b}$$

where S is the total acid number, S_{ic} the total acid number of pure beeswax, Sf that of fat, a the quantity of wax necessary for obtaining 1 grm. of substance as above described by the treatment with dilute hydrochloric acid, and b the quantity of fat which yields 1 grm. of insoluble fatty acids (see also this Journal, 1891, 52, 53, 728 and 729).

—H. S.

Analysis of Beeswax. C. Mangold. Chem. Zeit. 1891, **15**, 799—800.

An adulteration of beeswax with less than 6 per cent. of ceresin or paraffin cannot be detected with certainty by any of the ordinary methods because the relations between the free fatty acid and saponifiable and unsaponifiable matters in genuine beeswax vary within somewhat considerable limits. The detection of smaller quantities of these adulterants can only be made possible by a direct determination of the hydrocarbons present, and the author describes a modification of a method recently brought out by A. and P. Buisine (this Journal, 1891, 52 and 729) with that object. The method is based on the observation of Dumas and Stas that if a saponified wax be heated with potash lime, the fatty alcohols are decomposed with formation of fatty acids and evolution of hydrogen, the volume of which becomes a measure of the fatty alcohols present, whilst the hydrocarbons may be dissolved out of the residue and weighed. The recent improvements of the method consist in the simplification of the apparatus and a more exact knowledge of the conditions to be observed. From 2 to 10 grms. of the wax are saponified by melting with potash lime. The solid dry soap is then powdered and well mixed with three times its weight of potash lime, and placed in a strong pear-shaped flask, in which it is heated to 250° for two hours. The apparatus for conducting this operation is shown in the sketch. A is an iron vessel with a lid



Apparatus for Analysis of Beeswax.

fastened down by screws, and filled with mercury. The flask or eprouvette E is connected, gas-tight, with a Hofmann's burette H for measuring the hydrogen evolved. T is a thermometer and V a temperature regulator. K is a condensing tube for mercury vapour. The author recommends that the heating at 250° be continued for three hours to secure completion of the reaction, after which the flask is allowed to cool, and is broken up to liberate the residual mass, which is then powdered and extracted with petroleum spirit in a Soxhlet apparatus. The residue left on evaporation of the petroleum spirit is dried at 110° and weighed. Genuine beeswax examined by this method give always some hydrocarbons, but the experience of the author and other observers is to the effect that the quantity is almost invariably between 12·5 and 14·5 per cent. The mean of these quantities or 13·5 must therefore be deducted from the total hydrocarbon found, and the difference is the amount of hydrocarbon added by way of adulteration. The results of numerous analyses accompany the article.

—G. H. B.

New Reagent for Acetone. A. Schwicker. Chem. Zeit. 1891, **15**, 914.

A MIXTURE of acetone and aqueous ammonia dissolves powdered iodine with evolution of heat, the liquid becomes turbid, and after a time a deposit of iodoform is formed; a penetrating smell which irritates the eyes and is probably due to some iodine substitution product of acetone, is simultaneously produced. This reaction may be used as a test for small quantities of acetone even in presence of alcohol, as the latter gives no reaction under the circumstances.

The test is best made as follows:—A few drops of strong ammonia are added to the solution containing acetone, then 1 or 2 drops of decinormal iodine, a darkish precipitate of iodide of nitrogen forms but disappears on shaking, or on gently warming, and when the solution of acetone is not too dilute it is immediately succeeded by a yellowish turbidity due to the formation of iodoform. Successive additions of 1 or 2 drops of iodine solution are repeatedly made, allowing the liquid to stand a little while after each addition and then shaking it well. The smell of iodoform can be clearly distinguished in the liquid in spite of the presence of ammonia. Any accumulation of iodide of nitrogen formed after successive additions of iodine may be dissipated by adding 1 or 2 drops of a very dilute solution of sodium thiosulphate, but this reagent disturbs the reaction if added too soon.

Very dilute solutions of acetone should be treated with a more dilute solution of iodine and the precipitate of iodide of nitrogen, which in these cases forms at once, should be left to itself for a considerable time before warming or treating with sodium thiosulphate. The reactions which occur are probably represented by the equations—

$$CH_3.CO.CH_3 + NI_3 = NH_3 + CI_3.CO.CH_3$$
$$CI_3.CO.CH_3 + NH_4OH = CHI_3 + CH_3.COONH_4$$

The author believes that the iodoform reaction described would be given by all ketones containing the acetyl group. After prolonged standing aldehyde yields a similar precipitate of iodoform with ammonia and solution of iodine.

—S. B. A. A.

Analysis of Shoe Blacking. J. Pinette. Chem Zeit, 1891, **15**, 917.

ABOUT 5 grms. of blacking are weighed out into a 200 cc. separating funnel, 100 cc. of water added, and the liquid is made up to the mark with a mixture of equal volumes of ether and light petroleum. The whole is then well shaken, allowed to subside, and the height of the layers read off. 25 cc. of the ethereal solution are pipetted off, filtered, evaporated to dryness, and the residual fat weighed. An aliquot part of the aqueous layer is filtered and titrated with decinormal soda and phenolphthaleïn for free acids, the neutral solution obtained evaporated to dryness in an unweighed platinum dish, the dish and residue weighed, ignited and again weighed. The difference between the two last weighings gives the invert sugar and extractable matter.

Another aliquot part of the aqueous solution is neutralised with decinormal soda, evaporated until free from ether, filtered, made up to 25 cc., and the invert sugar determined with Fehling's solution. The extractible matter is found by difference. Water and ash are estimated in separate portions. The difference between the sum of the percentages thus obtained and one hundred is taken as carbon. The ash is analysed like other phosphatic mixtures. The free acid found is not sulphuric acid, as stated by Hölbing, but, phosphoric acid, and exists either in the free state or in acid phosphates. Of late, varieties of blacking free from acids have come into the market, a highly bituminous schist being used in place of bone-black in their manufacture. These blackings are simply mixtures of fat, molasses, and black schist, with the occasional addition of an antiseptic. The following analyses are given of the two classes of blacking:—

	No. 1. Acid Blacking.	No. 2. Blacking Free from Acid.
Water	23·84	13·28
Fat	5·53	3·48
Free acids	1·66	..
Invert sugar	20·14	..
Cane sugar	..	23·35
Extractive matter	3·40	10·81
Carbon	7·86	9·49
Combined water	..	
P_2O_5	10·24	..
SO_3	8·76	..
CaO	12·96	..
Na_2O	5·61	..
Ignited siliceous matter	..	39·59
	100·00	100·00

From this the proportions of the raw materials employed in the manufacture appear to be in round numbers as follows:—

	No. 1.	No. 2.
Bone black	13·0	..
Molasses	68·0	63·5
Sulphuric acid	12·0	..
Soda	4·5	..
Fat	2·5	2·5
Black schist (losing 20 per cent. on ignition).	..	34·0

—S. B. A. A.

Analysis of the Calcined Vinasse from Beet Molasses. C. Heyer Chem. Zeit. 1891, **15**, 915 and 959—960.

THE total potash in the ash of the vinasse from beet molasses is generally determined by converting the potassium sulphate in an aqueous solution into chloride, by the addition of an equivalent quantity of barium chloride, filtering and evaporating an aliquot part of the filtrate with platinum tetrachloride. The percentage of potassium chloride is also estimated directly in the solution of the ash

by neutralising exactly with nitric acid, and titrating with a decinormal silver solution. The author has found that these methods yield inaccurate results in many cases, owing to the incomplete calcination of the vinasse and consequent presence in the ash of nitrogenous compounds which on heating with water are partially converted into ammonia, and estimated as potash. In one sample 1·53 per cent. of ammonia was found in solution after boiling with water for five hours and with potash for one hour, and the residues still contained 0·19 per cent of nitrogen. It is, therefore, absolutely indispensable to recalcine the ash before estimation, and the percentage of potassium salts varies with the thoroughness of this calcination.

The following analyses of the same sample of ash show the extent of the variation —

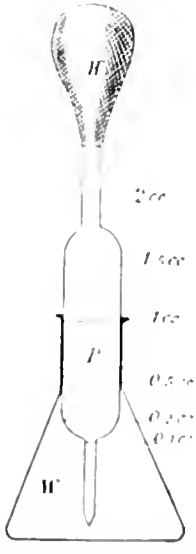
	a.	*a*¹.	*b*.	A.	B.	C.	D.
K_2CO_3.....	64·74	67·32	67·35	64·20	72·27	71·24	63·70
KCl	13·54	13·54	12·20	13·06	11·66	13·47	11·45
K_2SO_4.....	1·61	1·61	1·76	1·81	0·79	0·60	1·05
KPO_4.....	0·27	0·27	0·21	Trace	Trace	0·30	0·20
$NaCO_3$.....	6·84	8·70	10·74	10·74	6·42	5·93	13·72

a was obtained by precipitating the aqueous solution of the ash with barium chloride, evaporating a portion of the filtrate almost to dryness and adding a solution of platinum tetrachloride; a^1 was obtained by evaporating a portion of a solution to complete dryness, drying at 120° and gently igniting before treatment with platinum chloride; *b* resulted from the drying and thorough calcination of a portion of the original solution of the ash, with subsequent re-solution, precipitation of the sulphuric acid, and addition of the platinum salt; A, B, C, and D are determinations made by other analysts.

Before titrating the chlorine, it is advisable to boil the acid solution in order to decompose the cyanides which remain in the ash even after thorough ignition. When the ash contains soluble sulphides or sulphocyanides, a little nitric acid or bromine water should be added to the calcined mass, and the solution after addition of barium chloride should be allowed to stand for about six hours.—S. B. A. A.

An Apparatus for Weighing Oil. R. Hefelmann. Chem. Zeit. 1891, **15**, 989.

The pipette P fits air-tight into the small conical weighing beaker W. The pipette is graduated as shown and its



Apparatus for Weighing Oil.

upper end is closed by the rubber ball H. By this apparatus the required quantity of oil for various determinations may be quickly weighed.—A. L. S.

The Determination of Acid Tartrate in Wine Lees. B. Balli. Chem. Zeit. 1891, **15**, 989—991.

P. Philipp and Co.'s method consists in neutralising the acid tartrate with soda or potash, filtering and precipitating the acid tartrate from the solution of the neutral tartrate by acetic acid.

Kämmer neutralises in the cold instead of at the boiling temperature.

The author finds that this method is not applicable to the analysis of wine lees and other impure materials, which often contain calcium sulphate and carbonate and potassium carbonate.

On neutralisation calcium sulphate reacts with neutral potassium tartrate as follows:—

$$K_2C_4H_4O_6 + CaSO_4 = K_2SO_4 + CaC_4H_4O_6$$

When calcium sulphate is present the result of the analysis will consequently be low.

Calcium carbonate reacts on the acid tartrate as follows:—

$$2\,KHC_4H_4O_6 + CaCO_3 = H_2O + CO_2 + K_2C_4H_4O_6 + CaC_4H_4O_6$$

The analytical numbers will consequently in this case be also low.

The presence of potassium carbonate will, on the other hand, cause the analytical numbers to be high, as the presence of this salt is equivalent to the presence of neutral potassium tartrate which on the addition of acetic acid would yield its equivalent amount of acid tartrate, in addition to that produced from the acid tartrate available in the substance analysed.

The author recommends the following modification of the method.

The analysis is carried out in two parts.

The raw tartar is boiled with water, when the carbonates react on the acid tartrate as follows:—

$$2\,KHC_4H_4O_6 + K_2CO_3 = CO_2 + H_2O + 2\,K_2C_4H_4O_6.$$

$$2\,KHC_4H_4O_6 + CaCO_3 = CO_2 + H_2O + CaC_4H_4O_6 + K_2C_4H_4O_6.$$

On neutralisation the available acid tartrate is dissolved, and the clear solution thus contains neutral tartrate from the available acid tartrate and neutral tartrate as produced according to the first equation by the action of potassium carbonate, and neutral tartrate as produced according to the second equation by the action of calcium carbonate. The neutral tartrate in the solution is estimated by adding calcium chloride, acetic acid, and alcohol, the precipitate of calcium tartrate is filtered off and titrated with semi-normal alkali. The resultant figures are in excess of the amount of available acid tartrate as explained above, and a subsidiary analysis is necessary to determine the correction. This may be done in two ways:—

A. Indirect Method.—A portion of the crude tartar is boiled with water and the solution filtered; the solution is diluted and acidified with acetic acid and calcium chloride added. The precipitate is filtered off and titrated. The result gives the amount of bitartrate and neutral tartrate in the solution. The amount of bitartrate must be determined in another portion of the solution, in exactly the same way, only omitting the acidification. The difference between the two results gives the amount of neutral tartrate.

B. Direct Method.—The crude tartar is boiled with water and the solution is cooled and diluted. A part of the acid tartrate crystallises out and the mother-liquor is a saturated solution of acid tartrate containing all the neutral tartrate in solution. On adding acetic acid to this a quantity of acid tartrate is formed, equivalent to the neutral tartrate in solution, and as the solution is already saturated with the salt the whole thus formed crystallises out; it is filtered and washed with alcohol and weighed.—A. L. S.

Rapid Method of Estimation of Common Salt in Wine. J. Gondoin. J. Pharm. Chim. 1891, **24**, 8.

To 10 cc. of the wine under examination, 1 cc. of a standard solution of silver nitrate, containing 7·25 grms. per litre (1 cc. = 0·0025 grm. of NaCl), are added. After stirring, a drop of the solution is placed on paper impregnated with potassium chromate, the production of a red spot of silver chromate indicating that the whole of the chlorine of the common salt is precipitated. The addition of the silver nitrate solution, 1 cc. at a time, is, if necessary, continued until, on testing, a red colouration is obtained. Each 4 cc., or more exactly 4·07 cc., of the standard silver nitrate solution, corresponds to 0·01 grm. of sodium chloride in 10 cc., or to 1 grm. per litre, of the wine.—E. B.

Estimation of Tannins in Acid Liquors. A. Bartel. Dingl. Polyt. J. 1891, **280**, 233—234.

Meerkatz (Der Gerber, 1889, 350) sought to overcome the difficulty which exists in the determination of tannins in acid liquors, by neutralising the liquor with barium carbonate before making the estimation, and maintained that there was no loss of tannin caused by this treatment.

The difficulty referred to arises from the action of the organic fermentation acids on the hide-powder used for absorbing the tannins, the results obtained being too high.

The author suspected that the excess of barium carbonate, which must necessarily be added, would precipitate some of the tannin, and instituted experiments with a view to settling this point. To 1 litre of an extract of oak bark 20 grms. of carefully purified barium carbonate were added, and the mixture shaken throughout a day. The solution was then filtered alongside of another litre of the same extract which had been treated in exactly the same way without the addition of barium carbonate. The tannin was then estimated in the two filtrates by Löwenthal's process, with the result that the one to which barium carbonate had been added contained 15·58 per cent. of tannin, while the other contained 22·28 per cent. Another experiment in which 5 grms. of barium carbonate were used gave similar results, as also did determinations made by the Schroeder indirect gravimetric method (this Journal, 1888, 647).

An experiment was also made to see if exact neutralisation with sodium hydroxide could be allowed. A portion of the oak bark extract was mixed with a little acetic acid and then with sufficient sodium hydroxide (previously ascertained) to neutralise this acid; the tannin in this solution, and in another similarly treated with the exception of the addition of acetic acid and sodium hydroxide, was determined by the indirect gravimetric method. The solution which contained the sodium acetate gave 18·93 per cent. of tannin, the other 26·28 per cent.

The author concludes that neutralisation of the acid liquor cannot be permitted.—A. G. B.

ANALYTICAL AND SCIENTIFIC NOTES.

Sodium. M. Rosenfeld. Ber. 1891, **24**, 1658—1660.

Sodium which has become coated with a crust by being kept under rock-oil can be easily purified without loss of metal in the following way:—The incrusted metal is first placed in a mixture of amyl alcohol (1 part) and petroleum (3 parts), and rubbed with a rag soaked in the same mixture until it acquires a silvery lustre; it is now placed for a short time in petroleum containing 5 per cent. of amyl alcohol, then washed with pure petroleum, and finally kept under petroleum containing 0·5—1·0 per cent. of amyl alcohol. Potassium and lithium can be purified and kept in the same way.

For preparing sodium amalgam the sodium is best purified in the manner just described; combination between the two metals then takes place very readily at the ordinary temperature.

The liquid alloy of sodium and potassium can be easily prepared in a short time by placing equal quantities of the two metals, purified as described above, in a mixture of amyl alcohol (1 part) and petroleum (9 parts) and then pressing them together until liquefaction is complete; the alloy can be kept under petroleum.

Sodium sulphide can be very conveniently prepared by triturating sodium (1 grm.) with sodium chloride (3 grms.), and then mixing the grey powder obtained in this way with flowers of sulphur (0·7 grm.), but without employing any pressure; combination then takes place with development of light and heat, and the red monosulphide is formed, together with the yellow polysulphide. When quantities of sulphur corresponding to those required for the formation of the di- and trisulphide are used, a more energetic reaction takes place.—F. S. K.

Formation of Graphite by Contact Metamorphosis. R. Beck and Willi Luzi. Ber. 1891, **24**, 1884—1886.

The authors have recently found some beautifully crystallised specimens of graphite in rocks, which have undergone metamorphosis by contact with ancient volcanic rocks, the graphite crystals being in this case discernible from the amorphous carbonaceous substances of the original clay slates and siliceous slates. Although in our literature on this subject reference is made regarding the occurrence of graphite in certain slates which have been metamorphosed by contact with granite, proof of this is wanting owing to the absence of analytical and crystallographic data. These are now furnished by the authors, who have proved beyond doubt that graphite has been formed from carbonaceous substances by contact metamorphosis. In Pirna and Kreischa upper Silurian clay slates and siliceous slates have been found which are very rich in carbonaceous substances. They lie partially within the region of contact of granitite and hornblende granitite, and it has been found on close examination that those within this region of contact have become converted into rocks rich in graphite. A graphitic chiastolite slate and a graphitic quartzite were examined by the authors. The former was found embedded in the greatly metamorphosed upper Silurian grey trap of the Burkhardt Forest, whilst the latter proved to be a genuine contact rock from the immediate vicinity of the granite found in Kreischa. Both rocks have been formed from original siliceous slates, and their structure and chemical composition show that they are true contact products. The graphite from the chiastolite slate formed perfectly opaque jagged lumps, having a metallic lustre by reflected light, and being from 0·003 mm. to 0·02 mm. in diameter, whilst the carbonaceous portions in the unaltered upper Silurian clay slates and siliceous slates measured less than 0·001 mm. The quartzite from Kreischa was still richer in graphite. The latter was even more beautifully crystallised, single, well-defined crystals being 0·03 mm. in diameter. It occurred most frequently, however, in the form of irregular granules and jagged ramified crystalline aggregates measuring 0·3 mm. This graphite had a greasy touch and gave a metallic streak. The following results were obtained on analysis:—

	Carbon.	Hydrogen.
Graphite from the chiastolite slates	98·84	0·21
Graphite from the quartzite	99·94	0·05

The graphitic quartzite contained over 2 per cent. of graphite and had a specific gravity ranging from 2·62 to 2·637.—D. B.

Quantitative Determination of the Chemical Action of Light. Part III. The Influence of Dilution. G. Lemoine. Compt. Rend. 1891, **112**, 1124—1127.

Determinations of the decomposing action of light on solutions of oxalic acid and ferric chloride, present in equivalent proportions, but with varying amounts of water, were made. The authors consider that the physical effect of dilution may be disregarded, and the change effected

attributed to chemical action. From mathematical considerations they conclude further that, from the point of view of the influence of dilution, the chemical change effected by light and by heat follow the same law.—J. W. L.

PATENT.

Improvements in Centrifugal Apparatus for Testing Relative Volumes of Mixtures of Liquids of Different Specific Gravities. J. Laidlaw, Glasgow. Eng. Pat. 10,492, June 20, 1891. 6*d*.

See under L., *page* 822.

New Books.

Solutions. By W. Ostwald, Professor of Chemistry in the University of Leipsic. Being the Fourth Book, with some additions, of the Second Edition of Ostwald's "Lehrbuch der Allgemeinen Chemie." Translated by M. M. Pattison Muir, Fellow of Gonville and Caius College, Cambridge. London: Longmans, Green, & Co. New York: 15, East 16th Street. 1891.

In the notice by the translator this paragraph occurs. "The facts amassed about solutions are now so many, and the theory is now so fully developed, that a systematic arrangement of these facts, and an authoritative statement of the theory, are sure to be welcomed by chemists." It is probably safe to add, "and Technologists," at the end of this paragraph.

The book is an 8vo. volume, bound in cloth, price 10*s*. 6*d*., and contains title page, Translator's notice, Preface, Table of Contents, list of Errata and Addenda, 310 pages of text, and an Alphabetical Index of names of investigators, as well as one of the matter treated of.

The text is sub-divided into groups or chapters described as follows: Chapter I. Solutions in Gases. II. Solutions of Gases in Liquids. III. Solutions of Liquids in Liquids. IV. Solutions of Solids in Liquids. V. Osmose. VI. Diffusion. VII. Vapour Pressures of Solutions. VIII. Freezing points of Solutions. IX. Salt Solutions. X. Simultaneous Action of several Solvents.

Examination of Water for Sanitary and Technical Purposes. By Henry Leffmann, M.D., Ph.D., Professor of Chemistry in the Woman's Medical College of Pennsylvania, &c., and William Beam, Demonstrator of Chemistry in the Pennsylvania College of Dental Surgery, &c. Second Edition, revised and enlarged, with Illustrations. London: Kegan Paul, Trench, Trübner and Co., Ltd. 1891.

Small 8vo. volume, bound in cloth. Price 5*s*. It contains, Preface, Table of Contents, 148 pages of text, a set of tabulated Analytical and other data, and an Alphabetical Index. The text is illustrated with 17 excellently executed wood engravings exhibiting the various forms of apparatus described.

The subject-matter is classified as follows:—

The History of Natural Waters. Analytical Operations, classified as *Sanitary examinations* and *Technical examinations*. Interpretation of Results. Biological Examinations. Purification of Drinking Water. Identification of Source of Water. Technical Applications. Analytical Data.

A Treatise on the Law and Practice relating to Letters Patent for Inventions, with an Appendix of Statutes, International Conventions, Rules, Forms and Precedents, Orders, &c. By Robert Frost, B.Sc. (Lond.), Fellow of the Chemical Society of Lincoln's Inn, Barrister-at-Law. London: Stevens and Haynes, Law Publishers, Bell Yard, Temple Bar. 1891.

Large octavo volume, bound in cloth. Price 28*s*. Containing Dedication page, to Sir Richard E. Webster, M.P., Preface, Table of Contents, List of Abbreviations used in the Work, Table of Cases, List of Addenda and Corrigenda, and subject-matter covering 741 pages. The Work closes with a very full and complete Alphabetical Index. The text is carefully paragraphed by marginal references and notes to assist search, and at foot of pages are given references to cases. Considerable prominence is given to leading chemical law cases.

The general treatment of the subject may be gleaned from the Chapter headings, which are as follows:—

Chap. I. The Patentee. II. The Subject-matter. III. Novelty. IV. Utility. V. The Specification. VI. Amendment of the Specifications. VII. Obtaining Letters Patent for Inventions. VIII. Assignment of Letters Patent. IX. Licences. X. Revocation of Letters Patent. XI. Prolongation or Extension of Letters Patent. XII. Action to restrain Threats of Legal Proceedings. XIII. Action of Infringement. Appendix, dealing with Statutes, International Convention for the Protection of Industrial Property, Orders, List of Fees, War Office Memorandum for Inventors.

Fortschritte der Theerfarbenfabrikation und verwandter Industriezweige, 1887—1890. An der Hand der Systematisch Geordneten und mit kritischen Anmerkungen versehenen Deutschen Reichs-Patente. Dargestellt von Dr. P. Friedlander a.o. Professor an der technischen Hochschule zu Karlsruhe i.B. Berlin. Zweiter Theil, 1887—1890. Berlin: Verlag von Julius Springer, 1888. London: H. Grevel and Co., 33, King Street, Covent Garden.

Large 8vo volume, bound in paper cover, price 24 M. (1*l*. 4*s*.). It contains Preface, Table of Contents, 560 pages of subject-matter, Alterations of the Patent Lists, a Register of the Numbers of the German Patents recorded, as also of the Applications for Patents, covering two pages, an Alphabetical Index of the holders of Patents, and finally, a complete Alphabetical Index, covering 13½ pages.

The classification of the matter of the contents is as follows: Intermediate products of the Tar Industry (1 to 15 pages). Triphenyl-, Diphenylmethane derivatives and Phthaleins (pages 16 to 93). Indigo-blue, Isatine, and Indole Derivatives (pages 96 to 100). Quinoline-, Quinazoline- and Pyrazolone Derivatives (pages 102 to 127). Salicylic acid, Salicylic ether, and Phenolcarbonic acids (pages 130 to 140). Methylene Blue (pages 142 to 156). Oxazine-, Phenazine-derivatives and Indophenol (pages 156 to 186). Indulines (pages 186 to 214). Nitro- and Nitroso compounds (pages 215 to 225). Naphthol- and Naphthylamine sulphonic acids, Dihydroxynaphthalenes, Amidohydroxynaphthalenes, and their Sulphonic acids and Naphthylenediamines (pages 229 to 278). Primuline dyes (pages 286 to 301). Azo-Dyes for Wool and Mordanted cotton (pages 308 to 337). Cotton Azo-dyes (pages 341 to 471). Dyes of various composition (pages 472 to 498). Compounds of various composition (Medicaments) (pages 501 to 558). The work gives a clear and precise account of all that has been done in Colour Chemistry, and in Synthetic aromatic Medicaments between the years 1887 and 1890.

Chemisch-Technisches Repertorium. Uebersiehtlich geordnete Mittheilungen der neuesten Erfindungen, Fortschritte und Verbesserungen auf dem Gebiete der Technischen und industriellen Chemie. Mit Hinweis auf Maschinen, Apparate und Literatur. Herausgegeben von Dr. Emil Jacobsen, 1890, Erstes Halbjahr. Zweite Hälfte. Berlin: 1891, R. Gaertner's Verlagsbuchhandlung, Hermann Heyfelder, Schönebergerstrasse, 26. London: H. Grevel and Co., 33, King Street, Covent Garden.

The second issue for the first half year of 1890. It contains 203 pages of subject-matter, copiously illustrated with wood engravings. In the text the following branches of technology are treated of:—Food Stuffs; Paper; Photography, &c.; Waste Residues, Deposits, Manures, &c.; Disinfection and Sanitation; Soap; Explosives, Matches; Preparation and Purification of Chemicals; Chemical Analysis; Apparatus, Machinery, Electro-technology, Technology of Heat; Appendix, &c. The Annual Report concludes with Reviews of New Books.

The first issue for the second half year of 1890 has also appeared. It contains 96 pages of text illustrated with wood engravings. The following branches of technology are treated of:—Building Materials, Cements, and Artificial Stone; Colouring Matters, Dyeing and Calico Printing; Fats, Oils, Illuminating and Heating Materials; Fermented Liquors; Tanning, Leather, and Glue Manufacture Textiles; Glass and Earthenware; Wood and Horn; India-rubber; Cements, Plasters, and Artificial Stone; Lakes, Varnishes, and Paints; Metals.

The Rose Industry of Bulgaria. By Christo Christoff, Kézanlik, Bulgaria. Translated by Chas. Henry Piesse. London: Piesse and Lubin, 2, New Bond Street.

Octavo, cloth bound pamphlet, with Preface, Table of Contents, and 60 pages of Text, illustrated by six Wood Engravings and a Map of the Otto of Roses producing region. Price 1*s.* The subject matter is divided into chapters headed as follows:—I. Historical; II. Geographical Situation; III. Botanical; IV. Plantations—Attention to Cultivation; V. Harvest—Distillation; VI. Otto of Roses; VII. Adulterations; VIII. Commerce.

Piesse's Art of Perfumery, and the Methods of Obtaining the Odours of Plants. The Growth and General Flower Farm System of Raising Fragrant Herbs, with Instructions for the Manufacture of Perfumes, &c., &c. Edited by Chas. H. Piesse, Consul-General of Monaco; Fellow of the Institute of Chemistry; Member of the Royal College of Surgeons, &c. Fifth Edition. London: Piesse and Lubin, 2, New Bond Street. 1891.

Octavo volume, with paper covers. The price is 10*s.* 6*d.* It has a frontispiece illustrating the Vender Still at Mitcham, Surrey; Preface to the Fifth Edition. In this preface the following noteworthy sentences occur:—"The excise duty on spirits of wine prevents England from fairly competing in her own colonies with her German and French neighbours in this particular trade." Also—"Female labour, so useful in this business, is prohibited by present regulations within 'bonded' warehouses. The workmen are also injured in the matter of their wages, as at present, 'no man is allowed to work after four o'clock.'" "These things, fairly considered, are a hard 'set off' against the English manufacturing perfumers compared with the facilities given by the French Government to the same trade." The author refers to the increasing favour shown to English perfumery, and adds, "for England now produces the finest perfumery in the world."

Next follows the Table of Contents, List of Illustrations (some 71 in number), 474 pages of subject matter, and an Appendix of eight pages. The work terminates with an Alphabetical Index. The text is subdivided into chapters treated as follows:—I. Introduction and History; II. Theory of Odours; III. Flower Farming Statistics; IV. Expression, Distillation, Absorption, Enfleurage, Maceration; V. Primitive Odours. The Commercial Elements; VI. Perfumes of Animal Origin; VII. Smelling Salts, Snuff, and Vinegars; VII. Bouquets and Nosegays; IX. Sachet-powders and Incense; X. Perfumed Soap; XI. Emulsines; XII. Milks, or Emulsions; XIII. Cold cream; XIV. Pomades and Oils; XV. Hair Dyes and Depilatory; XVI. Absorbent Powders and Rouges; XVII. Tooth-powders and Mouth-washes; XVIII. Hair-washes; XIX. Of the Colours used by Perfumers; XX. Foreign Tariffs on Perfumery.

A Theoretical and Practical Treatise on the Manufacture of Sulphuric Acid and Alkali with the Collateral Branches. By George Lunge, Ph.D., Professor of Technical Chemistry at the Federal Polytechnic School, Zürich. (Formerly Manager of the Tyne Alkali Works, South Shields.) Second Edition, Revised and Enlarged. Volume I.—Sulphuric Acid. London: Gurney and Jackson, 1, Paternoster Row. 1891.

The work opens with a preface to Volume I. of the First Edition, another to Volume III. of the First Edition, and a very important and interesting one it is, and finally the Preface to the Second Edition. The Table of Contents follows, then the Introduction, and finally the text, covering 903 pages. The work concludes with a carefully arranged Alphabetical Index. The illustrations and drawings number no less than 374, and are beautifully executed. The price of the work (Vol. I.) is 2*l.* 2*s.*

Chapter I. is devoted to Historical and General Notes on the Manufacture of Sulphuric Acid. II. The Raw Materials of the Sulphuric Acid Manufacture; Brimstone; Pyrites; other Metallic Sulphides; By-products of other Manufactures; Nitrate of Soda and Nitric Acid. III. The Properties and Analysis of the Technically employed Oxides and Acids of Sulphur. IV. The Production of Sulphurous Acid. V. The Burner Gas. VI. Construction of the Lead Chambers. VII. The Chamber Process. VIII. The Recovery of the Nitrogen Compounds. IX. Theory of the Formation of Sulphuric Acid in the Lead Chambers. X. The Purification of Sulphuric Acid. XI. The Concentration of Sulphuric Acid. XII. Arrangement of the Apparatus of Sulphuric Acid Works. XIII. Yields and Costs of Sulphuric Acid Manufacture. XIV. By-Products of the Manufacture of Sulphuric Acid. XV. The Manufacture of Nordhausen or Fuming Oil of Vitriol, and of Sulphuric Anhydride. XVI. Other Processes of Manufacturing Sulphuric Acid. XVII. Applications of Sulphuric Acid, and Statistics. Appendix.

In view of the large amount of new work in the way of invention and improvement that has been done within the last few years, and the necessary description of more or less of it, the author has curtailed the merely retrospective portion, which describes processes and apparatus not now in use. However, though much of the latter has been cut down in this the Second Edition, the author refers in such places to the First Edition where the fuller descriptions may yet be found. The same observation applies to specific gravity tables and similar matter. Thus the First Edition remains useful, and should not be dispensed with. Much space is saved also by eliminating discussions or refutations of views now entirely obsolete. The author remarks that "hardly a single page now stands as it did in the first edition," and he very straightforwardly, if not bluntly, acknowledges that in sundry places he has not scrupled to contradict some few statements in the First Edition he then took to be fact, which by dint of closer observation and wider experience, he now regards more or less as error.

Le Titrage des Solutions Sucrées, par la Détermination de leurs Densités, à la Température de 15° Centigrade. Par C. Scheibler. Traduit de l'Allemand par H. Sidersky. Berlin: R. Friedlaender and Fils.

The German title of the original Work is "Die Gehaltsermittelung der Zuckerlosungen durch Bestimmung des Specifischen Gewichts derselben bei der Temperatur von 15° Celsius."

Octavo, paper cover, 188 pages, price 8*s*. The work consists of two carefully compiled and important tables. Table I. being for aqueous solutions of sugar ranging from 0 to 100 per cent., with values increasing for every variation of 0·01 per cent., giving the densities and the corresponding strength in sugar for 100 parts by weight, and also for 100 parts by volume, at the temperature of 15° C.

Table II. is for converting to the normal temperature of 15° C., sugar solutions, the strength of which has been observed at any temperature from 0° to 50° C.

In the preface it is stated that "the determination of the strength of saccharine solutions by means of their densities implies that the operation is conducted at a fixed temperature which is the same for all the experiments; that is to say, a *normal temperature* at which all the necessary instruments are graduated, and for which the tables are calculated. Up to a short time ago, the *normal temperature* in Germany was 14° R. or 17° C. But quite recently, the Imperial Commission of Weights and Measures, sitting at Berlin, having been solicited to establish the official verification of hydrometers, has decided to take 15° C. as the normal temperature for that purpose, because that temperature is the basis for taking the strength of alcohol and is also frequently employed in scientific researches," &c. The task of constructing the new tables has been carried out by Professor Scheibler in an able and painstaking manner, and these tables cannot fail to prove of great service to those who are engaged in the sugar industry.

Wattles and Wattle-Barks: being Hints on the Conservation and Cultivation of Wattles together with Particulars of their Values. By J. H. Maiden, F.L.S., F.C.S., &c. Second Edition. Sydney: George Stephen Chapman, Acting Government Printer. 1891.

Octavo volume in paper cover, price 1*s*, No. 6 of the Technical Education Series. It contains an Introduction to the First Edition; also a testimony from the Director General of Forests (Sydney) to the effect that he has much pleasure in recommending the work as an excellent Treatise upon the subject of Wattle Cultivation generally. In the immediately succeeding Preface to the Second Edition, the object of the pamphlet is set forth as for the purpose of supplying "farmers, tanners, merchants, and others, with authentic information in regard to the value of wattles." Australia is stated as being the native country of wattles, which will grow in the poorest soil, some requiring only a moderate rainfall. Their cultivation is strongly recommended to farmers who have a patch of poor soil which they cannot otherwise profitably utilise. The return is in about five to seven years. At present only the following wattles are recommended to be planted:—The South Australian Broad-leaf Wattle, *Acacia pycnanthar*, and the various varieties of *Acacia decurrens*, generally known as Black or Green Wattle.

There follow next a Table of Contents, List of Illustrations, numbering 10, and text covering 74 pages. The work concludes with an Alphabetical Index.

Trade Report.

(*From the Board of Trade Journal.*)

TARIFF CHANGES AND CUSTOMS REGULATIONS.

Russia.

The Effect of Import Duties.

In the course of a report on the Russian import duties, Mr. J. Michell, Her Majesty's Consul at St. Petersburg, has the following:—

In order to stimulate the exportation of mineral and other resources of the country, the importation of some articles of this class, hitherto free, will now be made subject to payment of duty. Under this head are ranged sulphur, clay, and stones for building purposes, bones, raw and worked phosphorites, superphosphates, and composts. At the same time it is satisfactory to note that the duty on coal will remain for a certain period unchanged. On machinery the duty has been considerably raised, with the exception of that on agricultural machines and implements, which has been reduced to its previous level of 70 c. gold per poud.

On chemicals the duty has been considerably increased; thus caustic soda, hitherto 72 c. gold per poud, will now pay 90 c. gold; bleaching powder from 52 c. is now dutiable at 70 c. gold; borax from 11 c. gold has been raised to 120 c. per poud. Business in these particular goods is said to be now at a standstill, the consumer not being able to pay the increased price. The rates under this head are in fact prohibitive, as they are intended to be, with a view to benefiting the native manufacturers of chemical products.

The native iron trade was so encouraged that no further protection was necessary. Iron wire is sold at the cost of the duty; the duty on iron joists, formerly 60 c. gold per pond, has now been made 85 c., or 100 per cent. *ad valorem*. Pig-iron, with a duty of 30 c. gold per pond, which is the same as heretofore, is equal in price at the present rate of exchange of 9 r. 25 c. to 11. to 3*l*. per ton, while the Middlesbrough price is only 40*s*. per ton f.o.b. The low price of the rouble which prevails at present makes importation of pig iron therefore almost impossible.

United States.

Customs Decisions.

The following decisions respecting the construction to be given to Acts of Congress relating to the classification of articles in the Customs tariff, and the application of the Customs laws of the United States, have recently been given by the Customs authorities in that country:—

Nitrite of soda is classified as a "chemical salt," and is dutiable at 25 per cent. *ad valorem*, under paragraph 92 of the Tariff Act of March 1883, which levies this rate of duty on "all chemical compounds and salts, by whatever name known, not specially enumerated or provided for."

Degras or brown wool grease is dutiable at one half of one cent. per pound.

Atropine sulphate is dutiable, under paragraph 74, at 50 cents a pound.

Spermaceti is dutiable at 8 cents a gallon, under the provisions of paragraph 46 N.T., for whale oil.

Naphthionate of soda, a compound formed by the treatment of naphthalene, a constituent of coal-tar, with sulphuric acid, potassium cyanide, and sodium hydroxide is dutiable only at 20 per cent., under paragraph 19 as a coal-tar preparation.

New Roumanian Customs Tariff.

The following is a statement showing the rates of import duty now leviable in Roumania on certain articles of British produce or manufacture :—

Note.—Lei = 1 franc. Bani = 1 centime.

Tariff Classification.	Tariff Rates of Duty.		English Equivalents.			
		Lei. b.		£	*s.*	*d.*
Hides, Skins, and Leather, Unwrought and Wrought:						
Hides and skins :						
Raw, fresh, dried, or salted...	100 kilos.	3·00	Cwt.	0	1	2¾
Tanned :						
Large skins.....	,,	100·00	,,	2	0	8
Small, except those mentioned below.	,,	120·00	,,	2	8	9
Castor; kid skins, glazed or gilt; glove skins, coloured or not; calf skins, glazed or varnished; also Russian leather.	,,	240·00	,,	4	17	6
Parchment and vellum.....	,,	240·00	,,	4	17	6
Scraps of leather of all sorts, not exceeding 5 centimetres in length or breadth.	,,	5·00	,,	0	2	0½
India-rubber and Gutta-Percha :						
Unmanufactured	Free		Free			
Manufactured articles of india-rubber or gutta-percha not combined with other materials.	100 kilos.	70·00	Cwt.	1	8	5
Manufactured articles of india-rubber or gutta-percha combined with other materials.	,,	100·00	,,	2	0	8
Chemicals :						
Alkali :						
Carbonate and bicarbonate of soda.	Free		Free			
Caustic soda	Free		Free			
Alum	Free		Free			
Arsenic, white.....	Free		Free			
Barytes :						
Carbonate of baryta.....	Free		Free			
Sulphate of baryta.....	Free		Free			
Bleaching Materials :						
Chloride of lime	Free		Free			
Chromate and bichromate of potash.	Free		Free			
Sulphite and hysosulphite of soda.	Free		Free			
Borax	Free		Free			
Brimstone, crude or refined, and flowers of sulphur.	Free		Free			
Copperas :						
Sulphate of iron	Free		Free			
Sulphate of copper	Free		Free			
Sulphate of zinc	Free		Free			
Epsom salts.....	100 kilos.	8·00	Cwt.	0	3	3
Sal ammoniac.....	Free		Free			
Saltpetre :						
Nitrate of soda	Free		Free			
Nitrate of potash	Free		Free			
Salt	Prohibited		Prohibited			
Oils, Minerals, &c.:						
Seed oils of all kinds.....	100 kilos.	30·00	Cwt.	0	12	2
Oil cake	,,	1·50	,,	0	0	7¾
Grease :						
Of fish.....	,,	6·00	,,	0	2	5¾
Tallow and all animal grease for employment in industries.	,,	6·50	,,	0	2	7¾

New Roumanian Customs Tariff—*continued.*

Tariff Classification.	Tariff Rates of Duty.		English Equivalent.			
		Lei. b.		£	*s.*	*d.*
Oils, Minerals, &c.—*cont.*						
Candles :						
Tallow.....	100 kilos.	25·00	Cwt.	0	10	2
Paraffin, ceresine, and ozokerite.	,,	100·00	,,	1	2	7
Stearine	,,	40·00	,,	0	16	3
Wax	,,	250·00	,,	5	1	7
Soap :						
Toilet soap.....	,,	180·00	,,	3	13	2
Other kinds.....	,,	30·00	,,	0	12	2
Petroleum and Rock Oils :						
Petroleum and oil of schist, raw.	,,	20·00	,,	0	8	1½
Do., do., refined.....	,,	15·00	,,	0	6	1
Other mineral oils	,,	20·00	,,	0	8	1½
Turpentine	,,	8·00	,,	0	3	3
Rosin.....	,,	8·00	,,	0	3	3
Pitch	,,	8·00	,,	0	3	3
Coal, &c. :						
Coal and coke.....	Free		Free			
Anthracite, lignite, peat, &c..	100 kilos.	0·50	Cwt.	0	0	2¼
Cement.....	,,	0·75	,,	0	0	3¼
Fireclay	,,	0·15	,,	0	0	0¾
Millstones and Grindstones :						
Rough stones for millstones..	,,	0·10	,,	0	0	2
Millstones of all kinds	Pair	25·00	Pair	1	0	0
Grindstones	100 kilos.	4·00	Cwt.	0	1	7½
Roofing slates	,,	0·50	,,	0	0	2½
Miscellaneous Articles :						
Indigo.....	Free		Free			
Matches of all sorts	Prohibited		Prohibited			
Starch.....	100 kilos.	10·00	Cwt.	0	16	3

Papers of Interest to Technologists and Manufacturers.

The following articles in the *Board of Trade Journal* for October will repay perusal :—

"The Petroleum Trade of Russia," p. 383.
"The Development of Mexico," p. 385.
"The Resources of Assam," p. 388.
"The Resources of Bolivia," p. 453.

GENERAL TRADE NOTES.

Austrian Mineral Production, 1890.

The figures relating to the production of the mines of Austria (proper), recently published by the Austrian Ministry of Agriculture in their "*Jahrbuch*" for 1890, are given in the *Handels Museum* of 10th September, from which we find that the total value of the mine products for 1890 was 68,167,000 florins (6,816,700*l.*), and of smelting products 36,889,000 fl. (3,688,900*l.*). The number of persons employed in mines and smelting houses was 121,678, and the average value of mine and smelting products produced by each employé was 745 fl. (74*l.* 10*s.* 0*d.*). The total value of Austria's mining and smelting produce, after deducting the value of the ores sent to the smelting houses, was 90,716,000 fl. (9,071,600*l.*). The values of the various mining products were as follows : — Coals, 30,401,078 florins (3,040,108*l.*) ; peat, 27,639,115 fl. (2,763,911*l.*) ; silver ore, 3,167,179 fl. (316,718*l.*) ; iron

ore, 3,105,765 fl. (310,576*l.*); lead ore, 969,622 fl. (96,962*l.*); quicksilver ore, 891,687 fl. (89,169*l.*); graphite, 726,036 fl. (72,604*l.*); zinc ore, 568,842 fl. (56,884*l.*); copper ore, 343,422 fl. (34,342*l.*); sulphur ore, alum, and vitriol shale, 100,261 fl. (10,026*l.*); and other ores, 254,166 fl. (25,417*l.*).

The values of the smelting products were as follows:—Pig iron, 27,310,617 fl. (2,731,062*l.*); silver, 3,257,927 fl. (325,792*l.*); lead and litharge, 1,696,049 fl. (196,605*l.*); quicksilver, 1,596,563 fl. (159,656*l.*); zinc, 1,467,832 fl. (146,783*l.*); copper, 602,163 fl. (60,216*l.*); sulphuric acid, 441,947 fl. (44,195*l.*); copperas and alum, 140,616 fl. (14,062*l.*); other metals and smelting products, 374,836 fl. (37,484*l.*).

In addition there are the products of the salt industry, the total estimated monopoly price of which was 23,040,106 fl. (2,304,011*l.*), showing an increase on the previous year to the extent of 1,464,551 fl. (14,646*l.*).

Compared with the year 1889 there is an increase of 9·2 millions of florins, or 15·65 per cent., in the total value of the mining products, the figures of 1890 and 1889 being, roughly, 68·16 millions and 58·96 millions of florins respectively. Comparing the total values of the smelting products for 1890 and 1889 the figures are, roughly, 36·89 and 32·75 millions of florins respectively, showing an increase in 1890 of 4·14 millions of florins, or 12·64 per cent.

The value of the mining and smelting products together was, as already stated, in 1890, 90·7 millions of florins, which, compared with the preceding year, shows an increase of 11·9 millions of florins, or 15·11 per cent.

Note.—The florin has been taken at the nominal value of 2*s.*

Discovery of Anthracite in Canada.

The discovery of new deposits of anthracite coal in the province of Alberta, comprising a portion of what was formerly known as the North West Territory of the Dominion of Canada, will prove, if the reports are correct, highly important not only to Manitoba and British Columbia but also to the Pacific Coast States of this country, there being no import duty on anthracite coal. It is said that large seams of this coal have been found along the Red Deer River, 40 miles north of Banff. Hitherto, it has been supposed that the only anthracite coal in Canada was at Anthracite, near Banff, from which place the present supply for the western part of the Dominion is taken.—*Engineering and Mining Journal.*

Recent Tests of Nickel Steel Armour Plates.

Experiments made on the 12th inst. at the Annapolis proving ground have again confirmed the superiority of nickel steel over ordinary steel for armour plates. The tests were made to determine the value of nickel steel for a protective deck. The targets were made of two superposed 4-in. plates, placed almost horizontally, presenting an angle of only 2° to the line of fire. A 6-in. rifle was used, with a 100-lb. armour piercing projectile. When fired at the target of ordinary steel the target was perforated, and the projectile, which was broken, passed through both plates and through 2 ft. of wood and 8 ft. of earth composing the backing. The velocity of the projectile was 1,780 ft. per second. When fired at the nickel steel target, the velocity of projectile was 1,874 ft., but it glanced off the target without rupturing either plate, but was itself smashed to pieces. Its effect on the target was a small crack 5 in. long in one plate and an indentation between 3 in. and 5 in. deep.

The demonstration of the superiority of nickel steel over ordinary steel for armour plate suggests that it may have other valuable uses in the arts. A wide field for metallurgical research is here afforded. In this connexion it seems strange that the world has waited so long for the discovery of the qualities of nickel steel to be made. For more than 20 years the open hearth steel process has been in successful use, producing the purest known varieties of carbon steel, and during all this time it would have been an easy matter to make experiments on alloying this steel with other elements, and to determine the physical qualities of these alloys, yet it has been only within a year or so that such experiments have been seriously attempted. During these 20 years millions of money have been spent in Europe in the manufacture of compound armour plate, viz., wrought iron with a steel face, all of which has now to be abandoned in view of the superiority of nickel steel, while the much simpler method of making a steel plate with a simple alloy has remained undiscovered. The time is ripe for further researches into the qualities of other alloys of steel. There are unlimited possibilities of the discovery of valuable qualities in numerous alloys yet untried; and it should be a matter neither of great difficulty nor of great expense for any open-hearth steel works to make the experiments which may result in such discoveries.—*Ibid.*

Gutta-Percha.

The price of gutta-percha has nearly doubled in two years, and now rules at 5*s.* 3*d.* per lb. This remarkable advance in the price of the article is attributed to two causes, the large quantities required in the manufacture of electric and other modern devices and the reckless destruction of the trees from which the gum is obtained. This gum or sap is not obtained by merely tapping the trees, as is done by the gatherers of crude rubber along the River Amazon and its tributaries; the Malays and natives of Borneo, who collect gutta-percha, fell each tree from which gum is to be extracted, and thus the destruction of the trees and the consequent scarcity of the product is explained. From 1854 to 1875, 90,000 piculs, weighing 133⅓ lb. each, of gutta-percha were exported from Sarawak alone, and this meant the death of 3,000,000 trees. As no trees are planted, the reason that this species of plant has been saved from annihilation is that it does not produce the gum in paying quantities until it is 25 to 30 years old.—*Iron.*

The Production of Crude Glycerin.

The basis for the preparation of the chemically pure glycerins used in pharmacy is the so-called saponification crude glycerin of the stearin works. The total output of crude glycerin in the world is said to be 40,000 tons per annum, of which 14,000 tons are obtained in soap manufacture, and 26,000 tons in stearin manufacture. Of the glycerin gained in soap-making, 5,500 tons are produced in the United Kingdom, 3,500 tons in France, 3,000 tons in the United States, and 2,000 tons in Germany. Many more countries participate in the production of stearin-glycerin, their approximate shares being as follows:—France, 6,000 tons; Germany, 3,000 tons; United States, 3,000 tons; Holland, 2,000 tons; Austria, 2,000 tons; Russia, 2,000 tons; Belgium, 1,800 tons; Italy, 1,800 tons; Spain, 1,500 tons; United Kingdom, 1,200 tons; Sweden and Norway, 350 tons; Switzerland, 300 tons; the Argentine, 300 tons; Australia, 300 tons; Portugal, 200 tons; Roumania, 150 tons; and Greece, 100 tons. Paris is the centre of the crude glycerin trade, and the place whence most of the speculative movements in the article originate. Between 1864 and 1891 the Paris quotation for crude standard glycerin has varied from 35 to 205 frs. per 100 kilos. In 1881 the price was forced up to 205 frs., but at that point the consumption suddenly decreased, while the stearin and soap works, enticed by the enormous price of the article, increased their output to an abnormal degree. Then the crash came, and in the summer of 1882 the quotation came down to 120 frs. Quite recently a process is said to have been discovered by which soapmakers are enabled to recover the entire proportion (10 to 12 per cent.) of glycerin in the fat in an almost pure condition, and with very simple and cheap apparatus. This process will very materially affect the glycerin industry, as the glycerin from the soap ley has hitherto been used almost exclusively for dynamite making. The output of this explosive in 1886 was estimated at 10,000 tons.—*Chemist and Druggist.*

The German Chemical Industry.

In the official report read at the annual general meeting of the Association for the Protection of the Interests of the (German) Chemical Industry, held at Nuremberg last month, the secretary stated that during the year 1890 there

had been a great advance in this important branch of German industry. The number of fully employed workmen employed had risen from 90,585 to 97,498; the total of wages paid from 71,611,000 marks to 80,075,000 marks. The average dividend paid by 82 limited companies, with an aggregate capital of 198,073,000 marks, rose from 10·58 in 1889 to 12·81 per cent. in 1890. These favourable results are not due to higher prices, but to increased sales of the products in various directions. An active participation at the forthcoming Chicago Exhibition was strenuously urged upon the members. A committee was appointed at the meeting to investigate the question of Sunday labour and draw up a report on the subject for presentation to Parliament.—*Ibid.*

Manchester Chamber of Commerce.

Report of the Chemical Section.

To the President and Directors of the Manchester Chamber of Commerce: Gentlemen, the Chemical Section of your Chamber having been requested to report upon a memorial presented by certain chemical and other manufacturers of this city with reference to smoke abatement, beg to state that they are of opinion:—1. That the emission of black smoke may generally be restricted, but that there are certain manufacturing operations in which its prevention is not practicable with our present means and appliances, and this is especially the case in carrying out processes in which the firing is of an intermittent character, or where very high and constantly varying temperatures require to be quickly obtained, or where some of the constituents of the coal enter into chemical combination with the article to be produced. We refer, amongst others, to metallurgical operations, the manufacture of glass, pottery, earthenware, soda ash by the Leblanc process, and to destructive distillation and distillation in retort glasses and stills. 2. That there exist no technical difficulties in reducing the smoke from ordinary boiler fires to a minimum. 3. That the use of anthracite or smokeless coal is not practicable in carrying out manufacturing operations in which the cost of fuel is an important item. Furthermore, anthracite is not suitable for many operations in which bituminous coal is absolutely necessary. In many chemical and metallurgical works a reducing flame is often necessary to carry out certain operations; in other words, air must not be admitted in sufficient quantity to completely burn the carbonaceous products, as if excess of air were introduced the product would be spoiled. In all such operations the production of black smoke cannot be prevented in the present state of our knowledge. 4. That the emission of black smoke may, however, be reduced with greater success even in some of the special processes referred to if manufacturers were able to secure cheaper coal-gas and coke at reasonable prices, as either of these, or in some instances the combination of both, might be found in certain cases to answer for a substitute of coal, as, for example, in retort firing, destructive distillation, and other operations. 5. Your committee's attention having also been called to a letter of the Manchester and Salford Noxious Vapours Association addressed to the Chamber, they have to say that the Association must have entirely misconceived the complaints made by the memorialists with reference to certain prosecutions for the emission of black smoke. The letter of the Association admits the exemption by the Legislature of certain manufactures, whilst as a matter of fact, prosecutions had been commenced against manufacturers carrying on the works and trades thus exempted. 6. That chemical works have not been specially mentioned as exempted by the Act is true, nor was there any need for it, as they are included in the general protecting clause (as already set forth in the memorial), which provides that any complaints should be dismissed if the court is satisfied that the furnace or fireplace is constructed in such a manner as to consume as far as practicable, having regard to the nature of the manufacture or trade, all smoke arising therefrom, and if such furnace or fireplace has been carefully attended to by the person having charge thereof (section 91, Public Health Act, 1875). In regard to the statement of the chief inspector referred to in the letter, the inspector may be theoretically right, that the prevention of the emission of black smoke is not impossible in certain cases where smokeless coal might be used, but in practice the high price of this coal, which is almost four times as high as that of ordinary coal, and for reasons already stated excludes its substitution for the latter in almost all the manufacturing operations referred to. Moreover, the chief inspector, whose authority and experience principally attend to alkalis and noxious vapours, confined his remarks, we venture at least to think, solely to these, but there exists a number of chemical operations in which the conditions and circumstances are very much different. Finally the committee observes that the Association is wrong in assuming that the Chemical Sectional Committee is practically identical with the memorialists. The fact is that the majority of signatures to the memorial are in no wise those of firms connected with chemical works, and only few of them are represented on the Chemical Sectional Committee.—I have the honour to be, gentlemen, yours obediently, Ivan Levinstein, Chairman. —*Chemical Trade Journal.*

Recent Trade Blue Book.

Thirty-fourth Report of the Commissioners of Her Majesty's Inland Revenue for the year ended 31st March 1891, with Appendix. (C.—6537.) *Price 6d.*

The following table shows net receipts of Excise in the years ended 31st March 1891 and 1890:—

	Year ended 31st March.		Increase.	Decrease.
	1891.	1890.		
	£	£	£	£
Spirits	14,770,730	13,860,002	910,728	..
Beer	9,390,141	9,410,426	..	20,285
Tobacco, home grown	131	86	45	..
Licences	230,150	530,245	..	299,795
Chicory	1,587	1,509	78	..
Coffee mixture labels	2,560	2,433	127	..
Railways	324,118	324,161	..	343
Charges on deliveries from bonded warehouses, &c.	4,200	4,070	130	..
	24,723,917	24,133,232	911,108	320,423
			Net increase £590,685	

Under the head of "Spirit Duty," there is a large increase of 910,728*l.*, being at the rate of 6·7 per cent. over prior year.

The increase chiefly occurred in June and September quarters, 1890, and was incidental to the general improvement in trade. The further sum of 703,557*l.* was also raised under spirit duty at 6*d.* additional per gallon, under the 7th section of Act 53 Viet. c. 8, which took effect from 18th April 1890. This amount was paid over direct to Local Taxation Account.

The number of distilleries at work during the year ended 30th September 1890 was, in England, 10; in Scotland, 124; and in Ireland, 29; being a decrease of 2 in Scotland, and an increase of 1 in Ireland as compared with the previous year. The following is an estimate of the quantities of the principal materials used:—Malt, 946,398 quarters; unmalted grain, 1,140,580 quarters; molasses, 175,873 cwt.; rice, 41,993 cwt.; sugar, 453 cwt.; saccharum, 37,041 cwt. It is stated that the average consumption per head in the United Kingdom, which from 1881 to 1889 had declined in each year, had risen in the year ended 31st March 1891 to 0·775. The previous year it was 0·736 gallon.—*Board of Trade Journal.*

BOARD OF TRADE RETURNS

Summary of Imports.

	Month ending 30th September	
	1890.	1891.
	£	£
Metals	1,921,250	1,837,262
Chemicals and dyes' tuffs	502,119	498,734
Oils	480,241	575,161
Raw materials for non-textile industries	1,676,544	1,029,509
Total value of all imports	35,551,688	34,189,301

Summary of Exports.

	Month ending 30th September	
	1890.	1891.
	£	£
Metals (other than machinery)	3,378,050	3,041,597
Chemicals and medicines	770,928	722,206
Miscellaneous articles	2,077,580	2,024,592
Total value of all exports	22,761,677	20,793,543

Imports of Chemicals and Dyestuffs for Month ending 30th September.

Articles.	Quantities.		Values.	
	1890.	1891.	1890.	1891.
			£	£
Alkali ..... Cwt.	[illegible]	6,703	2,219	1,216
Bark (tanners, &c.) ,,	[illegible]	46,764	20,196	21,453
Brimstone ..... ,,	[illegible]	[illegible]	[illegible]	[illegible]
Chemicals ..... Value £	..	..	113,542	101,318
Cochineal ..... Cwt.	[illegible]	18	4,585	5,753
Cutch and gambier Tons	[illegible]	[illegible]	[illegible]	[illegible]
Dyes :—				
Aniline ..... Value £	..	..	14,970	18,254
Alizarine ..... ,,	..	..	20,186	22,911
Other ..... ,,	..	..	928	967
Indigo ..... Cwt.	[illegible]	41	10,370	5,143
Madder ..... ,,	[illegible]	[illegible]	1,016	1,577
Nitrate of soda ..... ,,	[illegible]	[illegible]	[illegible]	[illegible]
Nitrate of potash ,,	[illegible]	[illegible]	[illegible]	[illegible]
Valonia ..... Tons	[illegible]	[illegible]	[illegible]	[illegible]
Other articles ... Value £	..	..	126,754	137,922
Total value of chemicals	..	..	502,119	498,734

Imports of Metals for Month ending 30th September.

Articles.	Quantities.		Values.	
	1890.	1891.	1890.	1891.
			£	£
Copper :—				
Ore ..... Tons	9,993	6,462	91,617	67,489
Regulus ..... ,,	9,553	8,740	281,489	224,284
Unwrought .... ,,	4,501	3,618	274,223	202,931
Iron :—				
Ore ..... ,,	282,768	201,764	216,264	154,852
Bolt, bar, &c. .... ,,	10,849	7,343	106,083	70,870
Steel, unwrought .. ,,	1,119	1,229	11,342	10,883
Lead, pig and sheet ,,	11,713	13,076	158,669	164,130
Pyrites ..... ,,	18,067	39,173	88,767	66,938
Quicksilver ..... Lb.	22,500	81,640	3,037	9,380
Tin ..... Cwt.	25,139	18,890	125,883	223,080
Zinc ..... Tons	6,002	5,632	159,639	129,008
Other articles ...Value £	..	..	124,797	513,167
Total value of metals	..	..	1,921,250	1,837,262

Imports of Raw Materials for Non-Textile Industries for Month ending 30th September.

Articles.	Quantities.		Values.	
	1890.	1891.	1890.	1891.
			£	£
Bark, Peruvian .. Cwt.	9,751	4,973	28,556	12,377
Bristles ..... Lb.	361,826	535,024	51,033	68,415
Caoutchouc ..... Cwt.	24,767	14,937	358,291	153,937
Gum :—				
Arabic ..... ,,	1,928	3,767	7,305	10,712
Lac, &c. ..... ,,	2,624	5,827	12,804	23,332
Gutta-percha .... ,,	7,075	4,827	79,708	48,781
Hides, raw :—				
Dry ..... ,,	34,178	31,560	86,635	85,530
Wet ..... ,,	48,068	62,206	111,263	144,723
Ivory ..... ,,	1,921	980	95,672	49,914
Manure :—				
Guano ..... Tons	2,103	1,731	14,183	10,174
Bones ..... ,,	3,191	3,737	16,170	17,600
Paraffin ..... Cwt.	15,189	15,271	58,670	67,101
Linen rags ..... Tons	2,889	2,258	28,564	22,615
Esparto ..... ,,	9,450	8,799	18,886	15,859
Pulp of wood .... ,,	13,515	14,340	76,581	75,160
Rosin ..... Cwt.	158,158	121,824	35,531	30,170
Tallow and stearin ,,	116,669	73,572	153,582	108,075
Tar ..... Barrels	40,911	29,633	28,270	16,916
Wood :—				
Hewn ..... Loads	257,326	258,257	573,785	549,364
Sawn ..... ,,	737,573	637,248	1,033,120	1,320,143
Staves ..... ,,	21,190	17,348	83,246	70,890
Mahogany ..... Tons	2,724	3,954	24,913	38,359
Other articles....Value £	..	..	1,009,773	1,059,050
Total value	..	..	4,676,544	4,029,509

Besides the above, drugs to the value of 58,575*l.* were imported as against 61,690*l.* in September 1890.

IMPORTS OF OILS FOR MONTH ENDING 30TH SEPTEMBER.

Articles.	Quantities.		Values.	
	1890.	1891.	1890.	1891.
			£	£
Cocoa-nut..... Cwt.	26,902	120	45,209	291
Olive ..... Tuns	924	1,169	34 734	58,477
Palm ..... Cwt.	90,318	81,133	111,834	91,578
Petroleum ..... Gall.	8,667,306	10,212,369	195,142	221,024
Seed ..... Tons	3,311	1,874	84,117	53,243
Train, &c..... Tuns	1,813	2,969	37,576	14,104
Turpentine ..... Cwt.	54,751	29,275	82,087	40,601
Other articles .. Value £	..	..	88,942	62 813
Total value of oils ...	..	..	680,241	575,161

EXPORTS OF METALS (OTHER THAN MACHINERY) FOR MONTH ENDING 30TH SEPTEMBER.

Articles.	Quantities.		Values.	
	1890.	1891.	1890.	1891.
			£	£
Brass..... Cwt.	7,931	10,084	39,235	45,782
Copper:—				
Unwrought ..... „	78,116	46,551	241,852	121,852
Wrought..... „	14,928	27,009	54,371	91,681
Mixed metal .... „	20,208	23,566	80,911	67,078
Hardware ..... Value £	..	..	236,340	220,059
Implements..... „	..	..	111,504	104,462
Iron and steel..... Tons	323,320	283,806	2,488,331	2,085,691
Lead ..... „	4,057	3,991	58,911	55,467
Plated wares... Value £	..	..	34,120	36,413
Telegraph wires, &c. „	..	..	98,104	78,662
Tin ..... Cwt.	7,239	9,388	36,229	44,849
Zinc ..... „	11,629	8,638	12,911	9,264
Other articles .. Value £	..	..	74,917	77,056
Total value	..	..	3,578,959	3,011,307

EXPORTS OF DRUGS AND CHEMICALS FOR MONTH ENDING 30TH SEPTEMBER.

Articles.	Quantities.		Values.	
	1890.	1891.	1890.	1891.
			£	£
Alkali..... Cwt.	397,686	569,000	210,253	220,522
Bleaching materials „	183,741	132,307	53,703	46,235
Chemical manures. Tons	34,662	27,792	180,434	149,402
Medicines..... Value £	..	..	91,118	92,218
Other articles... „	..	..	235,120	213,829
Total value	..	..	770,928	722,206

EXPORTS OF MISCELLANEOUS ARTICLES FOR MONTH ENDING 30TH SEPTEMBER.

Articles.	Quantities.		Values.	
	1890.	1891.	1890.	1891.
			£	£
Gunpowder..... Lb.	880,600	798,000	21,138	20,946
Military stores.. Value £	..	..	114,916	100,589
Candles..... Lb.	1,048,100	1,298,600	20,173	25,935
Caoutchouc ..... Value £	..	..	116,426	102,038
Cement..... Tons	53,837	46,242	110,981	91,197
Products of coal Value £	..	..	121,531	99,521
Earthenware ... „	..	..	158,951	172,672
Stoneware ..... „	..	..	11,860	10,163
Glass:—				
Plate..... Sq. Ft.	160,978	273,227	11,522	17,535
Flint..... Cwt.	10,942	9,663	24,297	21,084
Bottles..... „	84,857	67,740	40,667	32,361
Other kinds.... „	18,534	16,031	16,114	13,821
Leather:—				
Unwrought .... „	13,855	13,016	121 480	116,093
Wrought ..... Value £	..	..	34,664	33,066
Seed oil..... Tons	5,294	5,578	123,833	120,512
Floorcloth ..... Sq. Yds.	1,357,200	1,665,500	63,326	70,182
Painters' materials Val. £	..	..	137,570	140,221
Paper ..... Cwt.	87,960	89,280	151,146	152,405
Rags..... Tons	1,766	3,945	33,828	26,918
Soap..... Cwt.	39,501	46,534	44,968	46,842
Total value	..	..	2,977,539	2,629,592

Monthly Patent List.

* The dates given are the dates of the Official Journals in which acceptances of the Complete Specifications are advertised. Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the said dates.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

APPLICATIONS.

15,734. A. Heuze-Frison. Improvements in gas and air valves for glass works, ice works, and for other uses. September 16.

15,740. G. Stonehouse and H. Simon. An improvement in centrifugal drying machines. Complete Specification. September 16.

15,785. O. Imray.—From C. Spaeter, Germany. Improvements in regenerative and other gas furnaces. September 17.

15,815. P. Pfleiderer. — From Werner and Pfleiderer, Germany. Improvements in universal mixing, kneading, pugging, crushing, breaking, grinding, levigating, triturating, malaxating, masticating, and amalgamating machinery. September 17.

16,011. O. March. A novel improved apparatus for the automatic and continuous extraction of liquid from semi-fluid substances. September 21.

16,248. T. Ledward. Improvements in or relating to open air fluid condensers. Complete Specification. September 24.

16,281. B. L. Fletcher and J. Boyle. *See* Class XV.

16,560. J. P. Lancaster. Improvements in rail chairs. Complete Specification. September 29.

16,666. R. H. Yeomans. Improved method of heating and evaporating brine and other liquids. October 1.

16,806. J. Ellis. Improvements in ozonising apparatus. October 3.

16,904. A. Suiter and A. R. Margary. Improvements in regulators for compressed gas. October 5.

16,965. R. Morris. Improvements for preventing incrustation in steam boilers. October 6.

16,999. C. M. Martin and A. E. Tavernier. An improved thermostat. October 6.

17,031. H. C. Cox. Improvements in apparatus for the automatic control of sulphuric acid supply to carbonic acid generators used in aerated water manufacture and other industries. Complete Specification. October 7.

17,185. T. Scott. *See* Class VII.

17,274. R. W. Deacon.—From W. Maxwell, Java. *See* Class XVI.

17,401. J. Miles. The production of anti-corrosive boiler fluid from a vegetable compound. October 13.

17,623. W. H. Bowers. Improvements in retorts for the carbonisation of wood and other vegetable substances, and the drying of manures, sewage, sludge, peat, and other substances and products. Complete Specification. October 15.

17,750. J. J. McDaniel. Improvements in the method of and apparatus for securing a continuous time record of the rate of distillation and direction of flow of distilled fluids. October 16.

Complete Specifications Accepted.*

1890.

16,326. T. Slater. Multiple evaporating apparatus. October 14.

18,050. T. Thorp. New apparatus for clarifying liquids. October 14.

19,199. J. Kent. Thermometers. September 30.

19,985. H. Cotton. Construction of mills for grinding flint stone, bone, glaze, and other like substances. October 14.

20,309. F. C. C. Daly. Mercury vacuum pumps. September 30.

1891.

10,738. C. H. Haddold. Centrifugal machine for incorporating or mixing together various substances. October 14.

11,113. B. D. Heeley. Cauldrons for melting pitch and fatty substances. September 23.

12,512. E. Donard and G. Boulet, jun. Apparatus for desiccation of solid matters. September 23.

13,612. R. Crow. *See* Class XXII.

15,092. O. Lindemann. Steam and vacuum pumps for raising liquids. October 14.

15,740. G. Stonehouse and H. Simon. An improvement in centrifugal drying machines. October 21.

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* See Note (*) on previous page.

II.—FUEL, GAS, AND LIGHT.

Applications.

15,535. H. Brier and V. Jackson. Improvements in or connected with apparatus or means for obtaining oxygen and nitrogen from the air. September 14.

15,552. R. Orr and R. M. Sutherland. *See* Class III.

15,905. A. E. Dean. The purification of gases and vapours from accompanying fluids. September 19.

15,975. H. Brier. Improvements in or connected with apparatus or means for obtaining oxygen and nitrogen from the air. September 21.

16,013. S. Lewis. Solidifying and reliquefying petroleum and mineral or other volatile oils. September 21.

16,021. J. Ruscoe. Improvements in apparatus for charging inclined gas retorts. September 21.

16,578. H. W. P. Nugent. Improvements in retort-charging apparatus. September 30.

16,907. L. T. Wilcox. Improvements in devices for heating and lighting. Complete Specification. October 5.

16,915. R. F. Strong. An improved smokeless block fuel and manufacture thereof. October 5.

17,222. W. Creswick. Improved arrangement of coke ovens and retorts for the manufacture of coke and illuminating gas. Complete Specification. October 9.

17,298. Brin's Oxygen Co., Lim., and K. S. Murray. *See* Class VII.

17,302. F. J. Jones. An improvement in the manufacture of coke. October 10.

17,351. G. R. Prowse. Improvements in apparatus for forming oxy-calcium lights. Complete Specification. October 12.

17,368. G. B. Mee.—From E. Fahrig, United States. An improvement in the production of oxygen. October 12.

17,371. K. Lares. An improved coke furnace or oven. Complete Specification. October 12.

17,422. J. Swallow, C. West, T. Needham, H. Milling, J. A. Compston, H. Owen, D. J. Bailey, and A. Haughton. Improvements in or relating to the treatment of paraffin and other oils for rendering it or them odourless, smokeless, miscible, and non-explosive. October 13.

17,447. T. Settle. Improvements in gas and other retorts, and in the method of setting and resetting them. October 13.

17,510. F. L. Pease. An improved apparatus to be used for the purification of gas or for analogous or similar purposes. October 14.

17,557. A. Kitson. Improvements in apparatus for manufacturing gas. Complete Specification. October 14.

17,587. W. C. Hoskins and J. Crighton. Improved appliances for increasing the illuminating power of gas and other light and for neutralising the noxious effects of the vapours emitted in the combustion of gas or other luminants. October 15.

17,613. J. Lyle. Novel means for the transformation of oil into a gas and the utilisation of such gas as the agent for heating purposes generally. October 15.

17,652. H. H. Lake.—From the Thomson-Houston International Electric Company, United States. Improvements in carbons for electric arc lamps. Complete Specification. October 15.

Complete Specifications Accepted.

1890.

15,998. J. C. Lawson. Manufacture of oxygen. October 14.

17,261. L. Van Vestraut. Setting inclined carbonising or gas retorts. September 23.

18,230. L. Van Vestraut and M. Graham. Construction of shoots for charging inclined gas retorts. October 7.

18,360. H. Guyon and L. Métais. Manufacture of combustible gas for heating, lighting, and generation of motive power. October 21.

18,457. M. M. Bropby. Utilisation of gas for heating purposes, and apparatus therefor. September 23.

1891.

179. A. S. Davy. Apparatus for treating smoke and gases from furnaces and other fires. October 14.

9716. J. F. Allen. Manufacture of illuminating gas. September 30.

12,256. J. Stevenson. Transporting and delivering purifying material used in the manufacture of gas, and to apparatus therefor. September 30.

12,818. A. Hickenlooper. Gas-retort chargers. September 23.

13,506. P. Dvorkovitz. Manufacture of illuminating gas. October 14.

15,249. W. R. Lake.—From A. Hennin. Manufacture of ammonia and gas. October 14.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

Applications.

15,552. R. Orr and R. M. Sutherland. Improvements in and relating to retorts for distilling shale and like minerals, and for dealing with the resulting products. September 14.

17,221. E. Binney. *See* Class XIII.

17,409. P. McLaren and W. L. Moore. Improvements in the manufacture of pyroligneous acid. October 13.

IV.—COLOURING MATTERS and DYES.

Applications.

15,725. S. Pitt.—From L. Cassella and Co., Germany. Improvements in the manufacture of colouring matters from amidonaphtholsulphonic acids. September 16.

16,377. H. H. Lake.—From F. Reverdin and C. de la Harpe, Switzerland. Improvements in the manufacture of colouring matter. September 26.

16,852. The Clayton Aniline Co., Limited, J. Hall, and F. Moore. The manufacture and production of artificial indigo. October 3.

16,918. O. Imray.—From The Actiengesellschaft für Anilin-Fabrikation, Germany. Manufacture of a blue colouring matter. October 5.

16,919. O. Imray.—From The Actiengesellschaft für Anilin-Fabrikation, Germany. Improvements in the manufacture of colouring matters. October 5.

17,635. C Dreyfus. Improvements in the manufacture and production of colouring matters. Complete Specification. October 15.

17,711. J. R. Geigy. Production of violet black colouring matters or dyes. October 16.

Complete Specifications Accepted.

1890.

15,743. W. Davison. Colours or pigments for making imitation metallic and coloured enamels, paints, and printing inks. September 23.

17,712. B. Willcox.—From F. Bayer and Co. Manufacture and production of new derivatives of alizarine and its analogues. September 23.

18,527. O. Imray.—From La Société L. D. Huguenin and Cie. Process and apparatus for the manufacture of ultramarine. September 30.

18,623. H. H. Lake.—From Wirth and Co., agents for A. Leonhardt and Co. Manufacture of colouring matters. September 30.

19,065. S. Pitt.—From L. Cassella and Co. Production of sulphonated thionines, and dyestuffs therefrom. September 30.

19,330. S. Pitt.—From L. Cassella and Co. The preparation of colouring matters with gamma-amido-naphtholsulphonic acid. September 30.

20,845. H. H. Lake.—From Wirth and Co., agents for Halle and Co. Manufacture of colouring matters. September 30.

1891.

13,693. A. Lembach, U. Schleicher, and C. J. Wolff. A new soluble quinoline derivative. September 13.

V.—TEXTILES, COTTON, WOOL, SILK, Etc.

Applications.

15,608. J. R. Garratt and W. Scott. An improvement in the preparation of flax yarn for weaving. September 15.

15,808. A. S. Oetzmann and S. J. Narracott. Improvements in the manufacture of coverings for floors and other surfaces, and in apparatus used for this purpose. September 17.

16,265. H. S. Close, W. O. Roff, and F. R. Donisthorpe. Improvements in the decortication and treatment of flax, esparto grass, jute, hemp, and other like vegetable fibres. September 24.

16,266. H. S. Close, W. O. Roff, and F. R. Donisthorpe. Improvements in the decortication and treatment of rhea or ramie grass or fibre, and other like vegetable fibres. September 24.

16,554. W. Ross. Improvements in the process of cleansing cotton seeds and recovering the by-products therefrom. September 29.

17,081. R. Scott and W. J. Beard. Improvements in the manufacture of floorcloth and like fabrics, and machinery therefor; the improvements being also applicable to other purposes. October 7.

17,120. H. A. Mansfield. A method of and apparatus for manufacturing inlaid coloured linoleum and other materials. October 8.

17,325. G. E. Armstrong. Improved composition for treatment of fibres. October 12.

17,562. C. Ideson. Improvements in apparatus for gassing silk and other yarns. October 14.

17,642. F. J. H. Sampson. Improvement in the treatment of rhea to obtain fibre therefrom, and appliance to be used in such treatment. Complete Specification. October 15.

Complete Specifications Accepted.

1890.

18,284. P. W. Nicolls and J. Smith. Treatment of vegetable fibrous matters to obtain fibres therefrom. September 30.

18,585. J. Davidson. Use or application of thistledown. September 23.

19,252. C. D. Abel. Process for cleansing or purifying woollen fabrics. October 7.

1891.

11,724. J. E. Boyce. Sizing composition for cotton yarn. October 14.

14,272. J. C. Chapman.—From the United Indurated Fibre Co. *See* Class XIX.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

Applications.

15,713. L. Wallays and L. Nisse. A new or improved method of and apparatus for printing tissues and the like. September 16.

16,195. A. French. A method of and apparatus for colouring and inlaying coloured designs and colours through linoleum and other floor coverings and other materials. September 23.

16,196. H. A. Mansfield. An improved method of colouring and inlaying coloured designs upon and through linoleum and other materials. September 23.

16,163. D. Stewart. Improvements in apparatus for bleaching or dyeing textile materials and fabrics, or otherwise treating the same with liquids or gases. September 29.

16,700. O. Imray.—From H. W. Wilson, France. Improvements in the bleaching of vegetable textile materials. October 1.

16,725. S. D. Keene. Improvements in bleaching fibrous and other materials, and treating, charging, saturating, or impregnating materials or articles with liquids either simple or containing materials or substances in solution or suspension. October 2.

17,082. H. H. Lake. From K. Oehler, Germany. Improvements relating to the dyeing or printing of woollen and other goods. October 7.

17,624. G. W. Longfield. Improvements in means or apparatus for dyeing samples, patterns, and the like. October 15.

VII.—ACIDS, ALKALIS, AND SALTS.

Applications.

15,548. M. N. d'Andria. Improvements in the manufacture of ammonium chloride and other by-products. September 14.

15,641. C. Glaser. Improvements in and relating to the art or process of manufacturing phosphoric acid from phosphatic material. Complete Specification. September 17.

15,651. G. H. Gray. An improved process for converting strontium sulphate into strontium carbonate, and the manufacture of caustic alkalis. September 16.

15,822. J. H. Gossage. An improved method for obtaining monocarbonates from bicarbonates of the alkalis. September 18.

15,844. J. M. Milnes and A. Milnes. Improvements in the apparatus for the manufacture of bleaching powder chloride of lime, or similar commodities. September 18.

15,989. C. Pelouy. An improved process and apparatus for decomposing alkaline salts, particularly for the production of caustic soda, caustic potash, and the carbonates of the same. Complete Specification. September 21.

16,512. R. J. Chatfield. Improvements in the manufacture of nitric acid. September 29.

16,647. A. Beake and J. G. A. Roberts. Improvements in the manufacture of acid sulphates. October 1.

16,666. E. H. Veomans. See Class I.

16,683. C. A. Burghardt. See Class X.

17,130. L. Perez Gutierrez. A process for moulding common salt (chloride of sodium) by melting it previously. Complete Specification. October 8. Date applied for March 28, 1891, being date of application in Spain.

17,185. T. Scott. Improvements in evaporating pans for the manufacture of salt from sea water or brine, and for other like purposes. October 9.

17,298. Brin's Oxygen Co., Lim., and K. S. Murray. Improvements in the preparation of anhydrous oxide of barium or other substances of like properties for use in the separation of oxygen and nitrogen of atmospheric air. October 10.

17,329. M. N. d'Andria. Improvements in the manufacture of nitrate of ammonia and other bye-products. October 12.

17,659. P. de Wilde, A. Reychler, and F. Hurter. Improvements in apparatus for the manufacture of chlorine. October 15.

17,745. F. M. Lyte and C. H. M. Lyte. Improvements in the production of chlorine, the purification of lead, and the production of soft-burnt magnesia. October 16.

17,796. G. F. Brindley. New solid compounds of sulphur, trioxide, water, and the bisulphates or acid sulphates of sodium or potassium. October 17.

Complete Specifications Accepted.

1890.

11,931. J. H. Parkinson. Method of producing a porous mass of permanganate of potash. September 23.

16,233. H. C. Bull. Processes for the manufacture of sulphate of lead, and apparatus therefor. October 14.

20,071. A. Campbell, W. Boyd, and A. J. Kirkpatrick. Treatment of crude bicarbonate of soda to obtain caustic soda, carbonic acid, and other products. October 21.

21,217. C. W. Heaton. Treatment by the Claus process of gases containing sulphuretted hydrogen, and recovery of valuable products therefrom. October 14.

1891.

891. O. Imray.—From The Farbwerke Greisheim-on-Maine, W. Notzel and Co. Process for obtaining pure nitric acid direct in nitric acid reaction apparatus. October 14.

3230. J. Ascough. Manufacture of sodium biborate of borax, sodium crystal carbonate, or soda and other compounds containing sodium or boron, or both. October 14.

10,202. H. H. Lake.—From The Kayser Patent Co. Manufacture of caustic alkali, carbonates of the alkaline metals and muriatic acid, and of bricks, cakes, and blocks for use therein, and apparatus therefor. October 14.

14,941. H. Walter and E. Bærnig. Lead chambers used in the manufacture of sulphuric acid. October 14.

15,136. F. Fichstädt. Process for the production of caustic alkali, carbonate of alkaline metals, and useful by-products. October 14.

15,251. C. G. Collins. Process for purifying brine. October 14.

15,644. C. Glaser. Improvements in and relating to the art or process of manufacturing phosphoric acid from phosphatic material. October 21.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

Applications.

15,586. T. Knight. Improvements in the manufacture of earthenware jugs, cups, and such like vessels. September 15.

15,784. E. Lenk. Improvements in thimble pins for supporting earthenware while being fired. Complete Specification. September 17.

15,891. H. Stephenson. Improvements in and relating to the construction of kilns or ovens for drying and burning bricks, tiles and the like. September 19.

16,005. G. Pitt. An improved mode of constructing flues for brick, terra-cotta, and other kilns. September 21.

16,437. W. Ambler. An improved method and means to be used in the manufacture of glass bottles. September 28.

16,846. D. Rylands and A. Husselbee. An improved process for lining metallic or other vessels or tubes with glass. October 3.

17,126. J. Slater and J. J. Royle. Improvements in treating china, earthenware, and other like surfaces for various useful and ornamental purposes. October 8.

17,443. W. Goodman. Improvements in the manufacture or production of marbled glass. October 13.

COMPLETE SPECIFICATIONS ACCEPTED.

1890.

16,131. J. W. Payne. New or improved portable or fixed continuous firing kiln for burning and staining glass, china, tiles, and enamels. September 30.

17,068. J. P. Guy. Machines for pressing and making hollow earthenware articles. October 21.

19,532. D. Rylands. Manufacture of glass and other ware, and of the caps for such ware. October 21.

20,240. F. E. Grant. Process relating to the application of coloured designs to vitreous surfaces, and machinery therefor. October 14.

20,421. D. Rylands and B. Stoner. Manufacture of glass taps and glass tees and other hollow ware. October 21.

1891.

14,076. J. Sherwin. The encaustic method or process of decorating tiles, plaques, and other articles of earthenware, china, and stoneware. September 30.

15,784. E. Leak. Improvements in thimble pins for supporting earthenware while being fired. October 21.

IX.—BUILDING MATERIALS, CLAYS, MORTARS AND CEMENTS.

APPLICATIONS.

16,005. G. Pitt. *See* Class VIII.

16,137. J. T. Welch and W. J. Owen. Improvements in the utilisation of granite and other kindred rocks in the manufacture of bricks, tiles, and other articles. September 23.

16,200. H. Ratcliffe. Improved decorative or ornamental wallings, ceilings, and the like. September 24.

16,375. W. R. Taylor. Improvements in or connected with and apparatus for the burning of cement-making materials, lime, chalk, and the like. September 26.

16,860. S. de la G. Williams. Improvements in kilns for burning lime or cement. October 3.

17,050. J. U. Robertson.—From C. W. Kennedy, United States. *See* Class XIII.

17,135. A. T. Hall. Improvements in or relating to the manufacture of concrete and similar slabs or blocks for paving and other purposes, and in means therefor. October 8.

17,466. T. A. Lee. Improvements in fireproof floors and roofs. Complete Specification. October 13.

17,556. C. Cancellieri. An improved composition for paving, flooring, building, and like purposes. October 14.

17,632. E. Edwards. — From O. Terp, Germany. Improvements in the manufacture of artificial stone. October 15.

COMPLETE SPECIFICATIONS ACCEPTED.

1890.

15,782. J. F. Chiverall and A. Chiverall. Manufacture of imitation stone, slate, marble, and wood. October 14.

1891.

12,219. W. J. Reagan and R. R. Longley. Composition of matter for plastering walls. September 30.

X.—METALLURGY, MINING, ETC.

APPLICATIONS.

15,566. E. B. Parnell. Improvements in or relating to amalgamators for use in the treatment of metalliferous ores. September 14.

15,567. E. B. Parnell. Improvements in furnaces for treating ores. September 14.

15,744. E. L. Mayer. Improvements in or connected with the extraction and recovery of gold. September 16.

15,745. F. J. Clinch-Jones and J. Gardiner. Improvements in metallurgical furnaces and in the use of heat radiated or resultant therefrom. September 17.

15,782. G. L. Addenbrooke. Improvements in alloying aluminium with other metals. September 17.

15,892. R. Starke and W. Paterson. Improvements in the extraction of metals from ore. September 19.

15,893. R. Starke and W. Paterson. Improvements in the extraction of metals from ore. September 19.

16,178. C. Walrand and E. Legénisel. Improvements in the treatment of steel, and in apparatus therefor. September 23.

16,192. F. Edwards.—From H. Schoenwaelder, Germany. Improvement in Siemens-Martin furnaces. Complete Specification. September 23.

16,273. J. H. Bibby. Improvements in the process of smelting copper ores and in furnaces or apparatus applicable therefor. September 24.

16,274. J. H. Bibby. Improvements in reverberatory or other furnaces for treating copper, copper ore and certain other metals. September 24.

16,348. J. J. Shedlock and T. Denny. A process and apparatus for extraction of metals from ores. Complete Specification. September 26.

16,486. L. L. Burdon. Improvements in the manufacture of seamless compound ingots and wire. Complete Specification. September 29.

16,544. H. H. Lake.—From H. A. Harvey, United States. Improvements in the manufacture of armour plates. Complete Specification. September 29.

16,683. C. A. Burghardt. Improvements in the production of alkaline solutions of zinc or tin from their respective ores. October 1.

17,224. C. Simmons. Improvements in the method of and apparatus for casting a steel block or ingot with a hole therethrough. October 9.

17,315. J. H. Pratt. New or improved metallic alloys. October 10.

17,450. L. A. Pelitan. An improved process of treating copper ores and mattes. October 13.

17,527. J. H. Noad. An improved process for the recovery of tin from tinned iron scrap or waste cuttings, and zinc from galvanised iron at the same operation. October 14.

17,621. H. W. Wallis. Improvements in the concentration of pyritic ores. October 15.

17,636. F. Webb. Improvements in means or apparatus for extracting precious metals from their ores. October 15.

17,745. F. M. Lyte and C. H. M. Lyte. *See* Class VII.

17,755. J. B. Alzugaray. Improvements in basic furnace lining and basic material. October 16.

Complete Specifications Accepted.

1890.

14,658. J. F. Hall. Manufacture of steel. September 23.

17,173. J. C. Bull. Refining copper. September 30.

18,235. W. D. Bohm. Separation of gold from ores or materials containing it. September 23.

18,718. D. Jenkins. Apparatus to be employed in coating metal sheets or plates with tin or other metal or alloy. October 7.

19,734. J. Y. Johnson.—From A. Imbert and G. Jullien. Manufacture of iron and other metals, and apparatus therefor. October 7.

19,910. J. Heydon. Means and apparatus for making the moulds in which metals are to be cast. October 7.

20,393. H. C. S. Dyer. Manufacture of steel. October 21.

20,415. H. R. Haigh. Construction of furnaces for puddling, heating, &c. October 14.

1891.

210. T. Langer. Improved fusible mass for case-hardening purposes. October 21.

2049. E. Edwards. — From E. Honold. Process and apparatus for desilverising lead. September 30.

2673. J. H. Darby. Manufacture or purification of steel or homogeneous metal. October 21.

6303. J. H. Darby. Manufacture of steel. October 21.

12,116. H. H. Lake.—From J. C. Pennie. Apparatus for disintegrating ores, &c. for the purpose of separating metals and metallic compounds from their gangue. October 21.

13,739. C. James. Treating plumbiferous copper mattes and ores. October 21.

XI.—ELECTRO-CHEMISTRY and ELECTRO-METALLURGY.

Applications.

15,375. A. de Meritens. Improvements in galvanic batteries. September 14.

15,597. C. C. Fisher. From R. H. Thompson, United States. An improved battery. Complete Specification. September 15.

15,621. S. C. C. Currie. Improvements in the method of making the plates or elements of a secondary or storage battery. Complete Specification. September 15.

16,270. W. P. Thompson. From E. Correns, Germany. Improvements in or appertaining to accumulators for the storage of electric currents. September 24.

16,487. H. H. Leigh.—From J. B. Gardiner, United States. Obtaining a fluid for primary batteries and of recovering the effective matter from the spent fluid. Complete Specification. September 29.

16,522. W. P. Thompson.—From C. L. Coffin, United States. Improvements in or relating to electrically soldering or brazing metal. Complete Specification. September 29.

16,667. H. Williams and W. Hepworth-Collins. Improvements in the method of and means for manufacturing nickel tubes, rods, and other bodies by electrical deposition. October 1.

16,934. H. H. Lake. From P. Kennedy and C. J. Diss, United States. Improvements in secondary or storage batteries. October 6.

16,938. H. H. Lake.—From P. Kennedy and C. J. Diss, United States. Improvements in secondary or storage batteries. October 6.

17,003. A. F. Madden. Machines for making grids for secondary batteries. Complete Specification. October 6.

17,160. H. H. Lake.—From La Société dite Electriciteits-Maatschappij (Systeem de Khotinsky), Germany. Improvements in and relating to electric accumulators. October 8.

17,426. E. Andreoli. Generating ozone by electricity. Complete Specification. October 13.

17,430. H. M. Lamb. Electric batteries. Complete Specification. October 13.

17,655. G. D. Burton, A. H. Eddy, and G. T. Briggs. Improvements relating to the heating of metals by electricity and to machines therefor. Complete Specification. October 15.

17,725. A. P. Morrison, J. Hirshfeld, and W. Wright. Improvements in battery compounds. October 16.

17,758. The Mining and General Electric Lamp Company, Limited, and J. T. Niblett. Improvements in elements for secondary batteries. October 17.

17,808. A. J. Boult.—From H. L. H. Maugras, France. Improvements in electrical accumulators or storage batteries. October 17.

Complete Specifications Accepted.

1890.

16,747. J. R. Thame. Manufacture of electrical insulating materials. September 30.

19,344. E. Placet and J. Bonnet. Improvements in electrolysis in general, and particularly in electrolysis of metals. September 30.

19,650. Siemens Brothers and Co.—From Siemens and Halske. Distribution of electricity through accumulator batteries. October 21.

1891.

9683. T. J. D. Rawlins and A. Walker. Electric primary batteries. October 21.

10,347. D. Fitzpatrick. Electric battery. September 23.

12,898. T. Parker. Means for the electrical deposition of copper. October 14.

15,597. C. C. Fisher.—From R. H. Thompson. Improved galvanic battery. October 21.

15,621. S. C. C. Currie. Improvements in the method of making the plates or elements of a secondary or storage battery. October 21.

XII.—FATS, OILS, and SOAP MANUFACTURE.

Applications.

15,538. W. K. Marsden. An improved oil-press wrapper or envelope. September 14.

15,547. J. Alexander and Co., Lim., and H. de Laspée. Improvements in the manufacture of soap and saponaceous compounds. September 14.

16,034. R. Hutchison. Improvements in the manufacture of lubricants. September 22.

16,552. H. H. Lake.—From La Société Anonyme des Parfums Naturels de Cannes, France. Improvements relating to the purification of the residues or cakes obtained from fatty substances, oleaginous fruits, or grains. September 29.

16,557. W. R. Dodd. The manufacture of an improved soap. September 29.

17,410. R. F. Dewhurst. Improvements in the manufacture of a new soap for general purposes. October 13.

17,440. J. Templeman. Improvements in and relating to the manufacture of soaps and saponaceous compound. October 13.

17,482. A. F. St. George. An improved method of and apparatus for the boiling and refining of linseed and other oils employed in varnishes and for other purposes. October 14.

17,528. A. F. St. George. An improved method of and apparatus for removing or deriving glycerin from fats, oils, greases, and the like materials, and refining the glycerin derived therefrom. October 14.

17,553. H. H. Lake.—From J. Ketchum, United States. An improved lubricating compound for the chains and bearings of cycles and for other purposes. Complete Specification. October 14.

Complete Specifications Accepted.

1890.

17,160. E. Hermite, E. J. Paterson, and C. F. Cooper. Process for bleaching palm oil and other vegetable oils. September 23.

1891.

14,365. O. K. Thomassen. Apparatus for purifying waste oil. October 14.

XIII.—PAINTS, PIGMENTS, VARNISHES, and RESINS.

Applications.

15,767. L. Ingram and T. Allwood. A composition for laundry purposes, and means for containing and applying the same. September 17.

15,791. S. Banner. Improvements in substances applicable for varnish, paint, and other things, and in the method of manufacturing the same. September 17.

15,995. R. C. Anderson. An improved manufacture of paints or varnishes for coating leather, cloth, and other materials. September 21.

16,058. J. C. Martin. Improvements in the manufacture or treatment of lead pigments. September 22.

16,098. J. C. Fell.—From C. A. Stevens, United States. Improvements in the manufacture of white lead. Complete Specification. September 22.

16,129. F. J. Rowan and B. Dawson. Improvements in apparatus for oxidising lead sulphide and zinc to form white pigments. September 23.

16,331. S. Banner. Improvements in or appertaining to varnishes, paints, drying oils, or the like. September 25.

16,582. I. Frankenburg. Improvements in the manufacture of aniline lakes suitable for the manufacture of india-rubber cloth and other purposes. September 30.

16,837. T. A. Egestorff. Paste ultramarine laundry blue in tins. October 3.

17,050. J. F. Robertson.—From C. W. Kennedy, United States. Improvements in processes for making plastic compounds or compositions. October 7.

17,221. E. Binney. Apparatus for the manufacture of lamp-black, carbon-black, &c. Complete Specification. Filed October 9. Date applied for March 9, 1891, being date of application in United States.

17,566. C. Dreyfus. Improvements in the manufacture of coloured rubber goods or rubber-coated goods, and a material or preparation to be used in the said manufacture. Complete Specification. October 14.

Complete Specifications Accepted.

1890.

17,197. C. A. Fawsitt. Compounds to be used in vulcanising rubber and other substances or compounds. October 7.

1891.

9231. R. Haddan.—From A. Grammont. Method and apparatus for purifying gutta-percha. October 7.

13,513. M. E. Dejouge. Anti-fouling compounds for ships' bottoms and other purposes. September 23.

XIV.—TANNING, LEATHER, GLUE, and SIZE.

Applications.

15,661. J. de Hesselle. A new or improved method and apparatus for shrinking leather by means of fat. Complete Specification. September 15.

17,544. A. M. Clark.—From L. Starck and Co., through their agents, Wirth and Co., Germany. Improved tanning process. October 14.

Complete Specifications Accepted.

1890.

18,385. L. A. Groth. Process and apparatus for tanning hides and skins. October 7.

1891.

10,596. B. Cannon and W. J. Cannon. Treatment of size, glue, and gelatin. September 23.

XV.—AGRICULTURE and MANURES.

Applications.

16,281. B. L. Fletcher and J. Hoyle. Improvements in the method of and apparatus for treating or drying artificial manure, also applicable for drying grain, minerals, and other substances or materials. September 25.

17,754. J. B. Alzugaray. Improvements in insecticides and manures. October 16.

XVI.—SUGARS, STARCHES, GUMS, Etc.

Applications.

16,164. D. Stewart. Improvements in apparatus for extracting juice from sugar canes. September 29.

17,274. R. W. Deacon.—From W. Maxwell, Java. Improvements in multiple effect apparatus for evaporating or concentrating sugar juice and other liquids. October 10.

17,753. W. Marshall. Improvements in or relating to the utilising of gluten obtained as a bye-product in the manufacture of starch. October 16.

Complete Specification Accepted.

1890.

21,101. F. W. Tompson. Manufacture of invert sugars. October 21.

XVII.—BREWING, WINES, SPIRITS, Etc.

Applications.

15,923. A. Deininger. Improvements in malting apparatus. September 19.

16,960. R. N. Hendrie and J. Renison. Improvements in the manufacture of alcoholic spirits, beer, and stout. October 6.

17,374. J. Takamine. Improvements in the production of alcoholic ferments. Complete Specification. October 12.

17,395. J. Hillyard and E. Dugdale. Improvements in the manufacture of beer and porter or like beverages. October 13.

17,558. H. A. Snelling. Improvements in the manufacture of spirits. October 14.

17,681. R. B. Leaker. An appliance for distributing and aerating brewers' wort. Complete Specification. October 16.

Complete Specifications Accepted.

1890.

18,708. J. Cox. Brewing beer. September 23.

20,073. R. Gonge and Sigmond Bros. Production of dry yeast, cattle food, and spirit from vegetable products containing starch. October 21.

1891.

5700. J. Takamine. Production of ferments and of fermented alcoholic liquors. October 21.

13,047. W. Dawson. Improvements in distillers' safes; applicable for check sampling the spent wash at outlets of "patent" stills, and for taking and testing samples of liquids generally at different times or stages of manufacture. September 23.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

Applications.

A.—Chemistry of Foods.

15,580. V. C. H. Jessen. Improved method of preserving eggs and other articles of food. Complete Specification. September 14.

15,720. L. Rickett and T. Hyatt. Improvements in bread and in the process of treating, combining, and manipulating its materials (including cake materials and the like), and in raising or leavening and baking the same. September 16.

15,955. W. Mackean and C. Boothby. New method for preserving eggs. September 21.

15,992. Denayer's Peptonoids and Extract Meat Co., Lim.—From V. F. Denayer, Belgium. An improved preparation of meat and method of making same. September 21.

16,484. J. T. O'Callaghan. Improvements in the utilisation of malt and germ of wheat for use in bread, biscuits, pastry, confectionery, and beverages. September 29.

16,764. W. Garden. Improvements in the preservation of fish and the like. October 2.

16,765. J. J. Clark. Improvements in non-farinaceous bread, biscuits, and other articles of food. October 2.

16,787. V. Cortaz. Improvements in milk sterilisers. October 2.

16,909. A. D. McKay. An improved medicinal food. Complete Specification. October 5.

17,363. P. Meyer. *See* Class XX.

17,646. W. Cole. Improvements in the manufacture of butter, and in apparatus thereof. October 15.

17,717. B. J. B. Mills.—From A. M. de la Vieuville, France. An improved process for preserving eggs. Complete Specification. October 16.

B.—Sanitary Chemistry.

16,271. A. J. Boult.—From C. Lafforgue, France. Improvements in or relating to the purifying and separating of solid and liquid waste matter in sewage. September 24.

16,968. J. Howden. Improvements in and connected with destructors or furnaces for destroying refuse. October 6.

17,052. J. Johnston. An improved method for destroying smoke. October 7.

17,275. T. B. Wilson. Improvements in the utilisation of sewage sludge and in the production of filtering and purifying material therefrom. October 10.

17,623. W. H. Bowers. *See* Class I.

17,769. E. Grimshaw. A new or improved compound for the precipitation and purification of sewage, and other waste water, and drinking water. October 17.

C.—Disinfectants.

15,842. C. H. Busse. Improvements in disinfectants. September 18.

17,208. G. Spencer. A new or improved disinfectant block. October 9.

17,424. H. B. Thornton. Improvements in or relating to the manufacture of disinfectant tablets, blocks, or the like for use in water-closets, urinals, drains, and other places or articles. October 13.

Complete Specifications Accepted.

A.—Chemistry of Foods.

1891.

6417. A. J. Boult.—From J. J. Sheppard. Treatment of cereals for food and other purposes, and apparatus therefor. October 21.

13,369. G. C. Dymond.—From T. B. Taylor. New cereal food, and method of manufacturing same. September 23.

14,521. J. Falcimagne. Preservation of meat, and apparatus therefor. October 7.

15,580. V. C. H. Jessen. Improved method of preserving eggs and other articles of food. October 21.

B.—Sanitary Chemistry.

1890.

18,983. W. E. Adney. Purification of sewage and other waste liquors, and the recovery of ammonia therefrom. September 30.

1891.

11,716. E. Christield. Purification of sewage, consumption of town refuse, and utilisation of both for obtaining motive power, and apparatus therefor. September 30.

13,757. A. Mylius. Purifying sewage, waste water, and other liquids, and apparatus therefor. September 23.

13,758. A. Mylius. Sterilising liquids, particularly sewage, and apparatus therefor. September 23.

XIX.—PAPER, PASTEBOARD, Etc.

Applications.

16,839. A. S. Caldwell. Improvements in preparing materials for making paper and in apparatus therefor. October 3.

16,921. A. Bürkel and C. Osterwald. New manufacture of composition for blotting or absorbing liquids. Complete Specification. October 5.

17,522. W. Andrew. Improvements in boilers or digesters used in the manufacture of paper pulp. October 14.

17,536. S. Edwards. Improvements in corrugated paper, and in the manufacture of the same. October 14.

17,543. A. Vincent. Improvements in note paper to be used in writing and blotting pads in portfolios. October 14.

17,611. C. G. Moor and J. Nall and Co., Limited. Improvements in the process of and apparatus for obtaining chemical products from waste wood and sawdust. October 15.

Complete Specifications Accepted.

1890.

15,868. C. R. Bonne.—From P. Hunaeus. Manufacture of celluloid articles. October 14.

18,838. A. A. Haigh. Waterproof paper. September 23.

19,545. J. W. Bretherick. Machines or appliances used in the manufacture of paper. September 23.

1891.

14,032. J. D. Tompkins. Treatment of vegetable fibre for pulp manufacture. September 23.

14,272. J. C. Chapman.—From the United Indurated Fibre Co. Composition of matter for waterproofing pulp and other fibrous articles. October 7.

14,756. C. Schœnfelen. Process and appliance for producing fine granulated paper with uniform grain of pyramidical shape. October 7.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES, and EXTRACTS.

Applications.

16,371. O. Imray. — From The Farbwerke vormals Meister, Lucius, and Brüning, Germany. Manufacture of tropine. September 26.

16,552. H. H. Lake.— From La Société Anonyme des Parfums Naturels de Cannes, France. *See* Class XII.

17,137. O. Imray.—From La Société de Laire et Cie., France. Manufacture of vanilloyl carbonic acid and of vanilline by its transformation. October 8.

17,209. A. E. Wright. A new and improved preparation for use as a styptic. October 9.

17,363. P. Meyer. Improved apparatus for the production of dry extract of coffee or tea. October 12.

17,444. A. Reyehler. Improvements in the manufacture of carvacrol. October 13.

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1891.

14,224. P. Ernert.—From P. Ernert. Process for the preparation of phenylester salicylic acid or salol from salicylic acid. September 30.

15,514. S. Pitt. From R. Pictet and Co. Purification of chloroform. October 21.

XXI.—PHOTOGRAPHIC PROCESSES and MATERIALS.

Applications.

15,963. E. J. Browne. A photo-mechanical process of reproducing by chemical action pictures in half tones and set in Prussian blue and other dyes. September 21.

16,072. R. Bird. An improved photographic process and apparatus therefor. September 22.

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16,125. A. Hill. Enlarging photographic gelatin films by the aid of chemical means and without the aid of enlarging apparatus. September 23.

16,698. W. H. Caldwell. Improvements in sensitive materials for photographic purposes. October 1.

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17,143. A. Brin. Improvements in photography and in photographic apparatus. October 8.

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19,402. A. W. Scott. Method and apparatus for producing photographs, and in displaying them or the like. October 14.

XXII.—EXPLOSIVES, MATCHES, Etc.

Applications.

11,326A. W. E. Gedge.—From The California Explosive Co., United States. A novel explosive compound. Filed September 29. Previously included in No. 11,326, and therefore dated July 3, 1891.

15,569. J. R. Powell. Improvements in miners' squibs. Complete Specification. September 14.

16,972. G. McDonald. Improvements in fuses or shell exploders. October 6.

17,102. A. Guinard and G. Bonjour. A new or improved smokeless powder for smooth-bore and rifled guns. October 8.

17,319. W. E. Fidler. A new or improved detonating fog-signalling apparatus and detonators for use therewith for signalling on railways. October 12.

17,826. O. Imray.—From F. A. Spöcker, Germany. An improvement in the manufacture of cordite and like explosives. October 17.

Complete Specifications Accepted.

1890.

18,472. G. Trench. Explosives. September 30.

1891.

13,612. B. Kron. Centrifugal machine for separating acid from nitrocellulose. October 21.

15,569. J. R. Powell. Improvements in miners' squibs. October 24.

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Applications.

15,613. A. J. Boult.—From O. Korschelt, Germany. A new process and apparatus for utilising the vis viva of the ether. Complete Specification. September 15.

16,426. C. J. Price. A novel method of treating waste products of hat manufactories for their utilisation. September 28.

16,910. E. Dean. A new or improved manufacture of eucalyptus products for various useful purposes. Complete Specification. October 5.

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SESSION 1891-92.

1891:—
Dec. 7th:—
Mr. Watson Smith. "A Contribution to our Knowledge of the Soluble and Resinoid Constituents of Bituminous Coals."
Dr. Murray Thompson. "The Salt Industry of India."
1892:—
Jan. 4th—Mr. Boverton Redwood. "The Galician Petroleum and Ozokerit Industries."

Meeting held Monday, November 2nd, 1891.

MR. THOMAS TYRER IN THE CHAIR.

VOLATILE ORGANIC MATTER IN POTABLE WATER AND A SIMPLE METHOD OF ESTIMATING DISSOLVED FIXED AND VOLATILE ORGANIC MATTER IN WATER.

BY W. C. YOUNG, F.I.C., F.C.S.

Consulting Chemist to the Lea Conservancy Board, &c.

THE presence of volatile organic matter in potable water has long been suspected, but with the exception of some experiments by Tiemann and Preusse (Chem. Soc. J. **38**, 29), little has been done to prove its existence.

Frankland, in his book on water analysis, gives directions for the preparation of distilled water free from organic matter, thereby implying the probability of its presence in distilled water prepared in the ordinary way. More recently Berthelot and André (Chem. News, **63**, 176), have shown that the peculiar odour emitted by garden soil after a summer shower is due to volatile organic matter, and Phipson (Chem. News, **63**, 179) has confirmed this, and stated further that chalk and other porous rocks, &c. give a similar odour when moistened, which is due to the same cause. This being so, the presence of volatile organic matter in natural waters may reasonably be expected, and further, the products of fermentation being largely volatile and soluble compounds, it would seem that all waters polluted by decomposing organic matter must necessarily contain volatile organic matter.

In the course of some experiments on a new method of estimating organic matter in water, I made some observations which indicated, beyond a doubt, the presence of appreciable quantities of volatile organic matter, and, as a result of these experiments, extending over a long period, I am now able to submit to you a process by which the actual amount of fixed and volatile organic matter may be estimated, together or separately, in a water.

As it seemed to me hopeless to attempt to separate the organic matter directly from a water residue, I directed my

attention to separating as much as possible of the other constituents and determining the organic matter in the remainder by loss on ignition. Various ways of doing this were tried, but the addition of sodium carbonate and subsequent filtration of the water after concentration by evaporation was found to be the best. In the preliminary experiments, made in this way, I found that when the sodium carbonate was added to the water, before or in the early stages of the evaporation, much more organic matter was obtained than when it was added after the water was concentrated to a small bulk. It seemed to me that the increase could only be accounted for on the assumption that volatile organic matter was present and was carried off with the steam in the absence of sodium carbonate. The fact also indicated that sodium carbonate possessed the property of fixing the volatile organic matter, and subsequent experiments, to which I shall presently refer, confirmed this.

I will not weary you by detailing the very numerous experiments which resulted in partial success or utter failure, but proceed at once to describe the process ultimately adopted. To determine the total organic matter: 1 litre of water, to which 0·5 grm. of dried and ignited sodium carbonate is added, is distilled in a conical iron still of about 2 litres capacity, attached to a tin worm condenser. The distillate is received in a graduated measure and when 970 cc. has been collected the heat is removed, the still disconnected, the contents and washings placed in a platinum basin and evaporated to dryness on a water-bath. The residue is then dissolved in a little pure distilled water, filtered through an asbestos plug into a platinum basin, dried on a water-bath, and subsequently heated for an hour in an air-bath at 150° C. After cooling thoroughly in a good desiccator, the basin and contents are weighed in a quick balance. The residue is then ignited at a low temperature, cooled, and weighed, and the loss noted. The ignited residue is then dissolved in water, excess of sulphuric acid added, and standard solution of potassium permanganate (1 cc. = 0·0001 grm. O) added until the colour remains permanent after five minutes. The weight of oxygen lost, thus ascertained, is deducted from the loss on ignition and the difference is the organic matter. To determine the fixed organic matter the same course is followed, except that the sodium carbonate is not added until the concentrated water is transferred from the iron still to a platinum basin.

To determine the volatile organic matter the distillate from the last-mentioned process is placed in the still together with 0·5 grm. of sodium carbonate and distilled until about 25 cc. remains in the still, afterwards proceeding as before, except that it is unnecessary to ascertain the oxygen lost by ignition. The result represents about two-thirds of the total volatile organic matter present; further small quantities can be recovered from the distillate by repeating the process.

The asbestos used for filtering is prepared in the form of pulp. It should be white and free from hard pieces, ignited, boiled with dilute hydrochloric acid, thrown on to a funnel and washed free from acid, then boiled with strong solution of sodium carbonate, thrown on to a funnel and thoroughly washed. The filter is made by placing a small perforated platinum cone in a sheet-iron funnel, and covering it with the asbestos pulp. The asbestos is then washed down and pure distilled water passed through until the droppings are clear, when the filter is ready for use. The filter may be used repeatedly, in fact until it is completely clogged by the precipitate from the water. In the early part of this investigation an open vessel was used for evaporating the water, and the still was only employed in the first instance for the purpose of collecting the condensed water in order to see whether the volatile organic matter could be removed from it, but it was immediately seen that it was much the better method, as the evaporation was effected in less than half the time, and the water was kept from possible contamination by organic matter in the air during that part of the process.

Stills made of copper and of nickel were successively employed, but rejected as minute quantities of the metal were found in the residues. I have not yet tried platinum, but there can be no doubt it would be the best for the purpose. The process is extremely simple, requires little personal attention, and can be completed within four hours. Having described what I may call the mechanical details of the process, I will now describe its chemical aspects. By the employment of sodium carbonate the whole of the compounds of calcium, magnesium, and iron are precipitated, and any combined ammonia in the water volatilised. There only remains sodium chloride, alkaline nitrates, and uncombined silica to interfere with the loss on ignition being accepted as a measure of the organic matter present, and neither of these compounds being present in estimating volatile organic matter the results may be accepted as free from objection on that account. As regards sodium chloride, the burning of the organic matter is so rapid (a few seconds suffices) and the heat so low that none is volatilised, repeated trials giving the same amount of chlorine in the ignited residue as was found in the water originally. But if a little is lost through excessive heating the loss can be ascertained and due correction made.

As regards alkaline nitrates, provision is made in the process for ascertaining and correcting for loss of oxygen by reduction of nitrates, but I may mention that it is seldom of any great importance and has never exceeded, in ordinary drinking waters, the equivalent of 0·07 grain per gallon. The presence of nitrates assists the burning of the organic matter very materially, and in the case of very foul waters, such as sewage effluents or seriously polluted waters, which seldom contain any, I find it advisable to add a drop or two of solution of potassium nitrate before the final evaporation. With regard to uncombined silica, I have never found it present, and if it should be I do not think the heat required to burn off the organic matter is sufficiently great to cause it to decompose the sodium carbonate.

As there was a possibility of the sodium carbonate retaining some of its combined water after heating for an hour at 150° C., I placed 0·5 grm. in a platinum basin, moistened it with water, dried it on a water-bath, and subsequently heated it for an hour in an air-bath at 150° C. After cooling, the dish and contents were weighed. The sodium carbonate was then fused and the weight again taken after cooling, but no loss was observed. This experiment was repeated with the same result.

Until quite recently it was my custom, after weighing the ignited residue, to moisten it and dry, first on water-bath and then for an hour at 150° C. and again weigh, but as no difference in weight was ever noted I abandoned the practice as unnecessary. The following experiments with known weights of various soluble organic compounds show the accuracy of the process. The dried substance (with the exception of the albumen), was dissolved, together with 0·5 grm. of sodium carbonate, in a litre of distilled water perfectly free from organic matter, and the process carried out as described, a little potassium nitrate having been added in each case before the final evaporation. The experiment with albumen was made as follows:—a small quantity (about 0·1 grm.) of finely-powdered albumen was digested on a water-bath with 1 grm. of dried sodium carbonate in 10 cc. pure distilled water, with frequent shaking, for an hour. After filtering through asbestos the bulk was made up to 20 cc. One half of this solution was evaporated to dryness on a water-bath, heated for an hour at 150° C., and the loss on ignition ascertained. After correcting for reduction of nitrate present the loss amounted to 0·01 grm. The other half was made up to a litre with pure distilled water and submitted to the process in detail.

	Taken.	Found.
	Grm.	Grm.
Cane sugar	0·02	0·02
Grape sugar	0·02	0·0205
Asparagin	0·01	0·0115
Uric acid	0·01	0·0101
Albumen	0·01	0·0104

The following table gives some results obtained by this process with the East London Waterworks Company's water, which was drawn from the main at my laboratory in the offices of the Board of Works for the Poplar District.

TABLE I.

ORGANIC MATTER IN "EAST LONDON" WATER.

Grains per Gallon.

Date.	Fixed.	Volatile.	Volatile + Fixed.	Total in One Operation.
7 May 1890.....	0·315	0·280	0·595	0·637
20 May 1890.....	0·322	0·210	0·532	0·455
27 May 1890.....	0·469	0·280	0·749	0·595
1 July 1890.....	0·329	0·175	0·504	0·574
10 November 1890	0·330	0·350	0·680	0·546
14 November 1890	0·294	0·245	0·539	0·567
19 January 1891..	0·574	0·420	0·994	1·078
12 February 1891	0·484	0·500	0·994	0·980
17 February 1891	0·434	0·350	0·784	0·763
19 February 1891	0·434	0·350	0·784	0·840
24 February 1891	0·560	0·280	0·840	0·882

The first column gives the non-volatile, the second the volatile, the third the sum of the two preceeding, and the fourth the total organic matter obtained in one operation. These results show that volatile organic matter is present in considerable quantity in the "East London" water, exceeding that of the fixed in every case, as the figures represent not more than two-thirds of the total present. A comparison of the figures in the third and fourth columns affords a fair test of the accuracy of the process, and it will be seen that with two exceptions they agree fairly well with each other. In the next table I give the total organic matter, together with the free and albuminoid ammonia and oxygen required (Tidy's method) in a variety of waters of different degrees of purity.

TABLE II.

Grains per Gallon.

Source of Sample.	Total Organic Matter in Solution.	Free NH_3	Albuminoid NH_3	Oxygen required.
Hoddesdon Water Works chalk wells	0·350	0·0014	0·0007	0·0476
River Beane, tributary of the Lea.	0·252	0·0014	0·0021	0·0070
Source of the River Lea.	0·511	0·0007	0·0042	0·0400
Source of the New River	0·693	0·0021	0·0035	0·0560
Intake of New River Co. Hertford.	0·441	0·0014	0·0035	0·0268
Intake of East London, Water Co., Ponder's End.	0·483	0·0056	0·0056	0·0344
Well (shallow) at East Ham.	1·200	0·0630	0·0070	0·0770
Well (shallow) at Little Ilford.	2·360	0·0028	0·0182	0·0700
Well (shallow) at Shaftesbury.	3·080	0·0070	0·0224	0·3850
Effluent, Tottenham Sewage Works.	13·600	4·4100	0·5600	1·8800
Effluent, Tottenham Sewage Works.	30·100	6·7200	0·6300	3·0600
Effluent, Tottenham Sewage Works.	24·000	5·8100	0·5600	2·3000
Effluent, Leyton Sewage Works.	5·600	1·0500	0·1750	..
Effluent, Leyton Sewage Works.	4·930	0·3500	0·1400	..
Effluent, Leyton Sewage Works.	7·700	0·8400	0·2450	..

The two first are exceptionally pure, although one is river water, the next two natural spring water, the two following, river water as taken by the water companies for public supply, the next three, well waters undoubtedly polluted, and the others clarified sewage waters.

From these results it appears that there is no definite relation between the oxygen required or the albuminoid ammonia and the total organic matter in solution. The samples from the source of the Lea and of the New River were taken on the 14th and 15th April 1891 respectively, and those from the intakes of the New River Water Company and the East London Water Company on the 21st April, the weather for some time previous having been fine and dry, therefore they are fairly comparable. The results obtained by this process on these samples establish the interesting fact that the water rising in the springs in Leagrave Marshes, Bedfordshire, contains more organic matter in solution than the water in the River Lea at Ponder's End after travelling about 35 miles, and also that the water of the Chadwell Spring (which is the source of the New River) contains considerably more organic matter in solution than that of the River Lea at the point where the New River Water Company draws its supply, and more than the water from the source of the Lee. In Table No. 3 I give the results obtained with some of the London water companies' water as supplied to the public during six consecutive months. The samples, which were all drawn direct from the mains, were taken at the following places:—

East London, at my laboratory, 117, Poplar High Street; New River, hydrant in Gower Street; West Middlesex, Portland Road cab rank; Kent, Police Station, Blackheath Road.

TABLE III.

ORGANIC MATTER IN LONDON WATER.

Grains per Gallon.

	Fixed.	Volatile.	Total.
1891.			
East London, 12th March	0·294	0·07	0·392
New River, 16th March.....	0·252	0·14	0·350
West Middlesex, 24th March..	0·322	0·28	0·700
Kent, 2nd March.....	0·308	0·07	0·336
East London, 4th April	0·420	0·140	0·560
New River, 9th April	0·420	0·315	0·681
West Middlesex, 9th April	0·392	0·280	0·756
Kent, 2nd April.....	0·280	0·245	0·483
East London, 5th May	0·322	0·210	0·455
New River, 8th May	0·175	0·280	0·406
West Middlesex, 8th May	0·420	0·140	0·483
Kent, 8th May.....	0·273	0·140	0·330
East London, 19th June.....	0·287	0·245	0·525
New River, 13th June.....	0·301	0·350	0·567
West Middlesex, 13th June ...	0·462	0·280	0·777
Kent, 1st June.....	0·553	0·210	0·616
East London, 7th July	0·399	0·210	0·462
New River, 17th July	0·231	0·210	0·455
West Middlesex, 17th July ...	0·336	0·210	0·469
Kent, 1st July	0·266	0·455	0·672
East London, 14th August	0·266	0·210	0·476
New River, 8th August	0·322	0·175	0·462
West Middlesex, 8th August ..	0·357	0·140	0·483
Kent, 1st August	0·238	0·035	0·287

The high figures obtained from the Kent Company's water are very remarkable, as the organic carbon results published monthly by Frankland are always very much lower from this company's water than any of the others. With this exception, these results (taking the last column for comparison) classify the four waters very much as they have been hitherto by the ordinary processes of analysis: that is to say, the "New River" and "East London" are similar in quality, the former occasionally the better, while the "West Middlesex" is (except in July) always the worst. On the other hand, the "Kent," instead of containing very much less organic matter than the others, as we have been led to suppose, contained more than the "East London" and "New River" in June, and in July more than either of the others.

Occasionally, the monthly report of Messrs. Crookes, Odling, and Tidy on the water supplied by most of the London water companies contains an estimate of the organic matter present, which appears to be obtained by multiplying the organic carbon found by 2·5. For the purpose of comparison, I have taken the organic carbon given by Frankland in his official reports to the Local Government Board, multiplied it by 2·5, and placed the results by the side of the fixed organic matter obtained by my process in some of the London companies' water (before referred to) for the corresponding months.

	Frankland Organic C. × 2·5.	Fixed Organic Matter.
East London, March	0·236	0·294
New River, March	0·098	0·252
West Middlesex, March	0·262	0·322
Kent, March	0·057	0·308
East London, April	0·243	0·420
New River, April	0·117	0·420
West Middlesex, April	0·297	0·392
Kent, April	0·075	0·280
East London, May	0·231	0·322
New River, May	0·117	0·175
West Middlesex, May	0·245	0·420
Kent, May	0·063	0·273
East London, June	0·315	0·287
New River, June	0·155	0·301
West Middlesex, June	0·332	0·462
Kent, June	0·082	0·553
East London, July	0·220	0·389
New River, July	0·122	0·231
West Middlesex, July	0·210	0·336
Kent, July	0·082	0·266
East London, August	0·210	0·266
New River, August	0·101	0·322
West Middlesex, August	0·252	0·357
Kent, August	0·077	0·232

It will be seen that although the figures in a few cases agree fairly well, in nearly every instance the "fixed organic matter" is the higher, the greatest difference being in the Kent water results.

In Frankland's and all other similar combustion processes the water is evaporated in the presence of an acid. The experiments I have recorded indicate that the volatile organic matter in water possesses somewhat of an acid nature, and in order to ascertain whether or not the presence of sulphurous acid during the evaporation caused any loss of organic matter, I distilled a litre of East London water, to which 20 cc. of a saturated solution of sulphur dioxide had been added, in a glass retort. When the water was reduced to about 25 cc. it was transferred to a platinum basin and evaporated to dryness on a water-bath, taken up in a little water and filtered through an asbestos plug into a platinum dish. Half a gramme of sodium carbonate was then dissolved in the water, the process continued, and the loss on ignition ascertained as in the ordinary method already described. In this way three experiments gave 0·28, 0·28 and 0·42 grain per gallon respectively against 0·315, 0·322, and 0·469, obtained by evaporating without acid. It therefore appears that the presence of sulphurous acid during the evaporation causes a slight loss of the non-volatile organic matter.

By repeated distillation with sodium carbonate further traces of volatile organic matter are obtained until after the third or fourth repeat the distillate contains no more. The quantity obtained in the process described represents, in ordinary drinking waters, about two-thirds of the total quantity present. By largely increasing the quantity of sodium carbonate less organic matter is contained in the distillate, but distilled water absolutely free from organic matter on the first distillation can only be obtained by frequently agitating the water with 1 per cent. of calcium or barium hydrate and distilling after complete subsidence and separation of the precipitate.

During the last few years a large trade has sprung up in aërated waters prepared with distilled water, the manufacturers claiming, amongst other advantages, perfect purity and complete absence of organic matter. It is evident from the results laid before you that, unless special precautions are taken in its preparation, all distilled water must contain more or less organic matter in solution. Samples of aërated distilled water from two of the largest manufacturers gave the following quantities of organic matter:—

Sample A.	Sample B.
Grs. per Gal. 0·483	Grs. per Gal. 0·378
0·434	0·322

An attempt was made to substitute barium hydrate for sodium carbonate in the process, so that nothing should be present in the residue but the alkaline salts and organic matter contained in the water under examination. The method failed, but the results obtained were so very interesting that I cannot omit to mention them. The experiments were made as follows:—1·1 grms. of barium hydrate was added to 1,100 cc. of East London water, well agitated, and after subsidence 1 litre syphoned off into the still and evaporated to a small bulk. The water and washings of the still were then transferred to a platinum basin and evaporated to dryness on a water-bath, taken up in a little water and filtered through an asbestos plug into a platinum basin. Dilute sulphuric acid was then added in very slight excess, then an excess of barium carbonate, and the whole evaporated to a small bulk on a water-bath. It was then filtered through asbestos, evaporated, dried, and the loss on ignition ascertained as before described.

Two experiments gave 0·175 and 0·119 grain per gallon organic matter against 0·735 obtained with sodium carbonate.

The distillates were treated with 0·5 grm. sodium carbonate and gave only 0·035 grain organic matter per gallon in each case.

These results indicate very clearly that the organic matter present had formed an insoluble compound with the baryta, and was separated in the precipitate. In order to settle this beyond a doubt a litre of the East London water giving 0·56 grain total organic matter per gallon was treated with

a gramme of barium hydrate, well shaken and, after subsidence, the clear liquid syphoned off. The precipitate with the remaining liquid, measuring about 10 cc., was then made slightly acid with dilute sulphuric acid and filtered through asbestos into a platinum dish. To the filtrate 0·5 grm. of sodium carbonate was then added, and when dissolved evaporated to dryness, taken up in a little water, filtered, again evaporated, &c., and the loss on ignition ascertained.

The result gave 0·56 grain of organic matter per gallon, or precisely the same as was found in the water by the sodium carbonate process. This experiment was repeated on another sample of water with a similar result. It is therefore very evident that the organic matter was precipitated by the barium hydrate, and I have good reason to believe that the same result is obtained by substituting calcium hydrate for barium hydrate, although I find a much larger quantity is required.

The process gives only the quantity of organic matter, and although it does not afford any direct evidence of the quality of the organic matter in water still, when there is a large quantity present, the odour given on heating enables a fair opinion to be formed as to whether it is of animal or vegetable origin. Where only small quantities are present I find it quite impossible to decide as to its origin by the odour given on heating the residue. I need hardly say that in case of doubt Wanklyn's ammonia process is capable of giving the required information.

Discussion.

Mr. David Howard remarked that he had the misfortune to live on the lower part of what was, by courtesy, called the River Lea. He could not but regard that title as a misnomer, for the stream was really a prolongation upwards of the London sewers. His experience of the stream in question had caused him to have grave doubts whether the evaporation of water in a dish by ordinary methods could be depended on for the estimation of the impurities contained in it; for he had found that, when the so-called water of the River Lea was distilled in his works, the resulting product was certainly not what one would expect a distilled water to be. One valuable result of the reading of the paper would be its tendency to dispel the common assumption that any water which had been volatilised was necessarily pure distilled water—an assumption which often led to serious errors in analytical work.

Dr. Thos. Stevenson complimented the author on his excellent attempt to determine a very important question in the analysis of waters. He felt considerable diffidence in attempting to criticise the paper, because Mr. Young's work was practically a new departure in the treatment of the subject, and one would like the experiments to be extended over a larger number, and a greater variety of waters, before coming to any definite conclusion respecting the process. One point struck him as singular, namely, the comparison between the deep-well water supplied by the Kent Company, and the analyses of the waters from the Thames-supplied companies. Taking the first analysis given in Table 3, it seemed to him strange that the proportion of volatile organic matter in the East London water should be 0·7, while that of the New River water was 0·14, notwithstanding that the New River intake was partly from deep-well water, and partly from the same river that supplied the East London Company; while at about the same date the amount of volatile matter in the Kent water was precisely the same as that in the East London. This seemed to him to be a very striking fact. He had not himself often analysed the East London water; but taking the river-supplied water of London, and comparing with it that supplied by the Kent Company, one usually found by all the ordinary tests that the Kent Company's water was clear, destitute of colour, and contained less organic nitrogen than the Southwark and Vauxhall or the Lambeth Company's water. This general characteristic had been confirmed by the experiments: and there could be no doubt that the waters ordinarily supplied by those two companies were more coloured, because they received more organic matter than did the water of the Kent Company. This fact forced him to take one of two alternative views. Either rivers were capable of getting rid of organic matter to a greater extent than the water from the deep beds that supplied the Kent Company, or there was some defect in the method adopted by Mr. Young. It was obvious that the method laid before them by the author was a very promising one; and he did not wish his remarks to be taken as depreciatory of Mr. Young's work. With regard to the distilled water professed to be supplied by certain aërated water companies, he could not claim to have much personal experience of the matter; but he had heard from those who had such experience that, when distilled water was used for the manufacture of aerated waters, it was necessary to filter it through animal charcoal. It was well known that distilled water, notwithstanding the utmost care in its production, usually possessed a distinctly unpleasant flavour, and as it was necessary to filter it through animal charcoal, that was probably the source of the large percentage of organic matter—exceeding the amount usually found in the ordinary water supplied to London—which Mr. Young had determined. It was within his knowledge that in some aerated waters produced from distilled water, phosphates had been found, a fact which confirmed what he had said with respect to the use of animal charcoal.

Mr. William Thorp heartily welcomed this attempt to strike out a new method of water analysis. In such cases the common difficulty was that too much attention was given to particular figures, and too little to a broad view of the case. He regarded the analysis of water as analogous to the examination of a patient by a physician, when all the symptoms and factors had to be taken into account, though any isolated facts or figures might be of very little account in themselves. This added to the difficulty of following any proposed new method, and forced one to speak of such methods, in the first instance, with great reserve. At first sight, it certainly appeared to him to be a somewhat retrograde step to attempt to determine the organic matter by ignition, as so much depended in that case on the heat and the general conditions of the process. At one time it seemed to have been thought that organic matter could be absolutely annihilated by ignition. But it was obvious that all that could happen was a decomposition of the constituents, the matter itself remaining always in actual ponderable existence in some form or other. He was surprised to see such great variation in the results obtained from the Kent Company's water. When he was concerned in water analysis, the Kent Company's water was considered almost as a sort of datum line upon which to base the comparison of other waters. But in the tables before the meeting, that water appeared to vary considerably. In March the total amount of organic matter was said to be 0·336; in June, when one would hardly expect it to be much worse, it was given as 0·616; and in July, 0·672, or twice what it was in March. But the point which most puzzled him was that the ratio between the fixed and volatile matter varied so extremely. Referring to Table 3, it would be seen that in March the fixed matter was more than four times as much as the volatile matter; but in April the two were nearly equal, the volatile matter being 0·245 and the fixed matter 0·280. In May the quantity of fixed matter was twice that of the volatile, and in June two and a half times as much, but in July the proportions were reversed, the volatile matter being estimated at 0·455 and the fixed matter at only 0·266. On the other hand, in August the fixed matter was stated as being seven times as great as the volatile matter. Of course he had no evidence whatever against these figures, but it seemed to him unlikely that water drawn from deep wells in the chalk—which would have a sort of integrating action tending to cause the water to be of an uniform composition—would be affected to any great extent by mere surface variations, such as rain or sunshine, heat and cold. It seemed highly improbable that not only the quantity but the nature of the organic matter should vary to such an extent. Perhaps the author could

offer some explanation of these points. He took it that the actual condition of the organic matter in any water was at all times extremely complex, and every process of water analysis had to face that difficulty. Therefore any attempt to get figures directly representing the quantity of organic matter must be received with very great reserve. The usual method of proceeding was either to determine the amount by ignition, or by estimating some of the individual constituents such as the carbon or the nitrogen present. The total amount of the organic matter itself was never determined. If the one method were employed, it was assumed that the total organic matter would vary in proportion to the loss on ignition. If the other, that it would vary in proportion to the carbon or nitrogen. In no case did he think actual figures representing total organic matter could be obtained; and beside all this there was the question of its nature. It seemed to him, therefore, that it was the duty of the water analyst to give due consideration to all the facts of the case, and then report whether the water was good or bad, thus fulfilling the conditions he had started with of the examination of the patient by the physician. He had been greatly interested by the paper, and feared that in criticising it with imperfect knowledge, he might perhaps have unwittingly done the author an injustice.

Major Flower hardly felt justified in taking part in the discussion; but as the River Lea had been unfavourably referred to by Mr. Howard, he might be pardoned for reminding that gentleman that the condition of the River Lea near his works in no way affected the character of the water supply of London.

Mr. David Howard remarked that he did not intend to imply that it did.

Major Flower, continuing, said that many people were fond of using the expression "the filthy River Lea." The bad condition of that river, however, in its lower reaches, was due to the storm-water outlets of the Metropolitan sewers at Old Ford, from which sewage poured forth to the extent of millions of gallons daily. With regard to the samples which Mr. Young had analysed, it might be interesting to record the fact that he (Major Flower) had taken those samples himself, with the intention of putting them in his evidence before the Select Committee on London Water as to the condition of the River Lea. He could not but think that the opinion which Mr. Young had given would be a sufficient answer to those people who said that the River Lea authorities sold nothing but dilute sewage to the London Water Companies.

Mr. David Howard hoped that he had not conveyed the idea that the River Lea which he knew was the River Lea that the people of London had to drink. Unfortunately for him, the people of London drank up the River Lea before it reached his works.

Mr. W. C. Young, in reply, said that with respect to Dr. Stevenson's wish that there had been a greater number of samples, extending over a longer period of time and a larger variety of waters, it seemed to him that he had given sufficient evidence to enable those who read the paper carefully to form an opinion of the process. They had before them the result of six months' investigation into the waters from four representative companies supplying London. In another table they had a number of samples of various qualities from a very pure water down to absolute sewage. He ventured to think, therefore, that when Dr. Stevenson should have had time to read the paper quietly, he would see that it gave illustrations of all kinds of water, and that the analyses were spread over a sufficiently long period. Dr. Stevenson had compared New River and East London water, and expected to find a difference, because the New River supply consisted of a water partly drawn from deep-well water, and partly from river water. But the East London supply was of precisely the same character. The East London Company had supplemented their river supply by deep-well water, and were rapidly approaching the same standard as the New River Company. Dr. Stevenson's statement that distilled water had to be passed over columns of animal charcoal before being used for the manufacture of aërated waters was quite correct. Distilled water, as commonly prepared, had a very unpleasant taste, and gradually became "ropey." It was for this reason that it had to be filtered through animal charcoal. But that would not account for the organic matter contained in such waters; for, if the animal charcoal were properly prepared—and he believed that great care was exercised in preparing it—it would not be capable of adding any organic matter to the water filtered through it. It would, however, undoubtedly add phosphate, as Dr. Stevenson had said. Mr. Thorp seemed to be under an impression that the process which he (Mr. Young) had brought before the meeting was a *réchauffé* of the old "loss on ignition" process. But when Mr. Thorp had further studied the matter, he would find that it was quite a different thing from the old process that used to be relied upon. All the objections to that process were absent from the process which he had brought before them. One was compelled to estimate the organic matter by loss on ignition, for really there was no other satisfactory way of doing it, unless one determined the quantity of carbon present, and guessed at the quantity of organic matter from the carbon; but, as he had said, the present process was free from the faults hitherto connected with that method of working. With regard to the variation in the quantity of organic matter in the Kent water, he might say that he had not only ascertained the actual weight of the organic matter, but that the colour of the residue and the degree of charring was also an indication of the quantity of organic matter present. In every case in which the weight of the organic matter was low, the residue was nearly colourless and darkened little on heating and *vice versâ*; so that the figures given might be said to have been confirmed by observation of the colour during the experiments. He might mention also that the whole of the experiments made on London waters had been given. Not one had been omitted. With regard to the Kent water, the organic matter present therein was evidently of a very peculiar nature, for he had noticed in comparing the results obtained by Dr. Bernays with those got by Dr. Frankland, that the former sometimes showed twice as much as the latter. It seemed to him that the only explanation of this remarkable difference was to be found in the fact that, as shown in his tables, the organic matter in the Kent water varied very considerably. There were one or two objections to the process which members either had not observed or had not referred to, and perhaps it would be well that he should mention them. Where a large quantity of nitrate was present there was, of course, the possibility of decomposition of the nitrate with production of carbonate; but the temperature required for the process was so extremely low (below red heat) that there was no fear of the decomposition of nitrate. He had made experiments, using known weights of nitrate of potash (largely in excess of the quantity present in any of the London waters) with the quantity of carbonate of soda stated in the paper, and after allowing for the loss of oxygen as ascertained by the method the difference unaccounted for was only 0·0004 grm., showing that the nitrate of potash was not converted to any appreciable extent into carbonate, as might have been expected. Then, again, with regard to the precipitate formed from the water by the carbonate of soda, it might be suggested that it contained some organic matter, but he had found by experiment that the loss on ignition of the precipitate from 10 litres of water was only 0·004 grm. In another experiment, where 0·286 grm. of the precipitate was taken, there was no loss at all, and in a third the precipitate from two litres (0·427 grm.) lost 0·002 grm. That organic matter might have been suspended in the water; but it was to be remembered that the process which was the subject of his paper took account only of organic matter in solution.

Mr. William Thorp feared that Mr. Young had misunderstood his remarks about the Kent water. His doubts

referred not so much to the quantity of organic matter found in that water as to the great variation of its character In the August sample there was seven times as much fixed matter as volatile, whereas in the previous month—July—the ratio was reversed, and there was, roughly, twice as much volatile as fixed organic matter. It seemed hardly credible that the organic matter in water drawn from very deep wells in the chalk could vary in kind to such an extent as that. Then, again, he had not referred to the number and character of the samples, because Dr. Stevenson had done so for him; but it was to be noticed that all the author's samples had been taken from the neighbourhood of London, and he thought what Dr. Stevenson meant to convey was, that it would be advisable to extend the process to the waters from some of the harder non-calcareous rocks, such as those of the Midland and Northern counties, and in this suggestion he concurred.

Mr. Young remarked that he quite agreed with Mr. Thorp's latter observations.

SOME EXPERIMENTS ON PETROLEUM SOLIDIFICATION.

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It has long been known that the mineral oils can be readily gelatinised or converted into a more or less solid mass by the incorporation of various soaps or by the action of certain saponifying substances which occur naturally, and of which the common soap wort may be taken as an example.

During the last few years several patents have been granted for different modes of applying the above general principles with a view to obtaining a solid product containing petroleum which might be of some commercial utility. When soaps are employed for the gelatinisation of the petroleum a product is obtained which has most of the properties of the soap added, and if the percentage of soap be large the mixture of soap and petroleum can be utilised as a detergent, and many of the cheaper soaps have a considerable quantity of paraffin incorporated with them in this way. It was, however, with a view of ascertaining what was the best and minimum quantity of foreign material necessary to bring about the solidification of the petroleum that these experiments were undertaken, and as the literature on this subject is very meagre, consisting chiefly of patent specifications of inventors who for different reasons have not given a comparative statement of the properties of the different products described, it was thought that a short description of an attempt to systematise this subject would not be uninteresting to members of the Society of Chemical Industry. At the present time, to the best of my knowledge, none of these products are on the market in large quantities, but there is a good deal of private work going on, and there would seem to be no doubt that in a short time there will be industrial applications of these products.

I have grouped for convenience the more important experiments under different headings, and, while they do not pretend to be an exhaustive treatment of the subject, most of the proposed methods for effecting this object will be found to be included. In order to obtain comparative results of the different consistencies of the various products and thus form a guide for future work with those materials which give the most suitable bodies for the different purposes for which they may seem adapted, one kind of petroleum has been used throughout, and as it was a refined oil used for illuminating purposes, better products, so far as consistency is concerned, would in the majority of cases be obtained if a natural oil containing the heavier hydrocarbons were employed.

A.—Solidification by means of Soap.

It is obvious that various methods of procedure may be adopted both for making the soap and also for its incorporation with the petroleum. After several trials it was found that the most satisfactory results were obtained when the soap was actually made in contact with the petroleum, either simply by the addition of an alkali to a fatty acid dissolved in the heated oil, or by saponifying vegetable oils in intimate contact with the petroleum. As already mentioned the conditions for the best incorporation of crude paraffins as an adulterant of soaps is probably well known, although for obvious reasons there is little public knowledge of these conditions. The experiments under these headings were, however, undertaken with a different object in view, and as in only a few cases more than 10 per cent. of soap was present in the finished product, the results will have little interest to the soap maker. The chief results are embodied in the following tables:—

Table I.

Experiments with Fatty Acids.

Fatty Acid.	Lime.	Dry Soda.	Aqueous Soda.	Aqueous Ammonia.	Steam.	Sodium Silicate.	Sodium Aluminate.	Litharge.	Nitrous Acid.
Stearic acid	Soap remains partially suspended in liquid.	Translucent solid granular mass.	Granular, opaque, white firm mass.	Firm mass, opaque and white.	Translucent white jelly.	Pure white, pearly, hard mass.	Hard white translucent mass.	.. ..	.. ..
Oleic acid ..	.. ..	Stiff whitish jelly.	Stiff cream-coloured opaque jelly.	Soap formed, separates from the petroleum.	.. ..	Very stiff, flexible, white jelly.	Stiff cream-coloured jelly.	Separation of cream soap from oil.	No separation of solid elaidic acid.
Elaidic acid	.. ..	Soap formed, which separates.	Soap formed, which separates from petroleum.	Soap formed, which separates.	.. ..	.. ..	.. ..	.. ..	.. ..

An experiment was also tried with aniline, oleic acid, and petroleum to see if a solid product would be formed, but gave a negative result. In the above experiments 10 per cent. of fatty acid was employed, and sufficient base to neutralise it subsequently added.

TABLE II.

EXPERIMENTS WITH SOAPS AND BEE-WAX.

Solidifying Agent.	Water.	Cane Sugar Syrup.	Dilute Hydrochloric Acid.	Dry Soda.	Ammonia.	Sodium Silicate.	Alone.
Commercial soap.	Forms a viscous liquid in which soap is suspended.	Soap separates out and solidifies at bottom.	Semi-solid flocculent mass floating in petroleum.	.. ..	.. ..	.. ..	.. ..
Dry soap.....	Hard yellow compact mass.	.. ..	.. ..	.. ..	.. ..	.. ..	Soap separates out on cooling.
Beeswax	.. ..	.. ..	.. ..	Soft dark brown buttery mass.	Light yellow sloppy mass.	Soft light-brown mass.	.. ..

TABLE III.

EXPERIMENTS WITH OILS AND FATS.

Oil or Fat.	Aqueous Ammonia.	Aqueous Soda.	Dry Soda.	Nitrous Acid.	Sodium Silicate.	Sodium Aluminate.	Litharge.
Tallow	Remains fluid; slight separation of soap.	Separation of oil and of aqueous soap.	Fairly hard light brown mass.	.. ..	Viscous liquor containing insol. soap.	Fairly hard; cream-coloured; solid.	.. ..
Colza oil.....	Forms a perfectly fluid mass.	Forms soap which separates from the oil.	Forms a fairly hard brown mass.	.. ..	.. ..	.. ..	.. ..
Cottonseed oil...	.. ..	Complete separation of soap from oil.	Forms a viscous semi-liquid.	.. ..	.. ..	.. ..	.. ..
Suet	Complete separation of the soap.	20 per cent. forms a whitish cake; some separation.	Pasty brownish mass.	.. ..	Viscous liquid containing semi-solidified soap.	White soap separating from oil.	.. ..
Olive oil	Forms an opaque milky liquid.	Gives a yellowish pasty mass.	Semi-solid brownish mass like vaseline.	No separation of solid elaidin.	Highly viscous liquid containing solid soap.	Stiff opaque jelly.	Separation of soap formed from petroleum.
Lard oil	.. ..	Separation of soap from oil.	Forms a thick viscous liquid.	.. ..	.. ..	.. ..	.. ..
Castor oil.....	.. ..	Hard firm cream-coloured mass.	.. ..	.. ..	.. ..	Forms a very hard, firm mass; some separation.	.. ..
Rosin.....	.. ..	Rosin soap separates out entirely from oil.	Rosin soap separates out entirely.	.. ..	.. ..	.. ..	.. ..
Linseed oil	.. ..	Very little saponification takes place.	Semi solid yellow sloppy mass.	.. ..	.. ..	.. ..	.. ..
Cocoanut oil	Complete separation of white soap from oil.	Saponifies white, hard, and firm mass.	Fairly hard mass, white and opaque.	.. ..	.. ..	.. ..	.. ..

From the above tabular statements it will be seen that the hardest products at the ordinary temperature and those which are most readily formed are obtained (*a*) by the use of the free fatty acids; (*b*) by making the soap in the liquid. In the latter, the glycerin liberated by the saponification of the oil was not removed, and it therefore somewhat modified the appearance and consistency of the product.

A few experiments were also tried substituting potash for soda and ammonia, and it is interesting to note that with certain oils the products obtained are quite equal in consistency to those obtained with the two former alkalis. Although lime and stearic acid gave an unsatisfactory result, further work with lime and the carbonate on the other fatty acids might yield better products. The results obtained with aqueous potash are summarised in the following table (IV.), but no experiments have as yet been carried out with dry potash, although it will be noticed that very different results are obtained when dry caustic soda is substituted for the lye.

TABLE IV.

EXPERIMENTS WITH AQUEOUS POTASH.

Stearic Acid.	Oleic Acid.	Olive Oil.	Cotton-Seed Oil.	Tallow.	Suet.	Castor Oil.
White pearly hard mass.	Cream coloured thin jelly.	Soft, cream coloured mass; some separation of jelly.	Firm white flaky mass resembling lard.	Soft yellow soap separating from oil.	Soft flakes of soap, with considerable separation.	Firm white mass; no separation.

The procedure adopted to obtain these products varied somewhat with the particular experiment, but the following is a general outline of the method used in the laboratory:—100 cub. cms. (82·1 grms.) of commercial paraffin were heated in a capacious basin on a water-bath. The fatty acid or oil used was then added in proportions varying from 5 to 10 per cent. In the case of suet, 20 per cent. was necessary to obtain the best results. When the mixture was at a temperature of about 80° C., it was thoroughly agitated by means of a wheel egg whisk, and then from 1 to 2 grms. of dry soda or an equivalent amount of alkaline solution, &c., introduced. The agitation was then conducted rapidly for a few minutes, during which the saponification of the fat or neutralisation of the fatty acid takes place, and an emulsion of the melted soap with the paraffin is produced. In some cases the soap appears to be soluble in the paraffin at this temperature, but the mixture on cooling solidifies. In the best experiments the mixture gelatinises while still at 80° C., and it becomes difficult to rotate the agitator in the basin. It is obvious that the uses of a solid petroleum which was perfectly fluid at such a temperature would be somewhat limited, but it is more advantageous to determine the melting points of the solid products in the usual way than make any special determination of the temperature at which they become solid on cooling.

The melting points of the product depend on the kind of solidifying agent employed, some being viscous at the ordinary temperature and others varying from 42° C. to 132° C.

Among the vegetable oils employed, the best results were obtained with cocoanut oil and castor oil, both products being hard and white and far superior in these respects to those obtained when olive or linseed oil were used.

The apparent total separation of the rosin soaps from paraffin is noteworthy, as it was hoped that the resin acids would form compounds which would gelatinise the petroleum in a similar way to the vegetable fatty acids. The hardness and consistency of these products varies directly with the amount of soap present, those containing the most soap being the hardest, and, as already alluded to, the presence of glycerin when the gelatinisation is effected by the saponification of an oil or fat tends to lower the consistency to that of a buttery mass. In the case of castor oil the presence of glycerin resulting from its saponification does not, however, prevent the product from being a solid. The products obtained when dry soda is used in the saponification are usually darker in colour, more translucent, and less firm than those made with aqueous soda. Nevertheless, a greater number of good products were obtained with dry soda than when an aqueous solution was used, as the latter class include examples which were absolute failures, the soap produced apparently having no power of occluding of mixing with the paraffin.

On reference to Table I., the influence of water on the combination of finished soap with paraffin will be observed. The product made in this way is substantially that covered by Smith and Pearson in their Eng. Pat. No. 3044, 1889. Desiccated soap refuses to unite with petroleum at the temperature obtained on the water-bath, but on the addition of a small quantity of water and continuing the agitation, a product was obtained which when cold formed one of the best, both from its degree of hardness and its permanency in the air. It would seem that water, or possibly glycerin, was necessary to ensure the formation of these products, and that the solidification was purely mechanical, the soap frothing with the water and then enclosing the paraffin along with or in place of the air in the small bubbles formed.

The failure of the elaidin and elaidates to unite with the petroleum was a disappointment, as I can find no reference to any previous experiment in this direction. Possibly some of the new methods, such as Schmidt's, for the conversion of oleic acid into iso-oleic and stearic acids might be worked to advantage in conjunction with a petroleum solidification process. At the same time it will be noted that several of the products obtained by solidifying with oleates were very satisfactory.

All these processes for the utilisation of various soaps in order to solidify petroleum, are probably covered by the existing patents, especially those of Lawson (Eng. Pat. 2971, 1888), and of Smith and Pearson already referred to. At the same time no one has drawn attention to the modifying action of the glycerin if allowed to be present in the finished product. Saponification by means of silicate of soda is covered by Lawson in his patent, but the use of sodium aluminate appears to be novel. Sodium aluminate appears to be superior to sodium silicate with many oils. It is a much more efficacious agent, for example, with both tallow and olive oil, as it renders these oils available for solidifying petroleum, and which could not be effected under the same conditions with water glass. A patent dating so far back as 1883 by S. M. Eiseman, (No. 3972) apparently covers all methods of making soaps in conjunction with paraffin, either by the action of alkali on fatty acids or on the unsaponified fats and oils. This patentee has also devised a method of protecting the granulated petroleum from atmospheric influences and the action of a moderate temperature, by coating the product with a mixture of calcium or magnesium salts and sodium silicate. He draws attention to the hardness of the products obtained with castor oil and thus confirms what one would conjecture from a knowledge of the soaps made therefrom.

Some interesting products can be obtained by the blending of a soap solidified petroleum with petroleum jelly. When equal quantities of vaseline and refined petroleum are heated together and 10 per cent. of oleic acid and the requisite quantity of dry soda added, a jelly-like and yellow product is obtained which resembles ordinary vaseline in appearance, but of softer consistency and smelling of petroleum. When stearic acid is substituted for the oleic acid a pale-yellow translucent jelly is obtained with dry soda, and a pale yellow opaque jelly when aqueous soda is employed. These admixtures may probably be found useful as a lubricating medium and seem to indicate that useful products could be similarly made from a petroleum from which the lighter spirit only had been removed.

In Eiseman's patent already referred to, entitled "Improvements in heating volatile or inflammable fluids and oils for storage, transportation, and other purposes," an apparently essential part of the process consists in the admixture with the vegetable oil and paraffin before saponification of "an acid or acid combination." It is difficult, however, to see what part the acid plays in the process, as although he uses sulphuric acid and hydrochloric acid in many of the examples he cites, yet with castor oil no acid is employed, "owing to the peculiar acid found therein." As an alkali is subsequently added to bring about the saponification, I have made no experiments in this suggested variation. He further states that when a dry alkali is employed no heat is necessary, but when a lye is used it should be hot, but the temperature should be kept as low as possible. In the experiments done in my laboratory, heat has been found to accelerate if not absolutely to be necessary for the reaction when dry soda is employed, but in no case has the temperature been lower than that obtained on a water-bath. On the other hand, Smith and Pearson, who incorporate 3—5 per cent. of dry soap with the oil, recommend a temperature a little above 280° F. while the soap is added, and afterwards raise the temperature to 400° F. if necessary. At this high temperature the product is liquid and the process is necessarily complicated by the special closed apparatus required when a body like paraffin with volatile constituents is raised to such a temperature.

Lawson's patent and one by Stitt (No. 8604. 1888) are both for incorporating petroleum in soap so as to make an improved detergent, and are therefore somewhat foreign to this inquiry.

B.—Solidification with Vegetable Saponifiers.

Experiments have been tried with the bark of *Quillaia saponaria* which has long been known as producing a semi-solid mass when agitated with a mixture of oil and water. Saponin, the glucoside present in this bark, probably gives it this property, and as it is also contained in horse chestnuts, soap worts, and many plants of the *sapindaceæ* and *mimoseæ*, it may be possible to substitute one or other of these for the saponaria.

The use of Quillaia bark has been covered by two patents (Grave, No. 13,673, 1888, and Stringfellow, No. 14,832, 1890), but in my experiments with it the products have not equalled in hardness nor consistency those obtained by the use of soap.

The best results obtained by its use are given below.

Experiments.	Results.
1. After Grave's process, using 10 per cent. of saponaria decoction.	A stiff pinkish opaque jelly.
2. After Stringfellow's patent, using 1 per cent. ground bark and afterwards adding 10 per cent. water.	A stiff white opaque jelly, which slowly yields its petroleum as a liquid.
3. The same, but using 5 per cent. of bark and the same quantity of water.	White opaque jelly, more permanent than No. 2.

The essential difference in these two methods of working is the substitution of the powdered bark and water for the decoction in the latter process. There is very little difference in the appearance of the product, but it is stated that it is more economical to use the powdered bark, although when its extraction is properly conducted, the whole of the saponin should be present in the decoction, and thus prevent any waste of the bark.

From the low price of saponaria bark at the present time and the small percentage required, it is probably one of the cheapest materials to use for solidifying oils for transport and storage.

C.—Solidification with other Reagents.

The similarity between the absorption of water and paraffin by soap naturally led one to experiment with other materials which form solid masses with water. Gelatin, glue, albumen, casein, gum, and many mineral substances suggest themselves, but on trying these bodies under different conditions no very satisfactory results were obtained.

1. *Gelatin.*—On melting from 3—8 per cent. of size with a small quantity of water on the water-bath, and adding the petroleum, after violent agitation and cooling the mixture solidifies to a tough jelly. With the smaller percentages of gelatin, it was easy to remove the oil mechanically retained by the jelly by squeezing, and on standing it slowly oozed away, and when the percentage of gelatin was as much as 8 per cent. the amount of water required for solution was sufficient to prevent the paraffin from burning. When bichromate was added to the gelatin mixture before cooling, the product also turned out unsatisfactory, and with tannic acid the product obtained was so brittle that it is difficult to see any use for such a material.

2. Albumen coagulated by warming and with acetic acid did not retain any petroleum.

3. Milk, milk extract, and casein likewise gave negative results.

4. Ghatti gum mucilage and ferric chloride give, as is well known, a thick gelatinous mass, but the formation of this compound in the presence of petroleum does not prevent the latter from being easily removed again from the mixture.

5. Inorganic precipitation, *e.g.*, alum by ammonia, calcium chloride and borax, zinc sulphate and soda, calcium chloride and a sulphate, gave negative results.

The reliquefaction of these various products by means of heat or by appropriate reagents is a question of considerable practical importance. A ready means of solidifying petroleum for transport and subsequent reliquefaction for use would be a desideratum. Where saponaria bark is the agent employed, the solid can be reliquefied by the addition of a small quantity of dilute acid, probably owing to the decomposition of the glucose into its sugar and sapogeoin. Stringfellow has claimed the use of acetic acid for this purpose, and recommends the use of 2½ per cent., which he pours over the surface of the jelly so as to entirely cover it. Mineral acids do not behave so well as acetic acid, although if the breaking up of the mass is due to the hydrolysis of the glucoside, dilute sulphuric acid would seem to be the most suitable. When a soap is employed, the oil can be reconverted into the liquid state by heat or by warming with a mineral acid. The completeness of the reliquefaction in the case of a soap-solidified petroleum obviously depends on the nature of the fatty acid liberated from the soap. As I have already mentioned, free stearic acid and water form a translucent jelly with petroleum, hence if a stearate soap has been used, a warm acid will be required, and the stearic acid liberated immediately removed from the warm oil if a liquid is again desired. With oleate soaps the same difficulty does not occur as oleic acid forms no solid product with petroleum.

The disadvantages of a solidified petroleum which is liquid at a temperature below 100° C. are obvious if the material is to be used for burning purposes or as a constituent of briquettes. Stringfellow's saponaria product is stated not to flow when burnt; but apparently his jelly is not primarily intended to be used as a fuel. Many of the soap-solidified products melt at a temperature below 100° C., and would be practically useless for such work. Probably a suitable material for a fuel could be obtained by incorporating the solidified petroleum with finely-divided porous mineral matter, such as kieselguhr or ground brick. Using the latter, I have found such a mixture to burn very well in the open air, and it might be advantageous to substitute such a lamp for outdoor illumination in place of the naphtha lamps at present employed. The Solid Petroleum Pioneer Company, recently formed to exploit a patent applied for by the Messrs. Clenhall, is apparently about to introduce such a mixture. It may, however, be interesting to mention in this connexion that one of the earlier patentees (Eiseman) has already suggested the use of solidified petroleum for incorporation with sawdust, coal, &c., in the making of fuel. In my earlier experiments, using ammonium stearate for the solidification of petroleum, an attempt was made to overcome the difficulties met with in Russia, where this stearate has been used for the manufacture of petroleum candles. Apart from the objectionable smell which such candles emit, the loss of weight owing to the evaporation of the paraffin is considerable. Although only 10 per cent. of stearate is suggested in Russia, my own experiments indicate that about 20 per cent. of stearic acid must be incorporated to obtain a product as firm as ordinary candle material. The loss on exposure to the air may be in part prevented by protecting the surface of the candle with a glaze of some organic material impervious to paraffin. When incorporated with coal-dust, the solidified petroleum, if used in large amounts, can replace pitch in a briquette and form a block fuel which readily ignites.

I have already drawn attention to the vaseline-like products and their possible utilisation as lubricants. Since putting these notes together, I note that another application for an improved process for solidifying petroleum has been patented by S. Lewes.

Discussion.

Mr. Stringfellow said that he was the patentee of one of the processes referred to by the author. The object of that process was to deal with every kind of liquid hydrocarbon, and, in the case of petroleum, as it exuded from the well at the rate of, perhaps, 1,000 gals. per hour, so as to precipitate it rapidly into a gelatinous mass. For this purpose, the bark of the *Quillaia saponaria* was found to be readily applicable, all that was required being to pulverise the bark, and add it with a small proportion of water to the petroleum in cask. Upon agitation, the whole of the mixture solidified into a gelatinous mass in about two minutes, whether the oil thus treated was of a gravity of 0·650 or of the heaviest description, namely, what was known as dead oils—the refuse from the distillation of creosote.

Mr. Stringfellow asserted that in this condition petroleum could be used as fuel with very great advantage, or, on the other hand, it could be readily re-liquefied, in which case the water and bark would be precipitated, and the oil decanted off.

Mr. Boverton Redwood said that, after the very candid opening observations of Dr. Rideal and his too complimentary reference to himself, he felt a little diffidence in offering any critical remarks on the paper, especially as he was afraid that he would not be able to give any useful information. As the author had pointed out, the so-called solidification of petroleum—the conversion of mineral oils into a more or less solid substance—had been attempted many years ago; it certainly could not be less than 15 years since the possibility of so treating petroleum had been demonstrated by an enthusiastic inventor in his (Mr. Redwood's) own laboratory. It was not, however, only in relation to the incorporation of mineral oils with soaps intended for detergent purposes that the subject had made progress since that time; and he was bound to say that, in his opinion, the results given in the paper before them did not altogether satisfactorily indicate the advance which had been made. In some cases the experiments, the results of which were recorded, would, to his knowledge, have furnished different results had they been carried out under somewhat different conditions. Unfortunately, however, the work which had been done was, as the author had stated, of a private nature; and he (Mr. Redwood) was fearful that he might be led into saying things which ought not to be said if he entered into any critical discussion of the paper. The aims of the inventor in relation to the so-called solidification of petroleum might be divided under four heads: first, the production of a soap for detergent purposes; secondly, the manufacture of a grease for lubricating purposes; thirdly, the temporary solidification of petroleum with a view to its transport as a solid, and re-liquefaction; and, fourthly, the conversion of petroleum into a solid form available for use as fuel. The first of these aims was outside the scope of Dr. Rideal's paper, and he did not propose to say anything with reference to it. In respect to the second, the production of a lubricating grease, he presumed from his remarks that he (Dr. Rideal) was not aware that a material of that description, made by one of the processes referred to, had been an article of commerce for years past. A grease of that kind was found under certain conditions to give satisfactory results when employed for the lubrication of machinery. It was either applied through the medium of a spring grease cup, or its supply was regulated by the liquefying action of a copper rod resting on the bearings. It occasionally happened that the employment of such a lubricant resulted in heated bearings; it was therefore necessary for the engineer to carefully watch the action of the lubricators and be prepared to supplement the grease with a copious supply of oil in order to reduce the temperature. That was a serious objection; but it was one which might be overcome. It indicated, perhaps, that the grease in question was not sufficiently sensitive to alterations in temperature. With regard to the other two aims of the inventor, he gathered from the stress which the author had laid on the re-liquefaction of the petroleum, that he looked upon the solidification of the oil with a view to its transport as being more important than solidification in relation to the employment of the product as a solid fuel. He could not agree with that view. Taking for example that which of all petroleum products was the most important commercially, namely, kerosene, it was well known that a great portion of our supplies of that product were brought to the consuming markets in bulk; and practical experience showed that the transport of the liquid in the specially-constructed tank steamers now employed, resulted in a great saving of time and labour. The loading and discharging of an ordinary oil cargo, which formerly occupied a gang of men for many days, could now be effected by means of a steam pump in about as many hours. Obviously, therefore, it would be a retrograde step to convert such a material into a solid, and handle it like coal. At the same time, he considered that there might be certain cases of transport in which it would be advantageous to have the petroleum in a solid form. In his opinion the most important branch of the subject was the use of the material as a fuel, and he was glad to be able to state that the difficulty which appeared to have been experienced in the production of a solid fuel which would burn without fusion, appeared to have been overcome. He had reason to believe that a material of that character would shortly be available; and, looking to the enormous extent to which petroleum was now used as liquid fuel, there could be little doubt that there must be an immense field for the employment of petroleum in a form in which it could be burned in an ordinary fireplace. He might add in conclusion, that, assuming that the special risk connected with the storage of petroleum lay in the liability of the substance to escape in a liquid form under the influence of fire, a solidified petroleum of a suitably high flashing point which did not fuse when burning might presumably be stored without exceptional risk.

Mr. D. A. Sutherland: As Mr. Redwood had spoken exhaustively with reference to the use of solidified petroleum as a fuel, he only desired to make one remark with reference to his experience with the solidification of mineral lubricating oils. Since he first became acquainted with the reaction some eight years ago, he had from time to time solidified such oils and experimented with the view to finding out the chemical reaction that took place. He might at some future time bring forward the information which he had obtained. No doubt, as Dr. Rideal had said, the action was most mysterious. He understood him to say that such a reaction did not occur in the absence of water. His experiments were chiefly made with the lubricating oil obtained in the Scotch shale industry of a specific gravity of about 0·885, and he found it solidified with alcoholic soap solution or exsiccated soap. His object then was the manufacture of railway grease, and the substitution of vaseline in grease materials such as harness paste, for the solidified oil resembled vaseline in colour only and was seldom free from objectionable odour of mineral oil. It was of a jelly-like nature not being soft and pasty like vaseline. Thus, apart from objections from a medical point of view, it would not be a satisfactory substitute. After some time, he found that his compounds began to re-liquefy; but he had some with him which were made some five years ago, and while these, in some cases, had partially liquefied, in others they had remained much in the same condition as when they were made. In using dry soap he had found in all his experiments that it was advisable to use a temperature of about 400° F. The mixture of oil and soap was heated in an enamelled iron basin on a stove, and stirred with a glass rod, when the mixture instantaneously thickened; all that was necessary was then simply to pour the liquid jelly into bottles where it set in cooling. He also understood Dr. Rideal to say he had not found that any inorganic substance produced solidification. He might add that it was a well known fact to those experienced in the manufacture of mineral oils, that occasionally, for some mysterious reason, after treating with acid and alkali the oil becomes a complete jelly. As he hoped to deal specially with the subject later on, it was unnecessary to say more then, than to thank Dr. Rideal for giving them so complete a summary.

Mr. Peter McEwan said he was under the impression that Dr. Rideal had said that aluminate of soda had never before been used for the purpose of gelatinising petroleum. In that, he thought, he was in error, for it was employed in the manufacture of several lubricating bodies, and was recommended for that purpose in Brandt's work on fats and oils. He thought, too, that an important factor had been omitted from the paper, inasmuch as no mention was made of the melting points of the various bodies which the author had produced. That was a very material point, and he hoped that Dr. Rideal would be able to supply the omission. He could not help thinking that the importance attached to the employment of solidified petroleum as a substitute for coal was somewhat amusing. Supposing petroleum could be got as low as 2*d.* per gallon, by the time it was solidified it would cost about 3*l.* per ton, and he

hardly thought that that was a price which would be tolerated even in London, where one was accustomed to pay a pretty high figure for fuel.

Dr. Ridyal, in reply, said that it was hardly necessary for him to refer at any length to Mr. Stringfellow's remarks, as they dealt with his own process rather than with the paper before the meeting. Mr. Boverton Redwood had characterised his paper as being not quite up to date, but he had not specified exactly in what particulars his paper was wanting. In the paper he said that for obvious reasons certain gentlemen had been reticent on the subject; and it was to be inferred from the character of Mr. Redwood's remarks that he wished to include himself amongst the number. At any rate, he was glad to find that the knowledge he possessed on the subject was as complete as that which Mr. Redwood was willing to communicate to the Society. With regard to the production of greasy bodies, he was aware that for lubricating purposes such a mixture as he had described was already in use. Some experiments had been specially directed to ascertaining the viscosity of such mixtures, but, as far as he knew, the actual composition of the grease in the market was not generally known, so that, perhaps, his remarks on that head properly came within the same category as his other statement. With regard to the question of transport, he quite agreed with Mr. Redwood that under most circumstances petroleum could be more advantageously carried in tank-steamers than as a solid, but in certain other cases the opposite would be the case. Especially would it be so in India, where large quantities of castor oil were obtainable cheaply, and could be utilised for solidifying the native petroleum, to which Mr. Redwood had himself drawn attention at a recent meeting of the Society. It seemed to him that it might be feasible to utilise both those bodies on the spot by making a solid fuel for use on the native railways, if not for export. Recent experience in Southern Russia had shown that there were disadvantages in using liquid petroleum for that purpose, so that solidified petroleum might give better results. He was glad to learn that a reliable solid fuel made from petroleum was likely to be introduced soon. Mr. Redwood had not told them how it was to be made, and probably it was one of the patents to which he (Dr. Rideal) had referred as not yet disclosed. With regard to Mr. Sutherland's remarks he did not know that he had anything to say in reply. He had mentioned the vaseline-like products in his paper, but the beeswax product had never been, so far as he knew, mentioned before. That might be said to be a vaseline-like product; and it had certain advantages over a viscid material made from ordinary soap. Mr. McEwan's remarks seemed to him to refer to a patent that Mr. Redwood had drawn his attention to by Marriott, in which a combination of the oils with aluminium salts, forming oleate and stearate of alumina, had been covered for this purpose. But as far as he knew, sodium aluminate had not been described before as being superior for forming these solid products. With reference to the melting points, he might say that they were given in the corrected proof of his paper, and that they varied with the melting points of the soaps or fats employed.

Manchester Section.

Chairman: Ivan Levinstein.
Vice-Chairman: Edw. Schunck.
Committee:

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G. H. Bailey.	P. Hart.
R. F. Carpenter.	A. Liebmann.
G. E. Davis.	Sir H. E. Roscoe, M.P.
H. Grimshaw.	C. Ruby.
Harold B. Dixon.	D. Watson.

Hon. Local Secretary:
J. Carter Bell,
Bank House, The Cliff, Higher Broughton, Manchester.

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

Meeting held Friday, November 6th, 1891.

DR. EDW. SCHUNCK, F.R.S., IN THE CHAIR.

CHAIRMAN'S ADDRESS.

You will, I am sure, join with me in regretting the enforced absence on this occasion of our esteemed Chairman, Mr. Levinstein. Having been invited to take his place at this the first meeting of the session, and give a short opening address to the members of the Section, I do so with some reluctance, knowing how much more effectively, considering his intimate knowledge of what has recently been done and is being done relating to the various branches of chemical technology, our Chairman would have performed the duties devolving on me this evening.

To go over a wide field and into a variety of subjects on this occasion would not be possible within the time at my disposal, nor would it be desirable if possible. I shall confine myself, therefore, to some remarks on a few subjects of general interest.

There is no subject that has of late attracted more general attention, not on the part of experts only, but also on that of the general public, than that of technical education. It has been much discussed in various quarters and widely different views have been expressed in relation to it. Had our Chairman been present this evening he would probably have given us the benefit of his experience and information on this subject—a subject to which he has paid great attention. I must confine myself to a few general considerations.

An idea seems to prevail in some quarters that when once efficient technical schools have been established and are in operation, it will be possible to send a youth there, duly prepared or not, who when his course is completed will be able to take his place as an efficient workman or manager in any trade or branch of manufacture which he may have selected. That this is a complete delusion any one who has paid the least attention to the subject must see at once; for in the first place technical education is essentially and necessarily special education, and cannot advantageously begin before the general education is completed, *i.e.*, before some amount of general knowledge has been acquired, certainly not until a ready command of one language at least has been attained, for one who cannot speak and write correctly cannot for the most part think correctly. It may be said on the other hand that the boys who have completed their course at any of our first-class schools are duly prepared for a technical course; but if I understand the matter rightly, the proposed technical schools are not intended so much for the children of the higher classes, who can be sent regardless of expense to any one of the numerous excellent institutions already existing on the

Continent, but are intended rather for those of a somewhat lower class, the class from which the managers and foremen of our works are mostly taken. The question, it seems to me, is whether the children of members of this class have been and are properly prepared on leaving school to enter on the courses of instruction to be provided for them at the proposed technical institutions. Those who have read the interesting report lately presented to the council of this city by the members of the Technical Instruction Committee who were appointed to visit the educational institutions and schools on the Continent, as well as the report of a deputation from the Manchester Technical School, may possibly be led to think the establishment of technical schools on the model of those on the Continent no difficult task. No doubt it would be an easy matter for the government or municipalities of a wealthy country like ours to build large schools, to supply them with all necessary apparatus and appliances, to appoint competent teachers, and so on, but can they obtain the human material in the shape of scholars to fill these schools and work profitably in them? I confess I have my doubts in this respect. It must not be forgotten that as regards commercial and scientific education some of the continental nations are a generation or more in advance of us. A boy leaving a quite ordinary commercial, *i.e.*, non-classical, school in Germany or Switzerland has a perfect command of his own language, and has a sufficient knowledge of French and English to enable him to write and speak those languages fairly well. His general knowledge is on a par with this, and fits him for immediate entry into higher technical or other schools. Can we say the same of the pupils that have completed their course in schools of the same class in our own country? I am afraid not. In another respect, I fear, the expectations of the public, or a portion of the public, are raised too high. It is thought apparently that a boy, after passing through a technical school, will be able to enter at once on the practice of his own trade. This, however, can never be the case. Questions arise in practice for which no amount of systematic training can prepare the student. Some kind of apprenticeship must be gone through, whether called by that name or not. Difficulties, too, arise when working on a large scale which cannot be anticipated when operating on a small one, a fact which, in the chemical arts at least, is usually experienced by the student, however well trained, when proceeding from the laboratory to practical manufacturing.

On the whole I am inclined to think that the special industries for the promotion of which our Society was founded will not derive as much advantage from any system of technical education to be established in this country as some others, such as engineering and textile industries. Radical changes in great chemical manufactures, such as that of alkali, acids, bleaching powder, &c., occur but seldom, and when they do occur they have to be initiated by persons of profound chemical knowledge, such as is not likely to be possessed by anyone that has been trained in a technical school. When, on the other hand, new processes are firmly established, ordinary intelligence should be sufficient to keep them in good working order, and the same applies of course to such processes as have been going on almost unchanged for many years.

Of the manufacture of fine chemicals I know too little to pronounce any opinion, but I should imagine that the processes coming under this head must require the constant supervision of an educated chemist. There is, however, one department of industry in which even a moderate knowledge of chemistry may be of considerable use—I mean that of dyeing. It is no doubt a difficult task, taking an entirely new natural dyestuff, to separate in a state of purity and examine the colouring matter or matters to which its efficacy is due, and quite as difficult to discover a new artificial dyestuff which shall in any way surpass those previously in use; these are tasks which only an accomplished chemist is equal to. But to take in hand a new dyeing material, to ascertain its chemical and physical properties in general, to find out the various colours and shades it is capable of yielding with various mordants or without mordant on various fabrics, and, generally speaking, to what purposes it may be practically applied, should be quite within the competence of one who has passed through one of the existing excellent dyeing schools, such as those of Manchester or Leeds, or any similar school still to be established. How much remains to be done by the technologist in this department of industry will be apparent to anyone on perusal of Mr. Thomas Wardle's very interesting paper on Tussar Silk read before the Society of Arts on May 14th last. Speaking of the various Indian dyestuffs, of which he used no less than 181 kinds in his experiments, Mr. Wardle says that he succeeded with them in obtaining results absolutely impossible with most of the artificial dyes, good as some of them are, and further that European dyers are unaware of the excellence of scores of to them unknown Indian dyes. I will not here enter on a discussion of the relative value of natural and artificial colouring matters; but I concur with Mr. Wardle that it would be of importance to acquire a knowledge of all the dyestuffs which nature presents for our use. It is possible that we have gone too far in our preference of artificial over natural dyes, and that some of the latter present advantages not attainable by the use of artificial products.

The few remarks I have made are not intended to disparage or discourage the attempts that are being made to improve our present methods of technical instruction, but simply as a warning to those, if any such there be, who think that the task will be an easy one and one that will lead to immediate and striking results.

There is another subject which has of late attracted much attention and to which a few words may on this occasion be devoted. I mean the state of our atmosphere and the state of our rivers as affected by the vast population here gathered together, and the various industrial and other pursuits carried on in our neighbourhood. To most people our fog and smoke laden atmosphere and our polluted streams are exceedingly disagreeable, perhaps even offensive. No doubt it would be very pleasant, probably conducive to health, if our atmosphere could be rendered as clear and pure as that of the Alps or the moors of Scotland. No doubt it would be pleasant if our streams were made clear, pellucid, sparkling, and the abode of numerous fish, so that the contemplative angler might repair to the banks of the Irk or Irwell and pursue his favourite pastime at ease. No doubt, too, though such a desirable consummation might not be entirely reached, it would be possible to make a near approach thereto, and render town life almost as healthy and pleasant as country life. The question is whether the advantages to public health and pleasant living would be commensurate with the enormous expenditure involved in such transformations. At a time when the indebtedness of our towns is on the increase, when our capitalists and manufacturers are being harassed, on the one hand by the exorbitant demands of workmen and on the other hand by the increasingly hostile character of foreign tariffs, it is a question whether it is wise and politic to increase taxation or lay on fresh burdens except for purposes absolutely required by the public welfare. The insalubrity of our towns, as caused wholly or in part by the state of our atmosphere and our rivers, must be proved before we can accept it as a fact. The argument as ordinarily stated, though not perhaps in these exact words, is somewhat as follows:—Our towns are unhealthy—everything that is unpleasant to the senses is unhealthy—the impure state of our atmosphere and our rivers is unpleasant to the senses, and therefore it is one of the causes of the unhealthiness of our towns. This conclusion may be or it may not be correct. Were this Section a debating society, which fortunately it is not, the following thesis might perhaps be set up:—The ordinary impurities of our town atmosphere and of many of our rivers are not prejudicial to animal and vegetable life, provided they do not exceed a certain amount, but on the contrary are rather beneficial. Were animal and vegetable pathology exact sciences like astronomy or physics, founded on systematic observation and experiment, the opinion pronounced in this thesis would ere this have been established as correct or it would have been proved to be inexact. What I maintain is, that we are not in possession of a sufficient number of facts to justify a certain conclusion one way or the other. We must not forget that the difference in effect of surroundings on animal and vegetable life is a result quite as much of a difference of degree as of

kind. What is beneficial in small quantities may be injurious on a large scale. For instance, oxygen, in the proportion existing in the atmosphere, is necessary for the maintenance of animal life, but pure oxygen is a poison. Carbonic acid again, as everyone knows, serves as a food for plants, but a plant immersed in pure carbonic acid gas is soon asphyxiated and perishes. Iron in small quantities is absolutely essential to the life of plants, but a large dose of an iron salt kills them at once. It is possible, therefore, that some of the ordinary impurities of town air may not be so injurious to animals and plants, provided it does not exceed a certain amount, as is commonly supposed. Large quantities of sulphurous acid, as is well known, affect plants prejudicially, but a small quantity may serve to bind the ammonia of the atmosphere and thus act as a fertiliser. Even the finely-divided carbon, the result of the imperfect combustion of coal, may serve a useful purpose. I have observed during a course of years a gradual diminution of insect pests in my garden, especially caterpillars, some kinds of which have nearly disappeared, and also of aphides. This I attribute to a thin coating of carbonaceous matter from the smoke of the adjacent town covering the leaves and other parts of plants so as to render them unpalatable to insect parasites without injuring the plants themselves. I do not attach much importance to the observation, which is not one of a scientific character, but I think the point worth attending to. Our concern at present, however, is chiefly with the effect produced by our vitiated atmosphere on the animal frame. No one need be told that our air is impure—the question is, how much of each impurity is present. Dr. Bailey is at present engaged in solving this question, so far as regards the air of Manchester. When his labours are completed we shall be able to say how much carbonic acid over and above the normal quantity, how much sulphurous acid, how much unburnt carbon, and other products are contained in a certain volume of the air of the town. In possession of these data the physiologist might take up the question and experiment on animals, confining them in artificial atmospheres into which certain amounts of each of the supposed noxious constituents should be introduced, and then ascertaining the effects produced on the health of the animals. This would probably be a somewhat difficult and laborious investigation, but when completed the results would afford a secure basis on which to found argument as well as legislation. No objection to such experiments on the part of anti-vivisectionists or other well-intentioned persons need be apprehended, seeing that the conditions to which animals would be subjected in such experiments would not be more adverse to health than those by which the human inhabitants of towns are for the most part surrounded.

The time at my disposal will not permit my entering on the cognate subject of the pollution of rivers and streams. This subject, a most important one as regards our district, is moreover being taken up and worked out by heads and hands so much abler than my own, I may be excused saying anything about it on the present occasion.

RESEARCHES ON THE FORMATION OF PIGMENT LAKES.

BY CARL OTTO WEBER, PH.D., F.C.S.

The name "pigment lake" is applied to a class of pigment colours which, with regard to their chemical constitution, may be defined as insoluble salts of an organic colouring base or colour acid with either an organic or inorganic acid, or an organic or inorganic base. This definition applies to all true lakes, whatever be the medium, if any, they are fixed upon. A number of organic colouring matters, particularly the basic coal-tar colours, are capable of fixing themselves upon indifferent organic or inorganic media, such as starch, cellulose, alumina, China clay, and others, forming with them pigments, which at first sight appear to be true lake pigments. But in most cases, on treatment with water, they lose more or less of the colouring matter, and are without exception extremely fugitive. The formation of the lake pigments as such is in every respect identical with their production upon the animal or vegetable fibre in the dyeing and printing industries, and we may say that dyeing and printing are only special cases of the production of lake pigments. In all those cases where the production of what I may term the free lakes differs materially from the application of the dyes in those industries, the difference is solely caused by the nature of the respective media upon which the colours or lakes are fixed.

Chemically pure lakes, that is, lakes the formation of which, according to their composition, can be expressed by a simple chemical equation, are manufactured in very moderate quantities only. They are used on a limited scale in calico printing, in the printing of window blinds and playing cards, and in leather dyeing. By far the greatest part of the lakes, which are manufactured at present on a most extensive scale, contain about 90 per cent. or more of various organic and inorganic and mostly white bodies. These are not unfrequently alluded to as diluents, or even adulterants; a very mistaken notion. On the contrary, I venture to say that whenever such bodies are used they are absolutely required, as they have great influence not only on the depth of shade but also on the characteristic appearance of the lake. This fact, however, more closely viewed, is found to be simply an extension of the well-known fact that one and the same dye, if applied to cotton, wool, and silk, produces in many cases strikingly different results. We find, therefore, that in the manufacture of lake pigments the composition and quantity of the body is quite as important as the method employed for the precipitation of the colouring matter upon that body.

According to our definition of a lake pigment as a salt, it is obvious that an organic colouring matter to be capable of forming a lake must be either a base or an acid. This explains why indigo, which possesses neither of these qualities, is quite incapable of forming lakes, and the unique method by which indigo is applied to the fibre is another illustration of this fact. We may therefore divide the organic colouring matters, according to their lake-forming qualities, into two large classes, basic and acid colouring matters, to which correspond fundamentally different methods of producing lakes.

(*a.*)—*Lakes from Basic Colouring Matters.*

All basic colouring matters contain in their molecule one or more amido groups or substituted amido groups, and at least theoretically, each of these groups is capable of combination with acids. Natural basic colouring matters are not known, but amongst the coal-tar colours a considerable number of basic colours have been produced. As a class they are distinguished by a dazzling brilliancy of shade and very great tinctorial power. As regards their fastness, with a few exceptions, they do not occupy a very high position, and on the average are in this respect inferior to the acid colouring matters. For all those purposes, therefore, where great fastness is sought after, the last-named class of colours will be more satisfactory.

The production of lakes from basic colours consists in the formation of insoluble salts by decomposition of the soluble colour salts by suitable acids or their salts. These need not necessarily be soluble in water. In the manufacture of free lakes this process of transforming the soluble colour salts into insoluble compounds is called precipitation. The most important precipitant of the basic colouring matters is tannic acid, which for the application of these colours to cotton is nearly without a rival. For the production of free lakes, however, the use of tannic acid has been nearly abandoned. This fact may partly be accounted for by the exceeding sensitiveness of tannic acid, and therefore also of its lakes, to the presence of iron, which in the practical manufacture of lake pigments is very difficult to avoid. But on the other hand, I have come to the conclusion that to a still greater extent this disuse of tannic acid is due to the crude rule-of-thumb way with which this precipitant has been used, and indeed is still

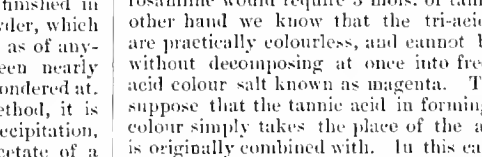
used. The principles of the production of lakes from basic colouring matters and tannic acid, the chemical proportions in which the reaction proceeds, and particularly the nature of the compound lakes of tannic acid and antimony, which are of such great importance in dyeing and printing, have never been so fully investigated as to allow of their successful application to the manufacture of free lakes. As a consequence of this the manufacturers have adopted methods for the production of lakes from basic colours which do not entail the difficulties and impediments of the tannic acid process, but which, unfortunately, entirely sacrifice fastness to brilliancy. The experience made in dyeing and printing has proved conclusively that the tannic-acid lakes are the fastest lakes that can be produced with basic colours.

Where the lake manufacturer uses tannic acid as a precipitant, his method of procedure is as simple as it is objectionable. He contents himself by adding the solution of colouring matter to the white body, which has been previously suspended in water, and he then adds a solution of tannic acid until the colour appears to be completely fixed upon the body. As soon as this point has been arrived at, the lake so obtained is washed and finished in the usual way, either as a lake in paste or in powder, which is more a question of the body the lake contains as of anything else. That this primitive method has been nearly abandoned at the present time is scarcely to be wondered at. In the first place, working according to this method, it is impossible to obtain anything like complete precipitation, except in case the colouring matter be the acetate of a colour base, which applies only to a certain brand of magenta; whereas all other basic colours are either hydrochlorides, sulphates, oxalates, or nitrates. If such a colouring matter is precipitated with tannic acid, the acid which is originally combined with the colouring matter is set free and at once begins to act upon the precipitated lake by redissolving part of it. How much, depends chiefly upon the nature of the liberated acid and the concentration of the solutions used. Acetic acid, in such concentrations as ever occurs in the manufacture of lakes, is incapable of dissolving them, and this is the reason why the acetates of colour bases are completely precipitated by tannic acid. But, as already stated, only a special brand of magenta is sold in the form of an acetate; all crystallised magentas are hydrochlorides, and so are the majority of basic colouring matters.

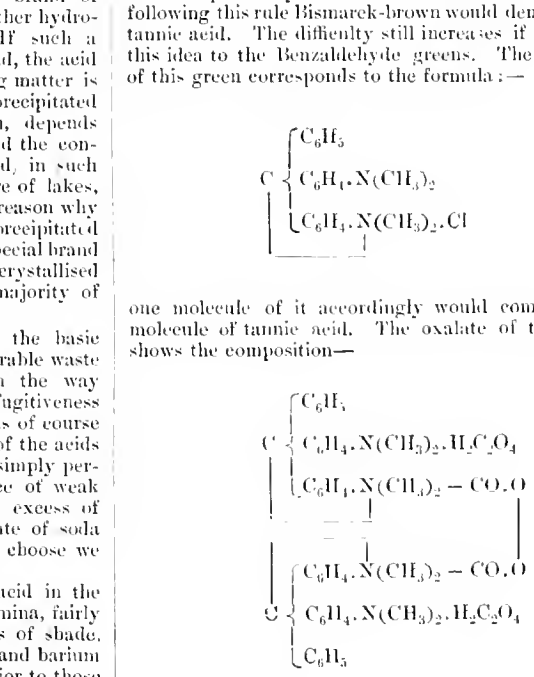
This impossibility to completely precipitate the basic colours with tannic acid is the cause of a considerable waste of colouring matter if lakes are prepared in the way described above. But worse than this is the fugitiveness and comparative dulness of these lakes. There is of course no difficulty in preventing this detrimental action of the acids liberated on precipitation with tannic acid, by simply performing the precipitation either in the presence of weak bases or carbonates, or in the presence of an excess of acetate of soda, or by precipitating with tannate of soda instead of free tannic acid. Whichever way we choose we always obtain complete precipitation.

By precipitating basic colours with tannic acid in the presence of weak bases, such as hydrate of alumina, fairly good results are obtained as regards brightness of shade. Instead of alumina, the carbonates of calcium and barium may be used, but as a rule the shades are inferior to those obtained in the presence of alumina, particularly so with magenta or methyl-violet; and there is no doubt that this is due to the detrimental action of lime or barium salts upon the lakes of the basic colouring matters. Tannate of soda is an excellent precipitant for basic colours, but the shade of the lakes so obtained is exceedingly dull and lifeless. If a lake so prepared is filtered and washed with hot water this fault still increases, and on addition of a few drops of acetic acid nearly the whole of the lake is dissolved. Undoubtedly the best results are obtained by precipitating the basic colours with free tannic acid in the presence of an excess of acetate of soda. The lakes are very bright, which to a certain degree is due to the liberation of a small quantity of acetic acid, and it is well known that in dyeing basic colours on cotton in most cases greater evenness and brightness are obtained by employing a faintly acid dye-bath.

In precipitating a basic colour with tannic acid we evidently transform it into a tannate, eliminating thereby the acid with which the colour base has been originally combined. The first question is now naturally as to the respective quantities of tannic acid and colouring matter, or rather the number of molecules of each which enter into reaction. This is a most important question, not only as regards the manufacture of lakes, but still more so as regards the application of basic colours and tannic acid in dyeing and printing. The reaction between the substances in question is a chemical one, and therefore one in which an absolutely fixed and invariable number of molecules take part. Many attempts have been made to solve this question, but although on the basis of practical experiments valuable information has been gained as to the quantities of tannic acid to be used for some of the most important colouring matters, the respective figures are at most not more than approximations, and do not in any way reveal the quantitative relations of the reaction. Theoretically we might conclude that one molecule of the monovalent tannic acid is required for each amido group contained in the molecule of any basic colouring matter. According to this 1 mol. of rosaniline would require 3 mols. of tannic acid. But on the other hand we know that the tri-acid salts of rosaniline are practically colourless, and cannot be dissolved in water without decomposing at once into free acid, and the mon-acid colour salt known as magenta. This might lead us to suppose that the tannic acid in forming a lake with a basic colour simply takes the place of the acid the basic colour is originally combined with. In this case 1 mol. of magenta would require only 1 mol. of tannic acid, but we find that following this rule Bismarck-brown would demand 4 mols. of tannic acid. The difficulty still increases if we try to apply this idea to the Benzaldehyde greens. The hydrochloride of this green corresponds to the formula:—



one molecule of it accordingly would combine with one molecule of tannic acid. The oxalate of the same green shows the composition—



which would indicate that at least two molecules of tannic acid are necessary to saturate one molecule of the green. The only conclusion these few examples lead to is that no amount of theoretical reasoning will ever enable us to determine the amount of tannic acid required by each of the many basic colours. It also must not be forgotten that the basic dyes of the trade may only in a very few instances be considered as practically pure substances. Most of them contain from 5 to 75 per cent. of indifferent soluble matter, such as dextrin, sugar, common salt, Glauber's salt, or sodium carbonate. Only those colours which are sold in the form of crystals may for all practical purposes be considered as pure. Supposing, therefore, the molecular relations between any basic dye and tannic acid to be known, in the majority of cases we should still require to estimate the amount of

pure colouring matter contained in a given sample. This is a task which at present is considered to be one of the most tedious and difficult to be met with in analytical chemistry.

In view of all these difficulties the way to solve the problem in question in a practical manner might appear to be the analytical estimation of the quantity of tannic acid necessary for the complete precipitation of a definite quantity of basic colouring matter. This is actually what the manufacturer does on a large scale, if he adds to the solution of colouring matter and suspended mineral body, a solution of tannic acid, until the precipitation appears to be complete. He simply aims at a certain physical condition; of the chemical reaction in this process he knows nothing. This slipshod way of working is directly responsible for the very bad reputation the lakes from basic colours enjoy. Working under these conditions the lakes will contain at the utmost only a fraction of that quantity of tannic acid which would have been required for the thorough fixing of the dye. The greater part of the latter is simply mechanically attached, partly by the body of the lake, partly by the real tannin lake which has been precipitated. All this mechanically fixed colouring matter is utterly incapable of resisting the action of the light and air, and a few hours' exposure of such a lake to direct sunlight is often sufficient to destroy its beauty beyond recall.

In my opening remarks I have been referring to the well-known fact that indifferent organic or inorganic bodies are able to fix upon themselves large quantities of basic colouring matters. The real cause of this phenomenon has never been clearly established, but in the meantime it has been christened "molecular surface attraction." Great quantities of lakes are produced in this way, containing nothing but the colouring matter and the base or body, generally starch, hydrate of alumina, or China clay. The distinguishing feature of these lakes, which with the genuine article have nothing in common but the name, is their extraordinary fugitiveness. Tannin lakes, however, are to a much greater extent than even the above-named bodies capable of mechanically fixing basic colours. Accordingly, in producing a tannin lake as just described, a certain quantity of the colouring matter is in the first instance taken up by the body before any tannin is added at all, and subsequently each drop of the tannin solution on being added carries down about twice as much colouring matter as is required for the formation of the normal lake. A simple calculation will show that even under the most favourable circumstances no more than about half the colouring matter contained in the lake is there fixed as a true tannin lake, the rest being present in the free state. Washing with water will only remove a small quantity of this free colouring matter, but it is worth mentioning that such washing is always most injurious to the brilliancy of the lake. Lakes made from magenta, methyl-violet, and Benzaldehyde green behave so in a remarkable degree.

The quantity of colouring matter absorbed by the above-mentioned bodies depends very much upon the nature of the body and its state of subdivision. But on the other hand the nature of the colouring matter is also of great influence, and it appears that the strongest colour base shows a minimum and the weakest a maximum, of mechanical fixation. Of perhaps as great importance is the observation I made that also the nature of the acid which combined with the colour base forms the commercial dye, has a most decided effect upon the phenomenon in question, the strongest acid corresponding to a minimum, the weakest acid to a maximum of so-called surface attraction. These observations may be briefly expressed by saying that the amount of surface attraction is inversely proportional to the respective strengths of the various colour bases and to the respective strengths of the acids which are in combination with them.

These relations are clearly expressed in the experiments registered above. The figures were obtained by suspending 2 grms. of alumina in the form of aluminium hydrate in 500 cc. of water, and adding so much of a half per cent. solution of colouring matter that a drop of the mixture just began to show on filter-paper the first trace of unabsorbed, *i.e.*, running colouring matter.

100 Parts of Al_2O_3 absorb

Colouring Matter.	Parts.	Manufacturer.
Bismarck brown G	8·30	Hampson Bros., Manchester.
Acetate of Magenta.....	7·13	Dan. Dawson Bros., Limited, Huddersfield.
Methyl violet B, extra ..	4·87	Bad. Anilin und Soda fabrik.
Brilliant green, cryst....	3·85	Kuehler und Buff, Crefeld.
Magenta, large cryst. ...	3·53	Dan. Dawson Bros., Limited, Huddersfield.
Indazine M.....	1·96	L. Cassella & Co., Frankfort-on-the-Maine.
Methylene blue B, conc.	1·62	Meister, Lucius, and Brüning, Hoechst.
Thioflavine T.....	1·43	L. Cassella & Co., Frankfort-on-the-Maine.
Solid green, cryst.....	1·21	Kuehler und Buff, Crefeld.
Safranine G G S	0·83	L. Cassella & Co., Frankfort-on-the-Maine.

These remarkable relations between the absorption of colouring matters and the strength of their respective colour bases and of the acids combined with them, show that this surface attraction in all its details is perfectly identical with the well-studied phenomenon of dissociation, which occupies such an important position in the theory of mordanting with the salts of antimony, tin, iron, chromium, alumina, and others. All these salts are more or less capable to dissociate according to the strength of the respective bases and the acids these are combined with, exactly as we found for the basic colours.

This description of surface attraction as dissociation seems, however, incompatible with the fact that the colour bases of most basic colours are colourless, or nearly so, while those lakes formed through surface attraction are nearly all fairly strong in colour, which ought not to be the case if dissociation had taken place resulting in the fixation of the insoluble colourless base of the colouring matter upon the indifferent body present, whereas the acid of the colouring matter would be free in solution. But this objection carries very little weight with it, as it is highly improbable for such a dissociation to result in a quantitative separation of colour base and acid, and the very fact of these dissociation-lakes still being coloured products only proves that the dissociation of the basic colouring matters proceeds on the same lines as that of the above-mentioned inorganic salts, namely, in the production of basic salts insoluble in water.

The capability of basic colouring matters to form basic salts is undisputed, and it is also well known that the latter are either totally insoluble in water or soluble with great difficulty, but all these basic salts are of a very strong colour. These circumstances can easily be demonstrated by adding to a moderately strong solution of Benzaldehyde green a concentrated solution of Glauber's salt or acetate of soda, when a basic salt is precipitated in the form of a dark blue green resinous mass, which in water free from carbonic acid is nearly insoluble. Of course this dissociation must be accompanied by a loss of colouring power, and it is not at all difficult to show that the lakes produced under that influence contain the colouring matter in what I might term a weakened and generally altered form. If we produce such a dissociation-lake upon a body of China clay we invariably find the shade to differ, frequently in a very considerable degree, from the shade of the corresponding tannin lake. As a rule the red dissociation lakes are yellower, the violet and blue ones redder, and the green ones bluer. If we add to any such lake tannic acid or any other preferably organic acid, a considerable change takes place, and the colour of the lake develops immediately into a new, often more than 50 per cent. stronger shade, thus proving that indeed the lake in its first stage contained the colouring matter in a dissociated and therefore partly colourless form. As a more striking illustration in proof of the dissociation we may wash one of these lakes with a large quantity of boiling water. Only traces of colouring

matter are found to go into solution, although at last the lake becomes practically colourless. If we now suspend this lake, which seems to have lost as nearly as possible the whole of its colouring matter, in water, and then add some tannic acid, the colour reappears in nearly its origioal strength. After this I think we may consider the dissociation of basic colours in the presence of organic or inorganic indifferent bodies to be an established fact.

That tannin lakes themselves are capable of absorbing in this way much larger quantities of basic colours than even the above-mentioned bodies, which are used to precipitate the lakes upon, has been already stated. I made this observation in attempting to estimate the quantity of tannic acid required to form lakes with the various basic colours, by titrating the latter dissolved in a 10 per cent. solution of sodium acetate with a 5 per cent. solution of tannic acid, until a drop of the titrated solution placed on filter-paper showed all the colouring matter to be completely precipitated. The results of these experiments are recorded in the following table:—

Colouring Matter.	Tannic Acid actually required.	Tannic Acid found by Titration.
Magenta.....	622	173
Methyl violet.....	510	138
Solid green.....	1,324	456
Methylene blue.....	620	198
Auramine.....	480	209
Chrysoidine.....	322	194

You see that on the average for the precipitation of the basic colours about half a molecule of tannic acid per molecule of colouring matter is sufficient. Now, on weighty theoretical grounds we know that at least one molecule of tannic acid is required to form a true lake, so that in those lakes at least one half of the colouring matter existed in free state. This shows that whenever tannic acid is added to a solution of any basic colour, complete precipitation of the latter is obtained with only partial conversion of the basic colour into a normal lake, and until a certain definite quantity of tannic acid is added over and above that quantity required for the physically complete precipitation of the basic colour, the lake obtained readily succumbs to the detrimental influence of light and air as well as soap and water. I need scarcely say that the same conclusions obtain in the case of cotton, mordanted with tannic acid and dyed in the presence of an excess of colouring matter; the attainment of which at present with the dyer is simply a question of good luck.

These difficulties are attributable partly to the fact that neither the dyer nor the lake manufacturer acknowledge the existence of definite molecular relations between colouring matters and mordants in any but the crudest form, and the calico-printer is in this respect no doubt considerably ahead of them. But on the other hand it must also be admitted that at least in the case of the lakes from basic colours our theoretical knowledge is, for reasons sufficiently stated, rather defective. We know that the formation of a lake from a basic colour and tannic acid is the formation of a tannin salt of the respective colour bases, and we know that at least one molecule of tannic acid is required for one molecule of the colouring matter, but beyond that we are treading on rather unsafe ground, and we must admit, if only the possibility, that two, three, or in certain cases even four molecules of tannic acid may be necessary. A reliable method for the estimation of the quantities of tannic acid actually combining with the various basic colouring matters is therefore of very great importance.

After the experience made in titrating solutions of basic colours with tannic acid, it is obvious that only by adding exactly the required quantity of the latter, or an excess of it to the colour solution, can we expect the whole of the colouring matter present to be converted into the normal lake. What this exact quantity amounts to we do not know, but we are always able to use an excess, and we are also able to estimate volumetrically that quantity of it which did not enter into combination with the colouring matter.

For carrying out this estimation I use (1) a solution of 50 grms. of purest tannic acid and 200 grms. of chemically pure* sodium acetate in 1,000 cc. of distilled water;† (2), a solution of 1 grm. of permanganate in 1,000 cc. of water; (3), a solution of 5 grms. of dry indigo carmine and 100 cc. of pure concentrated sulphuric acid in 1,000 cc. of water. Of the basic colouring matters 1 grm. is dissolved in 200 cc. of water. The first operation is to determine the standard of the permanganate solution against the tannic acid solution. For this purpose 20 cc. of the latter are diluted to 200 cc.; 5 cc. of this diluted solution, 20 cc. of the indigo solution, and 750 cc. of water are mixed in a beaker and then titrated by slowly dropping in the permanganate until the well-known change of colour appears. In exactly the same way the indigo solution is titrated, and we are then able to calculate the number of milligrammes of tannic acid equal to 1 cc. of the permanganate solution.

The mode of procedure is now the following:—25 cc. of the colour solution are run into 20 cc. of the tannin solution, which is contained in a 200 cc. flask. The contents of the flask are gently agitated by shaking, and the flask put on a water-bath for 10 minutes; the colouring matter is now completely converted into the tannin lake. The flask is filled up to 200 cc., well shaken, and the 200 cc., or part thereof, is filtered into a dry flask through a dry fluted filter. 5 cc. of the filtrate, 20 cc. of the indigo solution, and 750 cc. of water are then titrated with the permanganate as usual. We find then the quantity of tannic acid required for 1 grm. of the basic colour under examination by a simple calculation, which leads to the general formula—

$$\gamma = 0{\cdot}32\ b\ (a - c).$$

The number of cc. of permanganate used in the two titrations are respectively a and c in this formula; b stands for the number of milligrammes of tannic acid corresponding to 1 cc. of the permanganate solution.

Supposing we have found of the tannin solution as diluted for standardising 5 cc. + 20 cc. of indigo solution to require 35·4 cc. of permanganate, likewise of the filtrate from the lake 5 cc. + 20 cc. of indigo solution to require 33·2 cc. of permanganate; lastly, 1 cc. of permanganate to represent 1·420 mgrm. of tannic acid, then we have in the above equation $a = 35{\cdot}4$, $c = 33{\cdot}2$, $b = 1{\cdot}42$.

$$\gamma = 0{\cdot}32\ b\ (a - c) = 0{\cdot}32 \times 1{\cdot}42 \times 2{\cdot}2 = 0{\cdot}9988$$

This would mean that 1 grm. of the examined colouring matter, to be completely converted in a tannic lake, requires 0·9988 grm. of tannic acid. From this we can easily find the molecular relations between these two, which figure, however, for practical purposes is of little value, as most of the commercial basic colours are very far from pure, containing as they do varying quantities of sugar, dextrin, or other suitable diluents. Only those colours which are sold in crystals may for practical purposes be considered to be pure.

In the table on the next page I have embodied the results of the examination in the described manner of practically all basic colouring matters known at present.

The first conclusion these results enable us to draw is that, with the exception of chrysoidine, the molecules of all basic colours require more than one molecule of tannic acid to form a tannin lake. This result is perhaps not particularly surprising as far as such colouring matters are concerned, which contain in the molecule two or more molecules of hydrochloric acid (Solid green, Bismarck brown, Indazine), but it is scarcely to be expected for those dyes, which although containing polyacid bases, still are only capable of forming colour salts with one molecule of hydrochloric acid, as is the case with the majority of basic colouring matters. With the exception of auramine and chrysoidine, all basic colouring matters appear to require for each molecule of colour base two molecules of tannic

* Must remain unaffected by permanganate.
† Addition of a trace of thymol acts as an excellent preservative.

Colouring Matter.	Molecular Weight of Pure Product	Tannic Acid required. Per Molecule.	Per Cent.	Manufacturer.
Magenta cryst. A	305·5	622 = 2 mol.	157	Dan. Dawson Bros., Lim., Huddersfield.
Magenta small, cryst.	345·5	648 = 2 mol.	161	Meister, Lucius, and Bruning, Hoechst, a M.
Magenta medium, cryst.	345·5	636 = 2 mol.	161	L. Cassella and Co., Frankfort a M.
Magenta small, cryst.	305·5	611 = 2 mol.	162	Dan. Dawson Bros., Lim., Huddersfield.
Methyl violet BO	393·5	510 = 2 mol. (1)	130	L. Cassella and Co., Frankfort a M.
Crystal violet	351·5	651 = 2 mol.	118	Bad. Anilin und Sodafabrik.
Solid green, cryst.	926·0 (2)	1324 = 4 mol. (3)	143	Kuehler and Baff, Crefeld.
Brilliant green, cryst.	482·0	650 = 2 mol.	135	Kuehler and Baff, Crefeld.
Victoria blue B	470·0	312 = 1 mol. (4)	63	Bad. Anilin und Sodafabrik.
Auramine O	321·5	480 = 1·5 mol.	149	Bad. Anilin und Sodafabrik.
Rhodamine B	478·5	196 = [illegible] (5)	41	Bad. Anilin und Sodafabrik.
Pyronine G	333·5	118 = [illegible] (6)	36	A. Leonhardt and Co., Muhlheim o H.
Pyronine G O	302·5	136 = [illegible] (7)	45	A. Leonhardt and Co., Muhlheim o H.
Safranine G O	350·5	287 = [illegible] (8)	82	L. Cassella and Co., Frankfort a M.
Safranine G O S	350·5	603 = 2 mol. (9)	172	L. Cassella and Co., Frankfort a M.
Night blue	575·5	414 = [illegible] (10)	72	Bad. Anilin und Sodafabrik.
do blue	626·0	821 = [illegible]	122	Bad. Anilin und Sodafabrik.
Methylene blue B extra	703·0 (11)	1237 = 4 mol.	156	Meister, Lucius, and Bruning, Hoechst a M.
Muscarine I	326·5	295 = [illegible] (12)	83	Durand and Huguenin, Basle.
Muscarine R	[illegible]	[illegible]	163	Durand and Huguenin, Basle.
Basle blue B B	504·5	297 = [illegible] (13)	59	Durand and Huguenin, Basle.
Basle blue R	[illegible]	[illegible]	131	Durand and Huguenin, Basle.
Acridine orange	434·5	452 = [illegible]	104	A. Leonhardt and Co., Muhlheim o H.
Azine green B T O	476·5	322 = 1 mol. (14)	68	A. Leonhardt and Co., Muhlheim o H.
Vesuvine O O O, extra	496·0	823 = [illegible] (15)	166	Bad. Anilin und Sodafabrik.
Bismarck brown G	248·0	664 = 2 mol.	134	Hampson Bros., Manchester.
Chrysoidine X X	218·5	350 = 1 mol. (16)	111	L. Cassella and Co., Frankfort o M.
Indazine M	358·0	243 = 1 mol. (17)	41	L. Cassella and Co., Frankfort o M.

Oxalate. (2) Sulfate. (3) For 1 mol. of the colour base this amounts to: 662 = 2 mol. (4) Supposing it to be 75 per cent. strong. (5) Is probably 50 per cent. strong. (6) Very weak product. (7) Is about 50 per cent. strong. (8) A very strong safranine, nearly pure. (9) These colouring matters appear to be about 50 per cent. strong, the red shades Muscarine I R and Basle blue R are, obviously much stronger. (10) This figure for Vesuvine is unaccountably high. (11) This Chrysoidine is nearly chemically pure. (12) Appears to be about 50 per cent. strong. (13) Contains two molecules of colour base.

acid. For the exceptional behaviour of auramine and chrysoidine, I have not been able to find a reason. Both are the mon acid salts of di-acid bases, their respective formula being

$$C_6H_3N{=}N{-}C_6H_3\begin{cases}NH_2\\NH_2\,HCl\end{cases}$$

for chrysoidine, and

$$C\begin{cases}C_6H_4N(CH_3)_2\\C{=}NH\\C_6H_4NCH_3\,HCl\end{cases}+H_2O$$

for auramine. Considering the mono-basic nature of tannic acid, the 1·5 molecules of it combining with 1 molecule of auramine are rather difficult to account for. Of course, we can only speak of half a molecule of tannic acid as an expression of the simplest quantitative relations observed; actually it means that three molecules of tannic acid combine with two molecules of auramine.

The figures of this table and the previous one show that, generally speaking, one quarter the quantity of tannic acid necessary for the complete conversion of the basic colours into a tannin lake, suffices to produce perfect physical precipitation. The danger involved in this fact I have already taken occasion to emphasise, and although the lake manufacturer is by far the greatest sinner, still I must say that not a single sample of cotton yarns did I find dyed with basic colours on a tannin mordant, which did not contain an excess of colouring matter, although perhaps, in fairness to the respective dyers, I ought to state that I only examined medium and dark shades.

On the head of the results gained, it is now easy to understand why tannate of soda, although a good precipitant for basic colours, gives very bad results both as regards beauty of shade and fastness. The majority of basic colours containing only one molecule of hydrochloric acid or its equivalent, can assimilate from the tannate of soda only one molecule of tannic acid, for reasons which are sufficiently clear, whereas two molecules of it would be required to fully develop the shade and produce the maximum of fastness. This fault of the tannate of soda can now be easily remedied by substituting for it what I might term the bitannate of soda. In using the latter we are indeed able to produce lakes which in fastness and beauty are most satisfactory.

It is noteworthy that Koechlin, experimenting on the same subject, but on entirely different lines, obtained results

which approach my figures very closely, although they are still too low. Koechlin recommended the precipitation of the basic colours with such an acid tannate, and gives the following proportions :—

Magenta.—Four of colouring matter, 5 tannic acid, 2 soda crystals.

Methyl violet and *Solid green.*—Four of colouring matter, 5 tannic acid, 1 soda crystals.

The manufacture of tannin lakes has been nearly abandoned by the lake manufacturers, as the bad methods employed produced most ungratifying results, *i.e.*, dull and fugitive shades. Where the use of basic colours cannot be avoided, they are now almost exclusively fixed as arsenites, phosphates, or stearates, and palmitates, the two last ones by precipitation with soaps. All these precipitants give no fast lakes, but more or less brilliant shades, which to no small degree is due to the fact that the lake manufacturer, unconscious to himself, always uses these mordants in quantities amply sufficient for the complete fixation of the basic colours employed, a chance which he has never given to the tannin lakes.

In dyeing and printing, however, the use of tannic acid is predominant, and though other mordants are used sometimes, they are of subordinate importance. The dyer and printer knows well enough, that to produce darker shades stronger mordanting is essential, but dyeing according to molecular proportions is still a thing of the future. It is therefore not surprising to find that all the darker shades especially are more or less overdyed, and therefore more or less deficient in fastness to light, air and soap.

The results recorded in the tables above, and the analytical method brought before you, now enable the dyer to exactly estimate the quantity of basic dye that can be applied to a certain percentage of tannin mordant on the fibre. Of course, I am quite aware of the difficulty that the dyer uses a great variety of tanning materials besides tannic acid. The next thing required is therefore to extend the above tables for all these tanning materials, and also to estimate the quantities of the respective tannic acids which are fixed upon cotton on treating it in the various tannin baths of different strength. This involves some work, but there is no practical difficulty in the way of doing it.

It has been known for a long time to the dyer that the beauty of tannin lakes, as well as their fastness to all influences, is considerably enhanced by treating them with certain metallic salts, only the lake manufacturer has paid no heed to this fact.

On treating a tannin lake with a metallic salt such as certain salts of antimony, tin, zinc, lead, or iron, compound lakes are formed, and Witt has particularly showed that to produce a really bright and fast tannin lake the use of one of those salts is indispensable. Of the above mentioned salts, those of antimony proved to be superior to any other, and since the introduction of these salts, especially tartar emetic, through Th. Brooks, of Manchester, all others, except those of tin and iron, which are used for special purposes, have been practically given up. Neither the dyer nor the printer needs to be reminded of the usefulness of these salts, but the lake manufacturer has up to now never given them a fair trial.

In dyeing, the tanned cotton is always treated in the presence of a more or less considerable excess of tartar emetic or one of its substitutes, and this is of no consequence, as the tannic acid can only fix its due quantity of oxide of antimony, and, before dyeing, any excess of the latter will have been removed. In lake-making this is entirely different, and an excess of antimony salt, especially tartar emetic, would lead to results which are not intended. Tartar emetic, not through being an antimony salt, but through being a tartrate, is a very powerful precipitant of basic colours, with which it forms compound lakes by substitution of the colour base for the potassium, thus :—

$$C_4H_4O_6.K(SbO) + C_{19}H_{18}N_3Cl = \begin{matrix} H \\ OH—C—CO.O.(SbO) \\ | \\ OH—C—CO.O.C_{19}H_{18}N_3 \\ H \end{matrix} + KCl.$$

These lakes are neither very bright, and still less fast, and their formation must therefore be avoided by being careful not to employ an excess of tartar emetic. Other antimony salts containing no acid capable of forming lakes with basic colours, will not precipitate the latter, and may therefore be used with greater safety.

The reaction between tartar emetic and tannic acid might be thought to occur between equal molecules of each which practically would come to equal quantities, the molecular weights of the two being 334 and 322 respectively. But on titrating a solution of tannic acid with a solution of tartar emetic according to Dr. Gerland's method, I found that each molecule of tannic acid requires only half a molecule of tartar emetic, and I satisfied myself by numerous practical experiments that indeed this proportion must not be exceeded, otherwise the lake never settles and it becomes impossible to wash it sufficiently. The lakes obtained from basic colours with the required quantity of tannic acid and the corresponding quantity of tartar emetic are beautifully bright and immensely superior in fastness to the basic colour lakes produced at present.

For reds and pinks, bichloride of tin is frequently used by the dyer in preference to tartar emetic, as the shades, especially when light, are decidedly finer, but it must also be said that they are very moderately fast only. In a similar way, of course, bichloride of tin can be used for the manufacture of free lakes in the proportion of half a molecule of tin salt for one molecule of tannic acid. It is also advisable to add always a sufficient quantity of sodium acetate in order to paralyse the free hydrochloric acid which is produced by the reaction of the tannic acid upon the tin salt.

Besides tannic acid, a great number of organic and inorganic acids are able to form lakes with basic dyes. Nearly all aromatic acids, many of the fatty acids, and of the inorganic acids, phosphoric, antimonic, arsenic, tungstic, molybdic, silicious, and others appear more or less suitable. They are, of course, all used in the form of their alkali salts. The conditions under which lakes with these acids can be obtained are far less complicated as in the case of tannic acid lakes, the reaction being essentially one of substitution of the acid of the colour salt through the acid of the precipitating alkali salt. Most of these acids or their salts must be used in considerable excess, however, to obtain complete precipitation of the colouring matter. This applies especially when dark shades are to be produced; light shades scarcely require an excess of precipitant. But, without exception, I found lakes made from any of these acids not able to bear comparison with the corresponding tannin lakes as far as fastness is concerned. Of the above-mentioned acids, only silicic acid has been suggested for the dyer's use. It can easily be fixed upon cotton by treating the latter in a solution of silicate of soda, wringing out, passing through weak sours, and rinsing. Cotton prepared in this manner takes up most basic colours very eagerly, but the shades, which are generally very bright, are exceedingly fugitive.

Phosphates, arsenites, arseniates, and antimoniates may advantageously be employed for the preparation of lakes upon a body of starch. For the same purpose tartrates, and particularly so tartar emetic, give very good results. All these mordants, if applied in conjunction with other bodies, fail to act satisfactorily, which is due to the fact that lakes on starch are made by working all through the process with as little moisture as possible, whereas those lakes precipitated on mineral bodies are always precipitated from very dilute solutions. More satisfactory are the results if the above-mentioned acids are not used in the form of their alkali salts, but in the form of some sour salt insoluble in water. Used in this way phosphoric and arsenic acid give very good results.

This process is carried out by precipitating a solution of sulphate of alumina with arsenite of soda of the formula Na_2HAsO_3, the precipitate forms with basic colours compound lakes of great beauty, although not very fast. The chief drawback of these lakes is the large amount of arsenic they contain. In this respect the analogous alumina phosphate is quite innocent, but the lakes made from it, although good enough by themselves, are not so bright as

the former. The arsenite and phosphate of alumina used must be the acid salts of the respective formulæ—

$$\left.\begin{matrix}Al=:AsO_3H\\ |>:AsO_3H\\ Al=:AsO_3H\end{matrix}\right. \quad \text{and} \quad \left.\begin{matrix}Al=:PO_4H\\ |>:PO_4H\\ Al=:PO_4H\end{matrix}\right.$$

With the neutral salts of the formulæ—

$$\left.\begin{matrix}Al\ :AsO_3\\ |\\ Al\ :AsO_3\end{matrix}\right. \quad \text{and} \quad \left.\begin{matrix}Al\ :PO_4\\ |\\ Al\ :PO_4\end{matrix}\right.$$

the shades obtained are considerably duller and much more fugitive. The cause of this is evidently the neutrality of those latter compounds, which probably are not able to react with basic colours with formation of a true lake, whereas the above-mentioned acid salts are capable of chemically assimilating the colour bases.

Not unimportant is the use which is made of the alkali salts of the fatty acids (soaps) for the production of lakes in the free state and upon the cotton fibre, the latter application being only made in dyeing and not in calico printing. Only very few basic colouring matters can be precipitated with soap solution, but in the presence of hydrate of alumina, alumina arsenite and phosphates,* and most metallic hydroxides and oxides, lakes are formed in which the fatty acid, or rather an acid salt of it, forms a constituent part. The lakes obtained under these conditions are exceedingly beautiful. But considering the little affinity between colour bases and fatty acids, it is hardly surprising to find them highly fugitive.

This method suitably modified is also used for dyeing, especially for weak shades of magenta, safranine, and methyl violet. The yarn is steeped in a soap solution for some time, wrung out and passed through a solution of tin salt, if for pink or rose shades, or through calcium chloride if for violet. After rinsing the yarns they can be dyed at once, but better results as regards fastness are obtained by taking the yarns previous to dyeing through a weak tannic acid bath. As to the beauty of the shades so obtained there is no doubt, but their fastness amounts to very little, the yarns being very much given to rubbing off.

There now remains a class of acids, which although for a high degree capable of forming lakes, have scarcely been used for this purpose. I am referring to the colour acids, the alkali salts of which are the commercial acid colouring matters. It is well known that acid colouring matters can be used as precipitants of basic colouring matters, and indeed Rawson originated an excellent process for the estimation of naphthol yellow (alkali salt of dinitronaphthol-α-sulphonic acid), by titrating it with a solution of Night blue (basic diphenylnaphthylmethane colouring matter). But most acid colouring matters are able to precipitate basic colouring matters under suitable conditions, and I believe that some of the many possible combinations may prove useful for the preparation of lakes in the free state, but scarcely for dyeing and still less for printing, as these lakes probably will not stand soap. I shall, however, have to refer to this class of lakes again in dealing with the formation of lakes from acid colouring matters, a subject I propose to bring before you at some future date.

Discussion.

Mr. Hurst disagreed with the author when he stated that tartar emetic was not used by lake makers, nor could he quite follow his ideas about surface attraction of these colours. He (Mr. Hurst) had precipitated them on different bases, but had never noticed much surface attraction amongst them, with the exception of Bismarck brown. Had the author noticed that when lake pigments were dried and used as oil colours they seemed slow in drying, which perhaps would account for their being so little used? In paper staining this retarding action was not noticed. He had found the same defect with picric acid, and he attributed it to the action of the picric acid or tannic acid on the oil.

Dr. Weber, in reply, said Mr. Hurst evidently had not understood what he meant by surface attraction and the part it played. He must certainly be aware that if a solution of basic colouring matter were added to starch the starch would take up a great quantity and fix it without any mordant. If then a large quantity of colouring matter were added, which is precipitated with tannic acid until the precipitation appears to be complete, only that amount of colouring matter had been precipitated over and above the quantity the starch has already fixed without any tannic acid at all. Accordingly this quantity was not chemically fixed, but present in a state approaching that of a free base. He (Dr. Weber) had further shown that tannic acid precipitated much more colouring matter than it was able to fix chemically, and he had shown that under the present conditions of making these lakes scarcely ever more than half of the colouring matter was chemically fixed, but existed in the lake nearly as a free base. Taking into account the extreme sensitiveness of free colour bases against light and air, it was evident that such lakes would be extremely fugitive although the colouring matter might have been completely precipitated, which indeed could always be done without any trouble. If Mr. Hurst was of opinion that the dyer would be reluctant to observe methods of dyeing based upon scientific research he (Dr. Weber) thought the dyer would be the worse for that, as the adoption of such results could only turn out to be for his benefit. All yarns dyed in the presence of an excess of colouring matter would be defective in fastness. At present the dyer had no means of ganging the amount of colouring matter he had to apply, and means to do this was afforded by the results he obtained. He agreed with Mr. Hurst's remarks with regard to the behaviour of tannic acid lakes in oil, but it must not be forgotten that scarcely 1 per cent. of them was used in this manner. By far the largest quantity was used by paper-stainers and wall-paper manufacturers. Considering tannic acid was a monovalent acid, and considering further that the antimony radicle in the tartar emetic was also monovalent, the assumption of one molecule of tannic acid combining with one molecule of tartar emetic appeared very plausible; but the actual test he had made showed that only slightly more than half a molecule of tartar emetic was required for one molecule of tannic acid, which came very near Dr. Gerland's results.

* In this case, of course, the neutral salts are to be preferred.

Meeting held on Tuesday, November 24th, 1891.

SIR JAMES KITSON IN THE CHAIR.

Yorkshire Section.

Chairman: Sir James Kitson, Bart.
Vice-Chairman: Dr. F. H. Bowman.

Committee:

A. H. Allen.	J. Lewkowitsch.
W. Brelfitt.	C. Rawson
F. Fairley.	Jas. Sharp.
A. Hess.	A. Smithells.
R. Holliday.	Geo. Ward.
J. J. Hummel.	Thorp Whitaker.

Hon. Local Secretary and Treasurer:
H. R. Procter, Yorkshire College, Leeds.

Notices of Papers and Communications should be addressed to the Hon. Local Secretary.

INAUGURAL DINNER.

On Tuesday, the 24th inst., Sir James Kitson entertained the members of the Yorkshire Section of the Society of Chemical Industry to dinner at the Queen's Hotel, Leeds. The gathering was regarded as the inaugural dinner of the Section, and there was a large attendance, chemists being present from all parts of Yorkshire. Sir James Kitson presided.

The Chairman, after the loyal toasts had been honoured, proposed "The Yorkshire Section of the Society of Chemical Industry." He remarked that that was not an unsuitable spot from which to propose the toast, for across the street was the house in which Dr. Priestley made his great discoveries in chemistry and in applied chemistry. Dr. Priestley in 1772 received the gold medal of the Royal Society for experiments which he made in the method of impregnating water with fixed air. Dr. Priestley wrote at Leeds a familiar introduction to the study of electricity, and in his book he recounted how, in consequence of inhabiting a house adjoining a brewery, he at first amused himself with making experiments on the fixed air which he found ready in the process of fermentation. Dr. Priestley further stated that "the only person in Leeds who gave much attention to my experiments was Mr. Hey, a surgeon, who, when I left Leeds, begged of me the earthen trough in which I had made all my experiments on air." When he thought of Dr. Priestley and the opportunities and the resources which he had, being supported only by a man taking an interest in his experiments, and contrasted that picture with the one which he now saw around him, when gentlemen from all parts of Yorkshire were present—each taking a deep personal and active interest in the application of chemistry to various industrial pursuits—he thought he was justified in saying that Leeds was not an unsuitable place in which to inaugurate the meetings of the Yorkshire Section of the Society of Chemical Industry. His position as Chairman gave him the opportunity of acknowledging how much the iron and steel industry owed to the resources and the work of chemists. He need only refer to the researches made by Sir Lyon Playfair and Sir Lowthian Bell in the examination of the gases of the blast-furnace and the actual operation of the blast-furnace to show them how much the manufacture of pig iron was indebted to these men and to the chemists who have been taught by them. He also reminded them of the great process of Sir Henry Bessemer, which had revolutionised the railway world, the manufacture of steel in this country, Europe, and America, and said that that process owed much to Sir Henry Bessemer's inspiration, his mechanical genius, but it also owed almost as much, if not more, to the researches and teachings of the chemist Mushet. As steel manufacturers, they owed to the chemist the alloys of manganese and iron, silicon, aluminium, and the processes which were used and adopted in the open-hearth furnace. To Sir William Siemens, and more particularly to his brother, Dr. Werner Siemens, they owed the regenerative furnace, which would melt and treat as easily 20 tons of steel as 56 lb. was formerly treated in the ordinary crucible. It was wonderful to reflect upon what was done by Dr. Priestley and the early chemists with the imperfect implements and methods which were familiar to them. It was common to say that, with their Yorkshire College laboratories and with all the opportunities chemists had, they were not producing as much as the older chemists with their imperfect methods. He asserted that they were responding to their opportunities, and that chemists were producing much more than in the past. One special attribute of the chemist of to-day appeared to be the faculty of gathering up waste of every description, and the wealth he created was not subjected to the demands of labour, because all his wealth was the distinct product of his brain. He submitted the toast of the Yorkshire Section of the Society of Chemical Industry, in the belief that it would contribute not only to the prosperity of Leeds, but also of Yorkshire and the country at large.

Dr. Bowman, in responding, agreed with the Chairman, that when they took a retrospect of chemistry they saw a marvellous change. He felt that that inaugural gathering augured well for the future of the Section.

Mr. A. H. Allen also replied.

Sir Lowthian Bell, F.R.S., proposed "The Parent Society," observing that he had been asked what was the function of a Society of Chemical Industry? It was, he apprehended, to bring together gentlemen occupied in the various manufactures based upon the science of chemistry, and to give them an opportunity of comparing their own experiences, and out of that elaborating some general rule which underlays the whole range of chemical industry in the country. Such a society had, as they had been told, great advantages, and the only wonder was that they had not started it earlier in Leeds, which stood on a very high pinnacle in educational matters. Long before other places had colleges for teaching physical science, Leeds had taken steps to erect in its midst a most complete and best appointed college for teaching physical science. It was also a most important thing that they had filled that college with men well qualified to discharge their duties as teachers.

Mr. C. G. Cresswell responded to the toast. He said the Council of the Society congratulated Yorkshire on the formation of a Section, and wished them success in their enterprise. He trusted that the number present was an earnest of those who would attend subsequent meetings. The question had been asked, What was the use of the Society? When it was founded in 1881, many friends and well-wishers said that the Society was not required, that existing societies supplied them with all the information that was necessary for the prosecution of chemistry as applied to industry. The best proof that it did supply a want was that the Society now numbered 2,700 members.

Mr. Sydney Lupton gave the toast of "The Chemical Industries of Yorkshire," to which Mr. Hadfield (Sheffield) responded.

"Scientific Education in Yorkshire" was given by Mr. Richard Reynolds.

Professor Smithells, in acknowledging the toast, said the cry of technical education had penetrated the land to its utmost corners, and they were all now revelling in the grants of money which had come from one source or another in support of that cry. It had resulted in a certain impetus to institutions of a scientific character, which must be attended in the end with beneficial results. This universal dissemination of science was an exceedingly good thing, but addressing as he was a body of gentlemen representing chemical industries, he could not refrain from making the remark that he thought the advocacy of the general diffusion of science had had a fair innings, and that there remained to be advocated something for which he cordially invited their sympathy. It was no doubt a good thing to disseminate science widely, but if they came to ask themselves what would help them most in the operations in which they were daily engaged, they would not reply that it was the universal teaching of elementary science to the community at large. He had taken every opportunity of ascertaining from such gentlemen as he saw around him on that occasion what we really wanted in this country, and he gathered that what we wanted much more than the training of a large number of the population in the elementary truths of science was the training of a few to the highest possible extent. He spoke in all seriousness. This was a most important question; it was really the question of the survival and supremacy of British industries, and although he was not at all unsympathetic in regard to the demand to instruct our working men in the truths of science, he thought far more important was the instruction of the few to the very highest possible extent. There is one question which I have sometimes asked of those gentlemen who are so enthusiastic in the advocacy of technical instruction for the working classes—a question which, though it has caused annoyance, has never elicited any answer. It is this: what chemical industry is there in which foreign nations have excelled us or are likely to excel us in consequence of superior chemical knowledge of the artisans?

Mr. C. Rawson also responded. Mr. James Sharp (Halifax) proposed "The Chairman," and Sir James Kitson having replied, the proceedings terminated.

Glasgow and Scottish Section.

Chairman: E. C. C. Stanford.
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J. Christie. R. Irvine.
W. J. A. Donald. J. Falconer King.
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R. A. Inglis. R. R. Tatlock.

Hon. Treasurer: W. J. Chrystal.

Hon. Local Secretary:
Dr. G. G. Henderson, Chemical Laboratory, University of Glasgow.

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

SESSION 1891—92.

1892:—
Jan. 5th (Glasgow):—
Prof. W. Dittmar. "The Availability of Metallic Vessels for Chemical Operations in the Laboratory."
Mr. D. J. Playfair. "Notes on the Production of Cyanides."

Meeting held in the Societies' Rooms, 207, Bath Street, Glasgow, on Tuesday, 3rd November 1891.

MR. C. A. FAWSITT IN THE CHAIR.

NOTE ON THE PRECIPITATION OF PHOSPHORUS FROM SOLUTIONS OF IRON AND STEEL.

BY ROBT. HAMILTON, F.I.C.

The rapid and correct estimation of phosphorus in iron and steel is of such technical interest and importance, that I imagine any information concerning it will be welcome to many members of our Society.

Of the many methods proposed for this estimation, that chiefly employed is one form or other of the method depending on the precipitation of the phosphorus as ammonio-phospho-molybdate, often spoken of as "yellow precipitate."

It was known for many years that unless certain precautions were taken in dissolving the sample, there was a liability to obtain a solution from which the ammonium-molybdate solution would not precipitate the whole of the phosphorus.

In 1877, Arnd. A. Blair and Finkiner independently attributed this interference to the presence of carbonaceous matter in the solution, derived from the action of acids on the combined carbon of the metal, and they directed that the operation of solution should be conducted in such a manner as to destroy these carbonaceous compounds. This was practically effected by evaporating the acid solution to dryness and roasting the residue.

Adolf. Tamm (Chem. News, 1884) accentuated the same view.

There are methods founded on the afore-mentioned observations which leave nothing to be desired in point of accuracy; but the evaporation to dryness with subsequent roasting and re-solution, consumes much time, besides the minor inconvenience caused by large amounts of acid fumes.

Having a considerable amount of work to get through, I naturally neglected no opportunity of trying processes which promised to save time, and I may preface my further remarks by saying that my object was to obtain a rapid process for the correct estimation of phosphorus in hematite pig iron.

In 1888, P. W. Shimer suggested that the incomplete precipitation of phosphorus was due to incomplete oxidation of the phosphorus, and proposed to render all the phosphorus precipitable by oxidising the solution with potassium permanganate, &c.

The experiments recorded in this paper would appear to show that this view has much to commend it.

For the estimation of the phosphorus, Shimer used the filtrate from the determination of silicon by the nitric and sulphuric acids method. It was tried at the time with unsatisfactory results, though I now believe that with a little practice, good results could be obtained; but the method presented no advantages over the one I then used, and it was not followed up.

In 1889, Dr. Drown supported Shimer's idea and introduced an important improvement conducing to rapidity, namely, the solution of the metal in *dilute* nitric acid, thus retaining practically the whole of the silica in solution, but in this case the yellow precipitate should not be weighed, but, if large enough, should be converted into magnesium pyrophosphate; or, if two small for that, may be reduced with zinc and the solution titrated with standard permanganate. This method was carried out at the time exactly as described (Chem. News, July 1889) and unsatisfactory results obtained.

At intervals there continued to appear in the journals slight modifications of the foregoing methods, and the advantages offered were so tempting that I determined to perform a few experiments to find out whether the idea was a correct one or not. Though the process was wanted ultimately for hematite iron, yet the proportion of phosphorus in that iron is so small that experimental error forms a larger factor and renders the results less decisive than if operating with an iron containing more phosphorus; besides it is desirable to weigh the phosphorus as magnesium pyrophosphate whenever possible, so I determined to work with phosphoric iron.

First, to see what effect the presence of the carbonaceous matter had, a sample of hematite white pig-iron was selected, low in phosphorus and high in combined carbon.

A full analysis was not made, but the following figures will give a fair idea of its composition: phosphorus, 0·037 per cent.; silicon, 0·71; sulphur, 0·26; graphite, a trace; and combined carbon fully equal to that of a pig to be mentioned further on, which had $2\frac{1}{2}$ per cent. of combined carbon.

The general details of the method followed are much the same in each case, and I shall describe the first experiment fully, and only detail the *differences* in those following.

Experiment No. 1.—25 grains sample plus 500 measured grains of nitric acid (1·2), evaporated till a good deal of iron salt dried, taken up with hydrochloric acid, evaporated to small bulk, diluted, filtered, evaporated till skin just began to form, added excess of ammonia, then a slight excess of nitric acid, then molybdate solution, gave yellow precipitate, equal to 0·30 per cent. phosphorus, equal to 81 per cent. of the phosphorus present.

A solution of phosphoric acid was prepared of such strength that 100 measured grains contained about 0·25 grain of phosphorus, so that 100 grains of the phosphoric acid solution added to 25 grains of the pig-iron, came to about the same thing as working with a sample of iron containing 1 per cent. of phosphorus.

Experiment No. 2.—25 grains iron plus 500 grains nitric acid (1·2), heated till all dissolved, added 100 grains phosphoric acid solution, then proceeded with as before, gave magnesium pyrophosphate equal to all the phosphorus added as phosphoric acid, plus that derived from the sample of iron used.

Experiment No. 3.—25 grains iron, plus nitric acid and phosphoric acid as last, evaporated till the solution would just run, but no iron salt dried, then exactly as before, gave the whole of the phosphorus present.

Experiment No. 4.—A repetition of the last gave the same result.

Experiment No. 5.—25 grains iron, plus nitric acid and phosphoric acid as before, but evaporated only to half bulk, and without filtering proceeded with as before, gave the whole of the phosphorus present. The filtrate from the yellow

precipitate was dark sherry-coloured, and the ammonio-magnesium-phosphate was mahogany coloured.

Experiment No. 6.—To test if the action of solution had any effect on the phosphoric acid, 100 grains of the phosphoric acid solution was measured out, 25 grains iron added, then nitric acid, evaporated to half bulk, and proceeded with as last, gave the whole of the phosphorus present; colours of solutions and precipitates same at last.

These experiments seemed to prove that the presence of carbonaceous matter in solution did *not* prevent the precipitation of phosphorus which existed as phosphoric anhydride in combination.

The next step was to find out if the phosphorus in iron could be rendered completely precipitable by oxidation while in solution. For this purpose the following experiments were made with a sample of white pig iron, made when a furnace was being blown in, of the following unusual composition :—

White Pig Iron (Phosphoric).

	Per Cent.
Graphite	0·67
Combined carbon	2·54
Total carbon	3·21
Silicon	0·39
Phosphorus	1·36
Sulphur	0·20
Manganese	0·89
	5·85
Iron (by difference)	94·15
	100·00

For the remainder of this paper, when iron is mentioned, this white iron with 1·36 per cent. of phosphorus is meant.

Experiment No. 7.—25 grains iron plus 500 grains nitric acid (1·2), evaporated to half bulk, added excess of ammonia, slight excess of nitric acid and molybdate solution. Phosphorus finally weighed as magnesium pyrophosphate equalled 70 per cent. of the phosphorus present. The filtrates were all tested, but this one was especially worked with, but no more yellow precipitate was obtained.

At experiment No. 8, I began to try the effect of oxidising agents. 25 grains iron plus 500 grains nitric acid (1·2), boiled, plus three additions of 100 grains each of 10 vol. hydrogen peroxide, boiling between each addition, evaporated to half bulk, and proceeded with as before, gave magnesium pyrophosphate equal to 95 per cent. of the phosphorus present.

The hydrogen peroxide destroyed the combined carbon colour, the solution became clear and the precipitates were pure yellow and white respectively.

It is hardly necessary to mention that the hydrogen peroxide and other chemicals used were tested for phosphorus.

Experiment No. 9.—25 grains iron treated as last, the only difference being that five additions of hydrogen peroxide of 100 grains each were made, instead of three as before, gave magnesium pyrophosphate equal to 99·3 per cent. of the phosphorus present.

To avoid the boiling between each addition of hydrogen peroxide, the following experiment (No. 10) was tried:—25 grains iron plus nitric acid, boiled, cooled, added 200 grains of a fresh solution of 20 vol. hydrogen peroxide, allowed to stand for 20 minutes, then heated very slowly and boiled down to half bulk, then as before, gave magnesium pyrophosphate equal to only 85 per cent. of the phosphorus present.

Small additions of hydrogen peroxide, boiling after each addition, seemed to render all the phosphorus precipitable, but the cooling between each addition was a loss of time, besides there was nothing to show when enough of the oxidising agent had been added.

In Shimer's paper it is directed to add the permanganate solution (the oxidising agent he used) till a precipitate of hydrated manganese peroxide comes down; this seemed a useful, visible reaction, and it was resolved to test it.

For experiment No. 11, 25 grains iron were taken plus 500 grains nitric acid (1·2), boiled, and a solution of permanganate added till the desired precipitate came down; the solution cooled, 20 drops hydrogen peroxide added, boiled, neutralised with ammonia, boiled again with a little permanganate till a precipitate came down, which was removed again with hydrogen peroxide, the solution evaporated to half bulk and proceeded with as before, gave magnesium pyrophosphate equal to 99·7 per cent. of the phosphorus present.

The use of hydrogen peroxide for deoxidising the manganese peroxide precipitate is both elegant and effective, but as the solution requires to be cooled to about 130° F. before adding it, there is a slight loss of time.

Shimer dissolved the manganese peroxide precipitate in hydrochloric acid, and Drown removed it with an organic acid or with sugar. When trying Drown's method, I had used tartaric acid, but had not got satisfactory results with it, and Jones (Chem. News, 1890) found the same thing and proposed the use of ferrous sulphate.

Five experiments were performed very much the same as the most successful of the experiments already mentioned, oxidising the solution with permanganate, and removing the manganese peroxide precipitate with ferrous sulphate; without going into details, I may say that the lowest result equalled 94·1 per cent. and the highest, 96·3 per cent. of the phosphorus present.

In each of the foregoing experiments (excepting two of the five with ferrous sulphate) the yellow precipitate was allowed to settle for hours, usually overnight, but to save time I now tried the effect of shaking for five minutes as proposed by Emmerton, and filtering straight off.

Experiment No. 12.—25 grains iron plus 700 grains nitric acid (1·135, being the strength recommended by Drown for keeping the silica in solution), oxidised twice with permanganate, removing the precipitate with hydrogen peroxide and neutralising with ammonia between the two oxidations, the flask stoppered and shaken vigorously for five minutes, cooled and filtered, gave magnesium pyrophosphate equal to 96·3 per cent. of the phosphorus present.

Experiment No. 13.—The above experiment repeated, gave 100 per cent. of the phosphorus present.

Even a single oxidation gave very fair results, as follow:—

Experiment No. 14.—25 grains iron plus 700 grains nitric acid (1·135), oxidised with permanganate and hydrogen peroxide, neutralised with ammonia, molybdate solution added, shaken for five minutes, cooled and filtered, gave magnesium pyrophosphate equal to 96·3 per cent. of the phosphorus present.

Experiment No. 15 is exactly similar to the last, that is, the solution was only oxidised once, but the yellow precipitate was allowed to stand for 1½ hours before being filtered off, and the magnesium pyrophosphate obtained was equal to 100 per cent. of the phosphorus present.

The magnesium pyrophosphate precipitates from five experiments in which dilute nitric acid had been employed, were added together and tested for silica by evaporating to dryness with hydrochloric acid, &c.; the insoluble matter weighed only 0·09 grain, which may fairly be allowed to have been derived from the filter ashes, and evidently the precipitates have been free from silica.

At this point I may refer to an experiment of some interest, only completed this morning.

Experiment No. 16.—In this experiment I took 25 grains of the white phosphoric iron, added 500 grains nitric acid (1·2) and boiled, neutralised with ammonia, and precipitated with molybdate solution. The flask stood a few hours, the precipitate had settled thoroughly and left a clear liquid which was decanted through a filter and the precipitate washed once.

To the clear filtrate I added permanganate solution and placed it on the water-oven; in a short time the liquid became turbid, and deposited yellow precipitate. After standing about one hour I added excess of hydrogen peroxide and allowed it to settle over night; when filtered and weighed this morning, the yellow precipitate equalled 33 per cent. of the phosphorus in the pig iron. Referring to experiment No. 7, it will be observed that it is so far much the same as No. 16, only the original nitric acid

solution was evaporated further and gave 70 per cent. of the phosphorus present, so it may be considered that the 33 per cent. found in the filtrate of experiment No. 16, was the whole of the phosphorus in that filtrate.

Experiment No. 17.—One other experiment may be quoted which goes to support the oxidation theory.

In the Chem. News of March 1890, there was an abstract of a paper by Clere, recommending the employment of bromine and hydrochloric acid for the estimation of silicon in iron.

Using the white phosphoric pig iron before mentioned and following exactly the directions given, only 50 per cent. of the silicon was obtained, but the filtrate yielded on proper treatment, without either evaporation to dryness or further oxidation, magnesium pyrophosphate equal to 99·7 per cent. of the phosphorus present.

I think it may be fairly assumed that the two sets of experiments quoted prove to satisfaction: 1st. That the carbonaceous matter in a solution of iron does not prevent the complete precipitation of properly oxidised phosphorus as ammonio-phospho-molybdate. 2nd. That the reason of the incomplete precipitation of phosphorus from a nitric acid solution of iron, which has not been evaporated to dryness and roasted, is that the phosphorus has not all been properly oxidised. And 3rd. That in such solutions all the phosphorus can be completely oxidised and rendered precipitable, in the wet way, by means of certain oxidising agents.

In conclusion, I cannot claim much originality for any of the experiments quoted, but I think they put this point in a clearer light than it has been, and, at any rate, they have served their purpose, inasmuch as there has been founded upon them a rapid and accurate method for the estimation of phosphorus in hematite pig iron.

Discussion.

Professor Mills said that nitric acid was a bad oxidiser; and, in qualitative analysis, he had given it up in favour of bromine. He suggested bromine as an addition to nitric acid during the operation of attacking the steel.

Dr. Muntz said that as an oxidising agent he had discarded bromine entirely, and used instead peroxide of hydrogen, which he found to work extremely well, more especially in the precipitation of manganese in iron ores, cinders, &c. It was what might be called an elegant reagent, the secondary product of its reaction being simply water, thus obviating the introduction of nitric acid, hydrobromic acid, and their salts, all of which caused a good deal of extra trouble afterwards. He regarded it as one of the most important oxidising agents of the future when it could be manufactured cheap enough.

Mr. Hamilton, in reply, said that he quite agreed with Professor Mills as to the superiority of bromine over nitric acid as an oxidising agent. In this particular case he thought the use of bromine would be inadmissible, judging from the analogy between bromine and chlorine and the fact that the presence of hydrochloric acid interferes with the precipitation of ammonium phospho-molybdate. He had tested the hydrogen peroxide solution for impurities, but had not found phosphoric acid present in any of the samples. As was stated in the paper the quantity of hydrogen peroxide solution employed in the process was very small.

Journal and Patent* Literature.

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I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

Boiler Explosions in 1890. E. B. Marten. Engineering, 1891. **52**, 490—492.

It is gratifying to note that the number of killed last year was only 17, which is the smallest number on record. To these, however, must be added 16 deaths, resulting from the failure of steam pipes, keirs, and fittings. It is noticeable that 10 owners were among those killed or injured. The apparent increase in the number of explosions of late years is partly due to many cases being included that were formerly passed over as too slight for notice.

As before, the greatest number of explosions have been of boilers on shipboard, many of them being small vertical boilers for working fishing tackle. The most prolific cause of explosion has been corrosion, from want of sufficient inspection.

The exploded boilers were used for the following purposes:—

	No.	Killed.	Injured.
Ships, boats, fishing	20	4	12
Iron works	9	3	24
Farms	8	3	4
Collieries	1	0	0
Brick, glass, and oil works	6	4	5
Mills	6	2	7
Electric and gasworks	2	0	0
Lathe, crane, and brewery	3	1	8
Total	55	17	60

* Any of these specifications may be obtained by post, by remitting the cost price, *plus* postage, to Mr. H. Render Lack, Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C. The amount of postage may be calculated as follows:—

If the price does not exceed 8*d.* ..... ½*d.*
Above 8*d.*, and not exceeding 1*s.* 6*d.* ..... 1*d.*
„ 1*s.* 6*d.*, „ „ 2*s.* 4*d.* ..... 1½*d.*
„ 2*s.* 4*d.*, „ „ 3*s.* 4*d.* ..... 2*d.*

The causes of explosion are arranged under three heads :—

A. Faults of Construction or Material, which may be detected before starting or after Repair. B. Faults of Inspection. C. Faults which could be detected by Attendants.

	No.	Killed.	Injured.
A. Bad weld	3	0	0
Plug blew out	1	0	0
Seam rip	1	0	11
Unequal expansion	1	1	0
Weak tube	2	1	4
Weakness	2	1	9
Weak manhole	1	0	1
Broken pin	2	2	1
Total	13	5	26
B. General corrosion	5	2	9
External corrosion	13	3	9
Internal corrosion	12	4	5
Total	30	9	23
C. Short of water	5	3	7
Over-pressure	2	0	4
Salt or scale	5	0	0
Total	12	3	11

Total 55 explosions, 17 killed, 60 injured.

The exploded boilers were of the following kinds :

Cornish or Lancashire.

A. Weak tubes	2	1	4
B. Corrosion	10	2	8
C. Short of water	2	3	5
Total	14	6	17

Plain Cylinder.

A. Seam rip, bad weld, bad tube, weak manhole.	4	1	12
B. Corrosion	1	1	7
C. Short of water	1	0	2
Total	6	2	21

Marine.

B. Corrosion	5	0	2
C. Short of water or salt, or badly stopped tube.	7	2	10
Total	12	2	12

Furnace Uprights.

C. Overheating	1	1	3

Tubulous.

	No.	Killed.	Injured.
A. Bad weld	1	0	0

Locomotive or Multitubular.

B. Corrosion	5	2	2
C. Short of water	1	0	0
Total	6	2	2

Small Vertical.

A. Bad weld	1	0	0
B. Corrosion	10	4	1
C. Scale or over-pressure	4	0	4
Total	15	4	5

Total 55 explosions, 17 killed, 60 injured.

Domestic.

C. Frost in pipe	6	3	6

Keirs.

A. Weak shape and faulty casting.	2	0	4
C. Over-pressure or bolts slipped	5	2	4

Stop Valves, Pipes, or Fittings.

A. Bending strain, bad weld	10	9	3
B. Corrosion	1	0	1
C. Bad joints	4	2	1
Total	28	16	19

Grand total 83 explosions, 33 killed, 79 injured.

PATENTS.

Improvements in Lining Boilers or Digesters used in the Manufacture of Paper Pulp and for similar Purposes. C. Kellner, Vienna, Austria. Eng. Pats. 15,930 and 15,931, October 8, 1890. 4*d.* each.

See under XIX., *page* 944.

Improved Means of Manufacturing Glass Vessels and Adapting the same for the Storage and Conveyance of Compressed Gases and for Similar Purposes. D. Rylands, Stairfoot. Eng. Pat. 17,117, October 27, 1890. 8*d.*

See under VIII., *page* 927.

An Improved and Completed System of Apparatus for Evaporation and Distillation. P. Callibarcès, Paris, France. Eng. Pat. 17,237, October 28, 1890. 1*s.* 1*d.*

This invention comprises three apparatus, one employed for the evaporation and distillation of liquid, the other two complementary evaporating apparatus, intended to serve for completing the treatment effected in the principal

apparatus, and for obtaining a complete concentration of the liquid until it has lost its fluidity. For details the specification and drawings attached should be consulted. There are 19 claims.—E. S.

Improvements in Apparatus for Distilling Sea Water and other Water containing Foreign Matter or Impurities. A. Normanby, London. Eng. Pat. 17,939, November 7, 1890. *8d.*

The improvements described are particularly applicable to apparatus for use on board steamships. An outer chamber encloses a second one, containing preferably a number of pipes. A regulated supply of sea water is admitted automatically into the outer chamber so as to entirely cover the inner chamber. Steam is admitted into the inner chamber, and being condensed by the surrounding sea water escapes by a small opening, and returned to the boiler. The heat of the steam inside the pipes evaporates a portion of the sea water, and the secondary steam thus formed rises into the upper part of the outer chamber, and escaping through a steam valve to the condensers is used for feeding the boiler, or by passing through a second steam valve to a condenser may be used as drinking water. This latter condenser consists of an outer chamber in which is an upper and a lower chamber formed of tubes and communicating with each other. The secondary steam being condensed into hot fresh water in the upper chamber passes into the lower chamber to be cooled by the colder water circulating outside, and thence into the drinking water tanks.
—E. S.

Improvements in the Filling of Cylinders or other Receivers with Oxygen, Hydrogen, Coal, Oil and other Gases, or Mixtures of Gases under Pressure. J. H. Parkinson, Manchester. Eng. Pat. 18,445, November 15, 1890. *8d.*

The object of this invention is to provide means by which suitable vessels may be filled with compressed gas without the aid of compressors or pumps. Several storage cylinders of as large a capacity as can be readily transported from place to place are charged with the gas under a pressure much higher than that required to fill the receivers, with which they are connected by suitable valves. A safety valve or pressure gauge may be added to indicate when the required pressure of gas is obtained in the cylinder being filled.—E. S.

Improvements in Filtering Apparatus. L. A. Philippe, Paris, France. Eng. Pat. 534, January 10, 1891. *1s. 1d.*

This invention relates to filtering apparatus, having either simple or multiple pockets, and the improvements consist in the mode of fixing the pockets by which their sides are kept at a distance from each other; and also in a contrivance by which the filter can be emptied without turning over the apparatus. For details of construction the specification and four sheets of drawings attached to it must be consulted.
—E. S.

Improvements in Pumps for Petroleum, Oil, Spirit, Varnish, and other Liquids. F. A. Viehweg, Falkenstein, Germany. Eng. Pat. 12,115, July 16, 1891. *6d.*

The improvements consist in constructing a pump which can be readily emptied after use (by simply raising the top bd and pressing the piston rod deeper than when in ordinary use), and in which the liquid is prevented from splashing out above it. The first mentioned improvement is especially applicable to out door pumps in protecting them from the effects of frost. For details the specification must be referred to.—E. S.

Improved Apparatus for the Desiccation of Solid Matters. E. Donard and G. Boulet, jun., Rouen, France. Eng. Pat. 12,542, July 23, 1891. *6d.*

The material to be treated having been suitably prepared is introduced by a suitable opening into the body of the evaporator through which heating tubes pass. This opening being hermetically closed, a vacuum is formed by an air pump and condenser. Steam is admitted through one portion of the hollow shaft, and the apparatus is caused to revolve. Through the combined effect of the heat and vacuum, evaporation begins at once, and the vapour so produced passes through another portion of the shaft into a condenser connected with the air pump. The low temperature at which desiccation is carried on allows the animal and vegetable substances operated upon to retain all their nutritive qualities. A modification of the apparatus is also shown in the specification drawings, in which coils and double shells are employed instead of tubes.—E. S.

II.—FUEL, GAS, AND LIGHT.

Some Experiments on Petroleum Solidification. S. Rideal.

See pages 889—892.

Comparative Experiments on Boiling with Coal-Gas and Water-Gas. D. Coghevina. Jour. f. Gasbeleuchtung, 1891, **34**, 334—335.

The author has made comparative experiments on boiling with various types of apparatus used for cooking purposes in Austria. Three principal types of apparatus were selected:—(1.) A vertical boiler in common use, made on a French model, and furnished with two rows of flames. (2.) The well-known boiler made by the German Continental Gas Company in Dessau. (3.) An Austrian boiling apparatus with triangular slit opening. The results stated below are for the best of each type. The temperature of the room throughout the experiments was 14°, the gas pressure was equal to 2 cm. of water, and the amount of water used in each experiment was 1 litre. It was found that the amount of heat (in calories) generated in each case *per minute* was, with coal-gas—

	Cal.
1. French boiler	16·30
2. Dessau boiler	18·80
3. Austrian boiler	14·28
Mean	16·46

The amount of heat generated *per cubic metre* of coal-gas used was:—

	Cal.
1. French boiler	2186·0
2. Dessau boiler	2584·6
3. Austrian boiler	2093·0
Mean	2221·2

Taking the theoretical heating effect of 1 cubic metre of coal-gas as 5150 cal., these results show that the best types of apparatus have an efficiency of $\frac{2221{\cdot}2 \times 100}{5150} = 43{\cdot}13$ per cent.

Experiments were next undertaken with the object of investigating the efficiency of the same types of boiling apparatus when used with water-gas instead of coal-gas. It was found necessary to close the air openings and to increase the gas pressure up to 6 cm. of water. Under these circumstances the following results were obtained:—

The amount of heat (in calories) generated *per minute* with water-gas :—

	Cal.
1. French boiler	12·13
2. Dessau boiler	13·14
3. Austrian boiler	10·00
Mean	11·76

The amount of heat generated *per cubic metre* of water-gas used was :—

	Cal.
1. French boiler	942·0
2. Dessau boiler	1081·4
3. Austrian boiler	1036·4
Mean	1019·9

Taking the theoretical heating effect of 1 cub. metre of water-gas as 2813 cal., these results show that the best types of apparatus have an efficiency of $\frac{1019{\cdot}9 \times 100}{2813} = 36{\cdot}25$ per cent.

The author is of opinion that the commonest fault in all types of boiling apparatus (whether for coal- or water-gas) lies in the fact that the flame only plays on parts of the bottom of the boiler. Improvements can best be effected by securing an even spreading out of the flame.—D. E. J.

The Behaviour of Impure Materials in the Amyl Acetate Lamp. F. von Hefner. Jour. f. Gasbeleuchtung, 1891, **34**, 349—351.

As the question of the effect of impure materials on the illuminating power of the amyl acetate lamp has recently been raised (compare this Journal 1891, 685) the author has made a number of experiments in this direction with samples of amyl acetate containing various impurities, which were likely to be either present in, or added to, the commercial article. A sample of amyl acetate, to which castor oil was added in such quantities that the adulteration could not be detected by a specific gravity determination, was also investigated. The following results were obtained :—

Sample I.

Composition { Amyl acetate ..... 80 per cent. / Fusel oil ..... 20 „ } Mixt
Sp. gr. 0·8645 at 15°. Boiling point ..... 106°5—142°
Boiling point with reflux condenser ..... 106°5
Liquid consumed in half an hour after ignition. 4·98 grms.
Deviation from the normal consumption.. + 6·9 per cent.

Illuminating power clearly too low, on the average about 2 per cent.

Position of wick a little higher than the normal.

Sample II.

Composition { Amyl acetate ..... 98 per cent. / Diamylene ..... 2 „
Sp. gr. 0·8725 at 15°. Boiling point ..... 136—142°
Boiling point with reflux condenser ..... 139°5
Liquid consumed in half an hour after ignition 4·62 grms.
Deviation from the normal consumption .. − 0·8 per cent.

Illuminating power on the average the same as that of pure amyl acetate, greatest difference ± 1·5 per cent.

Sample III.

Composition { Amyl acetate ..... 91 per cent. / Alcohol ..... 5 „ / Castor oil ..... 4 „
Sp. gr. 0·8745 at 15°. Boiling point ..... 120—142°
Boiling point with reflux condenser ..... 120°
Liquid consumed in half an hour after ignition 4·94 grms.
Deviation from the normal consumption.... + 6 per cent.

The illuminating power could not be determined with accuracy.

Sample IV.

Composition { Amyl acetate ..... 80 per cent. / Isobutyl acetate ..... 10 „ / Amyl alcohol ..... 10 „
Sp. gr. 0·8650 at 15°. Boiling point ..... 135—142°
Boiling point with reflux condenser ..... 135°
Liquid consumed in half an hour after ignition 4·64 grms.
Deviation from the normal consumption.. − 0·4 per cent.

Illuminating power practically the same as that of pure amyl acetate, on the average 0·4 per cent. higher.

Sample V.

Composition { Amyl acetate ..... 50 per cent. / Alcohol ..... 50 „
Sp. gr. 0·8498 at 15°. Boiling point ..... 81—142°
Boiling point with reflux condenser ..... 81°
Liquid consumed in half an hour after ignition 6·46 grms.
Deviation from the normal consumption... + 39 per cent.

Illuminating power about 40 per cent. too low.

Sample VI.

Pure amyl acetate. Sp. gr. 0·8735 at 15°. Boiling point 136—142°, with reflux condenser 139°5°
Liquid consumed in half an hour after ignition 4·66 grms.

The composition of the above samples is given by weight.

The quantity of liquid consumed was determined by first burning the lamp for about 15 minutes, the flame being carefully adjusted to the normal height; the lamp was then extinguished, weighed, lighted again, and allowed to burn for exactly half an hour; the loss in weight was then determined with the results given above. The height of the barometer varied during the experiments from 767 to 758 mm., and the temperature from 15°5 to 20°.

The results of this investigation, taken in conjunction with others previously published, show that for all practical purposes the illuminating power of the amyl acetate lamp is not appreciably affected by the employment of commercial amyl acetate containing the most frequently occurring impurities. In the case of those impurities which have a considerable effect on the illuminating power, the rate of consumption is also materially altered; an increased consumption may, however, be accompanied by a decrease in illuminating power, and vice versâ.—F. S. K.

Girard's Thermo-Electric Stove. E. Hospitalier. Le Génie Civil, **19**, 1891, 30—46; and Abs. Proc. Inst. Civil Eng. **105**, 1891, 83—84.

The author refers to the want of success which has attended the use of thermo-electric batteries as sources of energy, and to the large consumption of gas which is found necessary, so that only about 0·5 per cent. of the thermal energy is obtained in the outside circuit for lighting purposes. He believes, however, that the problem is entirely different where it is possible to use the combustion of the gas or coal for heating purposes, and the thermo-electric stove brought out by Dr. Giraud, of Chantilly, fulfils the latter requirement. The stove resembles an ordinary stove used for heating purposes so far as its exterior is concerned. The products of combustion, however, rise vertically in a cylindrical chamber, and descend between this and a second envelope concentric with the chamber before passing to the chimney. This arrangement protects the metallic contacts from excessive heating, and equalises the temperature to which they are exposed. The heated gases come into contact with a series of rectangular boxes of stamped iron plate, forming a kind of cylindrical hive or chequer work, in which are placed the thermo-electric elements. These elements, to the number of about 700, are placed in the large pattern of stove in a series of 25 horizontal rings, and in a smaller type shown in the figures in a

series of 18. The elements consist of couples of nickel or tinned iron (tin-plate) and an alloy mainly composed of zinc and antimony, to which other metals are added in small quantities in order to increase the strength and retard fusion. The elements, which are set in cells in the stamped plate, are insulated by a coating of asbestos; cooling is effected partly by the wing shape of the elements and partly by the circulation of air between them. The whole of the 700 elements are joined in series and give practically the same electro-motive force whether nickel or tinned iron is employed. The electro-motive force at full power is about 40 volts, and the current in short circuit 4 ampères. At its maximum useful power, which is the only point necessary to consider, as the consumption of combustible matter is independent of the energy of the battery, the useful output is 40 watts, equal to about 1 kilowatt-hour per day for continuous working. The consumption of coke to effect this result is about 61·6 lb. per day, and with coke costing 27·5*d.* per cwt. the cost per kilowatt-hour would be 15*d.*, which is exactly the maximum price demanded by the central stations in Paris. As the output is too small to supply more than one lamp coupled direct, it is necessary to use accumulators, which raise the cost of the installation and reduce the quantity of electricity obtainable. In reality the electricity is obtained more expensively than from the central stations; but it must be remembered that the heating of the rooms is also obtained.

PATENT.

Improvements in Process and Apparatus for Procuring Cyanogen and its Compounds from Gases. H. H. Leigh. From J. Elsner, Paris, France, and R. Gasch, Mainz, Germany. Eng. Pat. 8293, May 14, 1891. *6d.*

See under VII., *page* 926.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

Production of Ozokerite in the United States. E. W. Parker. Eng. and Mining J. 1891, 127.

Ozokerite, or "mineral wax," belongs to the series of hydrocarbon compounds which include marsh-gas, petroleum, and paraffin, it being very similar in appearance to the last. It is colourless to white when pure, but frequently occurs leek-green, yellow, and brown. Prior to 1888 the only locality producing this mineral was in the province of Galicia, in Austria. Mining began there in 1862, and, though at first it was found exceedingly difficult to obtain sufficient capital to push the enterprise, it has increased rapidly since that date, and at present there are 35 companies engaged in the industry in the province of Galicia alone. For 26 years production was limited to this locality, but in 1888 American ozokerite began to receive the attention of the trade, and considerable work was begun upon a newly discovered vein in Utah. The mineral had been known to exist in Utah for some years, but whether in paying quantity was not satisfactorily determined until August 1888.

During 1888 and 1889 most of the work done was in the way of development, but in the latter year there were incidentally produced 75,000 lb. of crude ozokerite. Of this product 33·33 per cent. is lost in refining, the amount of refined ozokerite being 50,000 lb., valued at 2,500 dols. The product of 1888 was estimated at 65,000 lb. of crude mineral. The product for 1890 will probably exceed 300,000 lb.

Refined ozokerite is used for nearly all the purposes to which ordinary beeswax is applicable. It possesses nearly all the properties of beeswax except stickiness, but in cases where that quality is essential it is necessary only to mix the mineral with ordinary beeswax. Crude ozokerite, like other hydrocarbon compounds, is used to a considerable extent as an insulator for electrical wires.

The following table shows the quantity and value of crude and refined ozokerite imported into the United States from 1873 to 1889, inclusive:—

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	Lb.	$		Lb.	$
1873	25,135	4,244	1882	272,569	20,322
1874	380	40	1883	565,658	52,774
1875	7,430	1,026	1884	617,992	69,026
1876	16,525	2,229	1885	1,056,438	123,976
1877	101,604	11,720	1886	800,196	71,220
1878	69,884	7,878	1887	718,769	59,084
1879	44,963	6,016	1888	1,164,940	89,131
1880	103,973	14,057	1889	1,078,725	86,682
1881	98,911	12,792			

Asphaltum and Ozokerite in the United States. E. W. Parker. Eng. and Mining J. 1891, 193—194.

Gilsonite, elaterite, uintahite, wurtzilite, albertite, grahamite, asphaltum, maltha, and brea are names given to various semi-solid bitumens which differ considerably from one another in their chemical composition, in their action with acids or other agents, and upon the application of heat, but are considered under the head of asphaltum in this report.

No statement of the production of asphaltum is given in the Tenth Census reports. From 1882 to 1885, inclusive, the product was estimated at 3,000 short tons per year, having an average value of 10,500 dols. In 1886 the production increased slightly, being 3,500 short tons, value 14,000 dols. In 1887 a still further increase was noted; the product was 4,000 short tons, value 16,000 dols. The production each year was limited to California. The figures for 1888, as published in the "Mineral Resources of the United States," show a remarkable increase, due to the production in California of 50,000 tons of bituminous rock (a sandstone formation impregnated with asphaltum), which then came into the market as a competitor with other kinds of material for street paving. In addition to this, 450 tons of gilsonite, valued at 22,500 dols., were produced in the territory of Utah. The value of the total product was estimated at 331,500 dols., but in this aggregate the value of bituminous rock was taken at the price free on board cars. The value at the mines was about 165,000 dols.

The following table shows the product of asphaltum and bituminous rock for the United States for the calendar year 1889:—

States.	Product.	Value.
	Short Tons.	Dols.
California (bituminous rock)	47,968	126,885
Kentucky (bituminous rock)	112	252
Utah (bituminous rock).....	3,163	15,000
Utah (gilsonite)	492	29,400
Total	51,735	171,537

Sources of Asphaltum.—Although for a number of years asphaltum in different forms has been known to exist in California in large quantities, it was not until 1888 that its production assumed any important proportions as an

industry. In 1888 a large deposit of bituminous rock containing an unusually large percentage of asphaltum was discovered in Ventura county, and a company of San Francisco capitalists was organised for the purpose of developing and operating it. The owners styled this mineral "asphaltum," but, as it contained but 24 per cent. of bitumen, the other constituents being silica (about 64 per cent.), oxide of iron, and calcium carbonate, it should be classed among the bituminous rock products. Its high percentage of bitumen, however, increases its value, and the price ranges from 8 dols. to 10 dols. per ton, while the bituminous rock of San Luis Obispo and Santa Cruz is valued at about 2·50 dols. per ton at the mines.

There are several deposits of bituminous rock in San Luis Obispo and Santa Cruz counties, in which the peculiar features of asphaltum formations are strikingly illustrated, clearly showing that they belong to no particular era or age; that they are found at various altitudes, and with no uniform character in appearance, hardness, or chemical composition. Deposits of solid asphaltum and springs of viscid, oily material, commonly called "brea," occur in places not a thousand feet apart, and yet in strata of unquestionably different periods of formation.

Until the remarkable impetus given to the asphaltum industry in California and Utah in 1888, the island of Trinidad and the deposits of Seyssel, in France, and Val-de-Travers, in Switzerland, furnished the bulk of the world's supply. Cuba produces asphaltum of excellent quality, some of which has been imported into the United States. Venezuela has furnished a small portion of the supply in the past, and a few tons of bituminous limestone are imported annually from Germany and the island of Sicily. In the State of Tabasco, Mexico, large deposits of asphaltum are reported, but, although at a convenient place for shipment over the Mexican National Railway, only a few small lots have been shipped.

Preparation for Street Pavements.—The principal use of asphaltum, as is well known, is for street pavements. The bituminous limestone of France and Switzerland is prepared for this purpose by being first ground to a fine powder, then passed through iron cylinders, into which air heated to a temperature of 500° F. is introduced. It is thoroughly stirred as it passes through the cylinder, and when it reaches the opposite end is removed in a plastic condition and spread upon a concrete foundation, compacted by rammers, and when cool the street is ready for use.

The Trinidad asphaltum, upon being unloaded at its point of destination, is placed in large tanks and heated over a slow fire for a few days, care being taken not to heat the mass sufficiently to cause distillation. By this process all foreign substances are eliminated; vegetable impurities rise to the top and are skimmed off, while the earthy constituents settle to the bottom, and the asphaltum is then in a condition for manufacture. For street paving the refined asphaltum is treated with the residuum of petroleum, and mixed with fine sharp sand in the proportion of 14 per cent. by weight or 25 per cent. in bulk of asphaltum. The mixing is thorough, and is made at a temperature of about 300° F. While still hot and plastic it is spread upon the foundation already prepared and rolled by heavy steam rollers. The advantage claimed for the Trinidad asphaltum over the French and Swiss limestone material lies chiefly in the granular nature of the sand used in preparing it, which prevents the slipping of horses.

Gilsonite is prepared for this purpose by being first pulverised and mixed with petroleum oil. The mixture is then heated, care being taken to keep the temperature below 500° F., as above that temperature gilsonite will decompose. This composite is mixed while heated with broken stone or gravel, and is then ready for the street. It has been ascertained that a mixture of about 80 per cent. gravel makes the most durable pavement.

For the manufacture of street paving from the bituminous rock of Ventura and Santa Barbara counties, Cal., it is only necessary to mix it when heated with the sand of the locality where it is used. Sand is mixed with the asphaltum in the proportion of from three to eight times by bulk of sand to one of asphaltum. This method effects a considerable saving in transportation expenses. There is no appreciable loss of time in placing it on the street, as it requires only an hour after laying to "set" and be ready for traffic. Once properly mixed and laid it seems practically indestructible, as shown by a section of this pavement which had been in use for 18 months in one of the streets of San Francisco.

The bituminous rock of San Luis Obispo and Santa Cruz counties, California, is a sandstone thoroughly impregnated with bitumen. It is used almost entirely for street paving, and for that purpose is probably more easily and cheaply prepared than any of the asphaltum products. The only treatment necessary is to steam it, so as to thoroughly mix its ingredients and soften it for spreading to a uniform thickness and a smooth, even surface. Bituminous rock has supplied a limited local demand for 10 or 15 years, but it is only during the past two years that it has assumed any commercial importance as an industry. It is reported that pavements made of this material 15 years ago and used under heavy travel have recently been removed, and found to have lost very little either in weight or thickness; also that it stands equally well the high temperatures of the interior cities and the cold damp atmosphere of the coast. It is estimated that there are now 50 miles of bituminous rock street pavement in the State of California.

Although the production of bituminous rock in California and of gilsonite in Utah have assumed proportions of commercial importance, with indications of much greater activity in the near future, the island of Trinidad continues to be the main source of supply for the United States. In the Eastern cities, Trinidad asphaltum is used for street paving, to the almost entire exclusion of other kinds. This is due entirely to its advantage in cost of transportation. The railroad freight rates from the Pacific Coast practically shut out the bituminous rock of California from competition in the Eastern States, and a similar condition may be said to affect the sale of Trinidad asphaltum in the cities of Europe, since the bituminous limestones of Val-de-Travers and Seyssel, having the advantage in freights, control the markets. The cost of preparing the different varieties of asphaltum for street pavement is nearly the same, and, as all appear to be about equally durable, the exclusive use of any one of them is due merely to the advantage in freights.

Comparative Prices.—The ruling prices for the different varieties of asphaltum during the year 1889 were as follows:—Trinidad, crude, at New York, 13 dols. per ton; Trinidad, refined, at New York, 30 dols.; hard Cuban, at New York, 28 dols.; gilsonite, at the mines, 60 dols.; bituminous rock, California, at the mines, 2·50 dols. to 10 dols.; bituminous rock, Kentucky, at the mines, 2·40 dols.; prime Cuban, at New York, 4.5 to 5·5 cents per pound.

Other Uses.—Although the greatest use for asphaltum is in the manufacture of street paving, large quantities are consumed in making floors for warehouses, cellars, "wineries," breweries, &c. It is used for lining dams, levees, and reservoirs, and as a coating for piling, wharf timbers, ground ends of telegraph poles, &c. It is also used as a cement for sea walls and other marine architecture, and to protect iron work subjected to action of salt water from corrosion. It is to a considerable extent used as a roofing material, and, being practically a non-conductor of electricity, serves a useful purpose as an insulator for electrical wires. Varnish is manufactured from refined asphaltum or gilsonite by simply heating with spirits of turpentine.

New Discoveries.—Asphaltum deposits have been found in some of the north-western counties of Alabama, and some progress has been made in the way of developing the properties, but none of the mineral had been mined up to the close of the year 1889. Other deposits are reported in Grayson and Hardin counties, Kentucky, on which partial developments have been made, but the owners are waiting a more lucrative demand. In Burnet county, Texas, asphaltum is known to exist, but little authentic information is obtainable regarding its extent and character.

Imports.—The imports of Trinidad asphaltum by all companies in 1889 amounted to 52,881 long tons, and in 1890 to 54,692 tons. About 800 tons of asphaltum were imported from Cuba in 1881 and 1882, but there have been

no importations of any consequence since 1882. During 1885 and 1886 about 500 tons were obtained from Venezuela, but no amount of any importance has been imported into this country from there since that time. From Neufchatel, Switzerland, and Seyssel, France, the imports of bituminous limestone, sometimes called "asphaite," are about 200 tons annually, and about 150 tons of a similar material are imported each year from Hanover and Brunswick, Germany. All of this material was used in laying sidewalks and for interior work. During 1887, 1888, 1889, and 1890 about 6,000 tons of bituminous limestone were imported from Sicily and used for street paving.

Asphaltum Pavements.—The number of square yards of Trinidad asphaltum laid in the United States in the past decade is as follows: 1880, 106,838; 1881, 116,629; 1882, 196,184; 1883, 387,510; 1884, 424,524; 1885, 403,882; 1886, 623,188; 1887, 799,335; 1888, 757,101; 1889, 1,130,863; 1890, 1,857,000; total, 6,803,054, which is equivalent to 446 miles of roadway 26 feet wide. Trinidad asphaltum is being used for street paving in 19 cities in the United States and Canada.

From the best information obtainable the proportions of Trinidad asphaltum used for different purposes are about as follows: For laying sheet asphalt pavements 72 per cent., for manufacturing asphalt blocks and tiles for pavements, 24 per cent., total for paving, 96 per cent.; for roofing, 3 per cent.; for all other purposes, 1 per cent.; total, 100 per cent. The amount of asphalt blocks manufactured and laid as pavements has varied from 5,000 to 100,000 sq. yds. per annum, and the total from 1880 to 1890, inclusive, is estimated at 500,000 sq. yds.

About 55,000 sq. yds. of bituminous limestone pavement were laid in Washington, D. C., during 1876 and 1877, and about 3,000 sq. yds. in New York in 1883 or 1884. Nearly all of this was subsequently taken up and replaced by Trinidad asphaltum. In 1887 about 10,000 sq. yds. were laid in Rochester, N. Y.; in 1888 about 20,000 sq. yds. in St. Augustine, Fla., and in 1890, 40,000 sq. yds. in New York City. Capt. F. V. Greene, of New York, estimates that the total amount of bituminous limestone pavement now in use in the United States does not exceed 75,000 sq. yds.

The asphalt pavements in Europe are all made from the bituminous limestones obtained from the localities mentioned previously in this report. The pavements are found in Berlin, London, Paris, and a few other cities, probably not exceeding ten in all. The total area covered is, approximately, as follows, and it is about one-fourth of that covered by Trinidad asphalt pavements in the United States: Berlin, 681,486 sq. yds.; London, 360,000 sq. yds.; Paris, 357,360 sq. yds.; other cities, 300,000 sq. yds.; total, 1,698,846 sq. yds.

Presence of Ethylbenzene in Commercial Xylene. E. Noelting and G. A. Palmar. Per. 1891, **24**, 1955—1958.

The authors have isolated ethylbenzene from xylene by following the method devised by Friedel and Crafts for the purpose of separating ethylbenzene and the three xylenes which are formed together with other products by the action of aluminium chloride on toluene. The method is based on the fact that bromine in the presence of iodine converts all the xylenes completely into tetrabromo derivatives, sparingly soluble in light petroleum and ethylbenzene into a readily soluble dibromo-derivative, which is subsequently converted into pentabromethylbenzene by the action of bromine in presence of aluminium chloride. Since commercial xylene contains ethylbenzene, commercial xylidine should contain amidoethylbenzene, and the authors have also prepared pentabromethylbenzene from commercial xylidine by separating the metaxylidine with glacial acetic acid, converting the product contained in the mother-liquor into monobromoxylene, according to Sandmeyer's method, and subjecting the latter to the above-described treatment. A number of samples of xylene and xylidine were examined, all of which were found to contain ethylbenzene. As the latter boils a few degrees below xylene, the greater portion may be removed by concentrating the same by fractional distillation.—D. B.

Distillation of Coal Tar. Windmann. Jour. f. Gasbeleuchtung, 1891, **34**, 434—436.

The author describes the distillation of coal tar as conducted at the Pasing works in Bavaria. The distillation is effected in large wrought iron stills, heated by means of a furnace placed beneath the still. At the commencement a gentle heat is applied, and the distillation performed at the ordinary pressure, the water in the condensing apparatus being kept cold. The distillate consists of light oil and water. After all the water has come over, the heat is gradually increased, the atmospheric pressure diminished, and the temperature of the water in the condenser raised, the products of distillation being medium oil, heavy oil and anthracene oil. The distillation at the stage at which the latter comes over is aided by the injection of steam and the application of an exhausting air pump. The residue of distillation is pitch, which last product is run out from the bottom of the still. The products are worked up in the following manner:—The light oils having a specific gravity below 1·0, and consisting of benzene and its homologues, phenol, pyridine, and naphthalene, are subjected to fractional distillation. The crude benzene thus obtained is, in the first place, washed with a weak solution of caustic soda in order to remove all phenols, then treated with dilute sulphuric acid, which extracts the pyridine bases, and finally washed with concentrated sulphuric acid, which separates all tarry substances. The product is then subjected to distillation by means of steam, the following fractions being obtained:—

Benzene I.—Boiling from 80° to 100°, used in the preparation of aniline.

Benzene III.—Boiling from 100° to 120°,
Benzene IV.—Boiling from 110° to 140°, } used in the preparation of toluene, xylene, &c.

Benzene VI.—Boiling from 140° to 175°,
Benzene VI*b*.—Boiling from 175° to 195°, } used in the manufacture of india-rubber.

The residue is added to and worked up with the medium oils. The soda solution partially charged with phenols is completely saturated therewith by mixing it with oil rich in phenols, separating the solution from the undissolved oily portion and decomposing by means of an acid. Crude carbolic acid is thus obtained, and this is subsequently worked up into the pure crystallised acid. The acid solution charged with pyridine is neutralised with ammonia, and the crude pyridine thus liberated is subjected to fractional distillation. The product is now largely used for the denaturation of alcohol. The tarry acid liquor, after being washed with water and neutralised, yields a further portion of crude benzene on distillation, the residue being employed for fuel purposes. The medium oil, having a specific gravity of about 1·0, is subjected to fractional distillation. The first distillate represents crude naphtha, and is worked up with the light oil. The second distillate contains naphthalene and phenol. The former crystallises out on cooling, and is separated by draining the oil and subjecting the residue to hydraulic pressure. The drained oil is then submitted to fractional distillation, the first portions, which are highly charged with phenol, being used for the preparation of carbolic acid, whilst the higher boiling fractions are employed as creosote oils. The heavy oils, having a specific gravity of about 1·0, contain phenol, naphthalene, and neutral oils. On re-distillation, an oil highly charged with naphthalene is obtained, the lower boiling fractions of which contain large quantities of phenol. This oil is worked up like the second oil obtained by the re-distillation of the medium oil. On cooling, the last product of distillation of coal tar, anthracene, mixed with other high-boiling hydrocarbons, crystallises out. This is collected in filter-presses, and the mass subjected to hydraulic pressure. The filtered oil is re-distilled, the first fractions being added to the creosote oils, whilst from

the higher boiling portions a further quantity of crude anthracene is obtained, which, is, however, inferior in quality and percentage strength to the anthracene separated from the original oil. The water which comes over with the light oil in the early part of the distillation being saturated with ammonia is converted into ammonium sulphate along with the gas liquor separated from the tar before it is submitted to distillation.—D. B.

IV.—COLOURING MATTERS AND DYES.

Euxanthone. J. Herzig. Monatsh. Chem. 1891, **12**, 161—171.

Whilst engaged in his researches in the quercetin group (this Journal, 1889, 770), the author noticed some analogy between the properties of this group and euxanthone, and this investigation was therefore undertaken with the view to more clearly establish the relationship.

A striking similarity between the two substances is seen when they are converted into their acetyl-derivatives, the yellow colour disappearing in both cases whilst colourless substances are obtained.

Acetyleuxanthone, $C_{13}H_6O_2(C_2H_3O_2)_2$, crystallises from glacial acetic acid in pure white crystals, melting at 183°—185° (uncor.). It can be hydrolysed by means of sulphuric acid in the same way as Liebermann hydrolysed acetyl-quercetin (Ber. **17**, 1680).

Monethyleuxanthone, $C_{13}H_7O_3(OC_2H_5)$, is obtained on heating euxanthone with alcohol, potassium hydroxide, and ethyl iodide, even when two or three times the theoretical quantity of the reagents are employed. It crystallises in long yellow needles, melting at 144°—145°. It is absolutely insoluble in potash, although according to its constitution it must contain an hydroxyl group; with alcoholic potash it yelds an insoluble potassium compound, which, however, is decomposed on the addition of water, and ethyleuxanthone is obtained. Its acetyl-derivative—

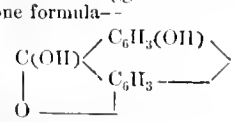
$$C_{13}H_6O_2\begin{cases}OC_2H_5\\OC_2H_3O\end{cases}$$

is sparingly soluble in absolute alcohol, from which it crystallises in long, white, lustrous needles, melting at 180°—182°. It can be hydrolysed by sulphuric acid.

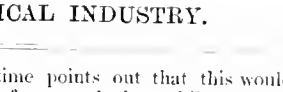
Diethyleuxanthone, $C_{13}H_6O_2(OC_2H_5)_2$, which has been previously described by Graebe and Ebrard (Ber. **15**, 1678), is obtained when the monethyl-compound is dissolved in absolute alcohol and repeatedly treated with an equal weight of potash and the corresponding quantity of ethyl iodide; it crystallises in long *white* needles, melting at 126°.

When diethyleuxanthone is heated with alcoholic potash for four hours at 130°—150°, and the product mixed with water and extracted with ether, the monethyleuxanthone already described is obtained. When, however, diethyl-euxanthone is heated on a water-bath with 20 parts of concentrated sulphuric acid for three hours, and the product diluted with water, monethyleuxanthone isomeric with the above is obtained. It crystallises from alcohol in *white* needles, melts at 223°—225°, and is soluble in dilute potash solution.

The properties of the isomeric monethyl derivatives lead to the assumption that the two hydroxyl-groups in euxanthone are of a different nature, namely, that one is of an alcoholic, and the other of a phenolic character. By way of explanation the author suggests the following modification of the euxanthone formula—



but at the same time points out that this would probably be a very labile form, and that whilst euxanthone may possibly exist only in the more stable modification—



its alkyl-derivatives may exist in both forms.—A. K. M.

Quercetin and its Derivatives. VI. J. Herzig. Monatsh. Chem. 1891, **12**, 172—176.

Molecular Weight of Quercetin.—In a previous communication (Monatsh. Chem. **9**, 537), the author showed that the examination of the alkyl- and acetyl- derivatives of quercetin led to the number 292 as the simplest expression for the molecular weight of this substance. According to this result, Lowe's formula, $C_{15}H_{12}O_7$, is the only one of those which have been proposed which can be correct. From analytical data, as well as from some of its reactions, it would appear, however, that the formula is $C_{15}H_{10}O_7$ rather than $C_{15}H_{12}O_7$.

In the present paper the author describes experiments on the determination of the molecular weights of quercetin and acetylethylquercetin by Beckmann's method. The molecular weight found was 258 for quercetin, the calculated being 302; the numbers for acetylethylquercetin were 402, 450, and 416, the calculated molecular weight being 456. The analytical numbers previously obtained with quercetin and several of its derivatives also agree with the formula $C_{15}H_{10}O_7$. Assuming this to be correct, rhamnetin should be *monomethylquercetin* and not the dimethyl-derivative as was previously assumed by the author.

The investigation of fisetin (*see* next abstract) and the relationship which this bears to quercetin, also tend to support the view that the latter substance has the formula $C_{15}H_{10}O_5$.—A. K. M.

Quercetin and its Derivatives. VII. J. Herzig. Monatsh. Chem. 1891, **12**, 177—190.

Fisetin.—The investigation of this substance was undertaken with the view to establish its composition and to clear up the discrepancies which are evident when the formula $C_{20}H_{16}O_9$, proposed by Schmid (this Journal, 1886, 450) is considered in connexion with the relationship which fisetin bears to quercetin.

Acetylfisetin was obtained in the form of lustrous white needles melting at 196°—199°, and agreeing in composition with the formula $C_{15}H_6O_2(OC_2H_3O)_4$. On hydrolysis it yielded practically the theoretical amount of fisetin, and when this was analysed numbers were obtained agreeing with the formula $C_{15}H_{10}O_6$. The fact that acetylquercetin contains five acetyl-groups, whilst acetyl-fisetin contains only four, is in accordance with the view that quercetin is hydroxyfisetin.

Methylfisetin, $C_{15}H_6O_2(OCH_3)_4$. The author finds that in accordance with Schmid's results, the same number of hydroxyl-groups which are replaceable by acetyl can also be replaced by methyloxyl. After very careful purification, the product is obtained in long *white* lustrous needles melting at 151°—153°; it is not yellow as stated by Schmid. In this property of losing its colour when completely acetylated or alkylated, fisetin resembles quercetin and euxanthon.

Ethylfisetin, $C_{15}H_6O_2(OC_2H_5)_4$, crystallises from alcohol in white lustrous needles melting at 106°—108°.

These white compounds do not react with acetic anhydride and, therefore, do not contain any free hydroxyl-group.

When an alkaline solution of fisetin in potash is exposed for 24 hours to the air it becomes completely oxidised, protocatechuic acid and resorcinol being produced. This is analogous to the oxidation of quercetin, which, under similar conditions yields protocatechuic acid and phloroglucinol, and the reaction thus affords further evidence in favour of quercetin being a hydroxyfisetin.

When ethylfisetin is boiled with alcoholic potash for 7—8 hours it undergoes a quantitative decomposition into diethylprotocatechuic acid, and a substance having the

properties of a phenol, and which the author names *ethylfisetol*. This substance crystallises from alcohol in white needles, melting at 42—44°, and gives a pale red colouration with ferric chloride. Its formula is probably $C_6H_6O_2(OC_2H_5)_2$. When it is treated with ethyl iodide and potash it becomes ethylated, and the product, probably $C_6H_3O(OC_2H_5)_3$, is insoluble in potash and crystallises from dilute alcohol in long needles, melting at 66—68°. Ethylfisetol readily yields resorcinol on fusion with potash.

Alcoholic potash decomposes methylfisetin in the same way, dimethylprotocatechuic acid and methylfisetol being produced. Methylfisetol crystallises in small white needles, melting at 66—68°; its methyl-derivative, $C_6H_3O(OCH_3)_3$, also forms small white needles, and melts at 62—63°, whilst its ethyl-derivative, $C_6H_3O(OCH_3)_2(OC_2H_5)$, forms soft lustrous needles, melting at 60—62°.

From the above results the following equation may be taken to represent the decomposition which occurs when the alkyl derivatives of fisetin are treated with alcoholic potash:—

$$\underset{\text{Fisetin.}}{C_{15}H_{10}O_6} + 2\,H_2O = \underset{\text{Protocatechuic acid.}}{C_7H_6O_4} + \underset{\text{Fisetol.}}{C_8H_8O_4}.$$

and since the four alkyl-groups of the alkyl-fisetin are all present in the two products, the conclusion is justified that the carboxyl-group in the protocatechuic acid and the free hydroxyl-group of the alkyl-fisetol have been formed by the addition of the elements of water. The constitution of fisetol is not yet determined; it is, however, a derivative of resorcinol, and contains a third hydroxyl-group, which, it is thought, must be present in a side-chain; the fourth oxygen atom appears to belong to an aldehyde- or ketone-group, as a phenylhydrazine-derivative has been obtained.

—A. K. M.

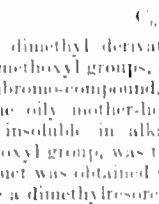
Methylation of Symmetrical Orcinol. A. Kraus. Monatsh. Chem. 1891, **12**, 191—204.

Zeisel and Herzig have shown that in the product of the action of alkyl iodide and potash on phloroglucinol, the alkyl groups are directly attached to the carbon atoms of the nucleus, and are not present as alkoxyl (Monatsh. Chem. 1889, 111). They also showed that in the ethylation of resorcinol, part of the ethyl introduced became directly attached to carbon, whilst part replaced hydroxylic hydrogen (Monatsh. Chem. 1890, 291). In continuation of these experiments the author has treated orcinol with methyl iodide and potash, and has obtained the following products:—1. A crystalline dimethylresorcinol which melts at 201°, and which is *soluble* in alkali; a methoxyl determination showed that neither methyl group was present in the form of methoxyl. The oily mother-liquor from this, which was soluble in alkali, was further methylated and treated with potash, and when the soluble portion was fractioned under diminished pressure it became *insoluble* in potash. These products contained no methoxyl. 2. A crystalline tetramethylorcinol melting at 93—94°; this contained two methoxyl groups, and its formula is consequently—

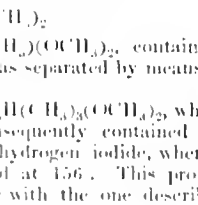
$$C_6H(CH_3)_3(OCH_3)_2$$

3. A dimethyl derivative, $C_6H_3(CH_3)(OCH_3)_2$, containing two methoxyl groups, and which was separated by means of its dibromo-compound.

The oily mother-liquor from $C_6H(CH_3)_3(OCH_3)_2$, which was insoluble in alkali, and consequently contained no hydroxyl group, was treated with hydrogen iodide, when a product was obtained which melted at 156°. This proved to be a dimethylresorcinol isomeric with the one described above, and which melts at 201°. The author assigns the following formulæ to these two substances:—



Melting point 156°.



Melting point 201°.

—A. K. M.

Gentisin. S. v. Kostanecki. Monatsh. Chem. 1891, **12**, 205—210.

Gentisin was first prepared by Henry and Caventou, from gentian root, and was believed by them to be the bitter principle of the root (J. de Pharm. 1821, 178). Trommsdorff subsequently showed that this was not the case, and stated that gentisin is a yellow, crystalline, and tasteless substance (Ann. **21**, 134). Its composition was shown by Baumert to be $C_{14}H_{10}O_5$ (Ann. **62**, 106), and this was confirmed by Hlasiwetz and Habermann (Ann. **175**, 63; **180**, 343), who further showed that it contained two hydroxyl groups and a methyl-group, and that on fusion with potash it yielded phloroglucinol and quinolcarboxylic acid; they eliminated the methyl-group by heating gentisin in a current of hydrogen chloride, but assumed that it was directly united to carbon, and they did not examine the product.

The author has demethylated gentisin by Zeisel's method, and has obtained a substance of the composition $C_{13}H_8O_5$ which he names *gentisein*, and which may possibly prove to be trihydroxyanthone. Gentisein crystallises from very dilute alcohol in groups of small needles of a straw-yellow colour, and containing two molecules of water of crystallisation. The colour becomes more pronounced when the water is driven off either by heat or by placing the substance in a desiccator. It melts at 315°, yields a pure yellow solution with alkali, and a blood-red colouration with sodium amalgam. When gentisein is boiled with acetic anhydride and sodium acetate, it yields a triacetyl-derivative—

$$C_{13}H_5O_2(C_2H_3O_2)_3$$

which crystallises in beautiful white needles melting at 226°. Since gentisin yields only a diacetyl-derivative, it follows that the methyl-group which it contains must be present in the form of methoxyl, and not directly attached to the carbon, as assumed by Hlasiwetz and Habermann.

A reaction which distinguishes gentisein from gentisin is that the latter, although it yields yellow solutions, will not dye mordanted cotton, whilst gentisein gives bright yellow shades. It is assumed that this property of gentisein is due to the hydroxyl-group, the hydrogen of which is replaced by methyl in the gentisin.—A. K. M.

On Gentisin. St. v. Kostanecki and E. Schmidt. Monatsh. Chem. 1891, **12**, 318—322.

One of the authors has described in a previous communication (preceding abstract) a substance (gentisein) which is obtained by splitting off a methyl-group from gentisin. In the belief that gentisin is a methyl-ether of gentisein, they have endeavoured to introduce methyl groups in both these bodies, in the hope that both would give rise to the same gentisein-tri-methyl-ether. Experiment shows that they do give the same end-product, thereby confirming the view that the one is a mono-methyl-ether of the other, since this end-product turns out to be not the tri-methyl but the di-methyl ether of gentisein.

Gentisein-di-methyl-ether (*Gentisin-mono-methyl-ether*)—

$$C_{13}H_5O_2(OCH_3)_2(OH)$$

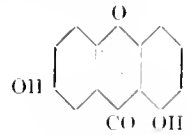
This is prepared as follows:—One molecule of gentisin is heated some hours in a tube at 100° with two molecules of caustic potash and two molecules of methyl iodide, in solution with methyl alcohol. The result is a yellow crystalline mass, which is treated with dilute caustic soda, to dissolve out unattacked gentisin. The major part remains undissolved, and, after treatment with dilute HCl, remains as a yellow mass. This crystallises from acetic acid in broad yellow needles, which melt at 170°, and is the mono-methyl-ether of gentisin. The characteristic property of this substance is that its alkali-salts are only soluble in water with great difficulty. This behaviour is opposed to the idea that gentisin is a xanthon derivative. Almost insoluble alkali salts of the oxy-xanthons are mentioned by Michael.

Acetyl-gentisein-dimethyl-ether—

$$C_{13}H_5O_2(OCH_3)_2(OCOCH_3)$$

This is prepared by the aid of acetic anhydride and dehydrated sodium acetate. The acetyl product thus obtained is crystallised from alcohol; melting point, 189°.

The results obtained by Hlasiwetz and Habermann on melting gentisein with caustic potash, give us some idea as to what the position of the three hydroxyl groups in this body may be. For as they obtained phloroglucinol and quinol-carbonic acid, gentisein would appear to have the following formula:—



However plausible this constitution formula may appear, there are strong objections to it. In particular, gentisein dyes mordanted wool, and should therefore have two hydroxyl groups in the ortho position, which is not the case according to their formula. There is little to support the supposition that the rule which holds good for the phenol colours does not hold good for the hydroxy-xanthone ones; in fact the author finds that all hydroxy-xanthones which do not contain two hydroxyl groups in the ortho position do not dye mordanted wool. This is also true for the oxyketones prepared by Nencki and his pupils. Tobel has also shown that even the hydroxy-cumarines in which the chromophore, CO, is not directly connected to the benzene-ring, behave in the same way; they act as fast dyes when they contain two hydroxyl groups in the ortho position.

It is rather remarkable that the colouring powers of the hydroxy-ketones and hydroxy-cumarines have been overlooked until recently. The explanation is that many of them are completely colourless, and it has long been a doubtful question whether a single ketone-group could act as a chromophore. This question can now be easily decided, for if the substance under investigation be converted into its orthodihydroxy-derivative, it can easily be decided whether that substance can play the part of a chromogen or not.

—D. E. J.

The Synthesis of Oxyxanthones. St. von Kostanecki and B. Nessler. Ber. 1891, **24**, 1894—1897.

The authors were led to a general method of preparing oxyxanthones by the observation that both orsellinic and paraorsellinic acids on distillation with salicylic acid and acetic anhydride yielded the same oxymethylxanthone, identical with the salicyorein ether of Michael. (Amer. Chem. J. 1883, **5**, 95.) But the reaction really furnishes two isomeric oxymethylxanthones.

α-oxymethylxanthone melts at 140°, forms a characteristic, difficultly soluble, yellow sodium salt, and yields an acetyl derivative crystallising in white needles having a melting point of 152°.

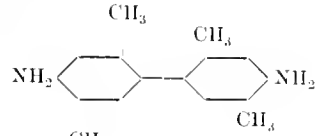
β-oxymethylxanthone, $C_{13}H_6O_2(OH)(CH_3)$ crystallises in colourless needles melting at 285° and dissolving easily in alkaline solutions with a yellow colour.

The distillation of resorcinol with salicylic acid and acetic anhydride yielded a similar substance, of which the chief part was identical with the *m*-oxyxanthone of Michael. By uniting phloroglucinol with salicylic acid, the author obtained a new isooxanthone, $C_{13}H_6O_2(OH)_2$ [1 : 3], crystallising in needles of light yellow colour, melting at 247°, and dissolving in alkalis with a yellow colour.

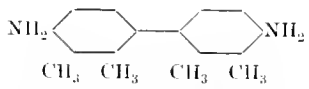
—G. H. B.

Benzidine Dyes. R. Brasch and G. Freyss. Ber. 1891, **24**, 1958—1966.

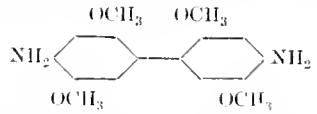
It is known that whilst ortho-derivatives of benzidine, such as orthotolidine and orthodianisidine, yield substantive cotton dyes, meta-derivatives give dyes suitable only for wool. The bases—



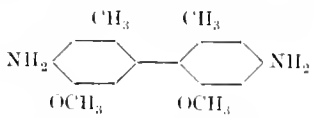
and



yield dyes which have but little affinity for the fibre (Noelting and Stricker, this Journal, 1889, 114), and the base—



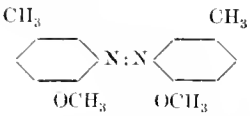
(diazotised and combined with α-naphthol-α-sulphonic acid) yields a dye similar in its properties to benzazurin; and the corresponding tetrabenzyl compound also gives dyes which attach themselves readily to the fibre (Colson, this Journal, 1889, 451). The author finds that the base—



yields dyes which show scarcely any affinity for vegetable fibre.

In order to prepare this base, a solution of paratoluidine nitrate is treated cold with nitric acid and sodium nitrite, the resulting diazo-compound is heated, and thereby converted into metanitroparacresol; this is then methylated and the resulting methylnitrocresol dissolved in methyl alcohol and heated with sodium methylate. The azoxy-product obtained crystallises in yellow prisms, melts at 148°—149°, and is readily soluble in benzene, glacial acetic acid, and alcohol.

Dimethyl azoparacresol—



is obtained by the action of sodium amalgam or a solution of methyl metanitrocresol, and crystallizes in large well-formed scarlet prisms melting at 178°—179°; it is sparingly soluble in alcohol, readily in glacial acetic acid, in chloroform, and in benzene. If a large excess of sodium amalgam be employed, the reduction goes further, and the base $C_6H_3(OCH_3)(NH_2)(CH_3)$ [1 : 2 : 4] is obtained. When this is diazotised and the diazo-compound combined with paracresol, methyl azoparacresol is produced, and this on methylation yields the above dimethyl azoparacresol. The conversion of this into the base sought for is effected by adding a solution of stannous chloride to the hot hydrochloric acid solution of the azo-compound. The pure base forms silvery scales melting at 156°—157°; it dissolves readily in alcohol, sparingly in water.

Diazotised orthodimethoxymetadimethylbenzidine combined with *R-salt* yields a reddish-violet colour, which dyes unmordanted cotton a light violet and wool and silk a fine violet-red. The red dye obtained with α-naphthol-α-sulphonic acid dyes wool and silk red and gives a pale pink on unmordanted cotton. The diazotised base yields a yellowish red dye with α-naphthylamine-α-sulphonic acid and a pure yellow dye with salicylic acid; this readily dyes wool and silk in an acid bath, but scarcely colours cotton.

—A. K. M.

Orthonitrotoluene. F. Streng. Ber. 1891, **24**, 1987.

Pure orthonitrotoluene boils at 218°, and not at 223° as usually stated; it solidifies completely at −10·5°; its specific gravity at 15° is 1·168.—A. K. M.

Synthesis of Indigo-sulphonic Acids (Indigo-carmine). R. Knietsch. Ber. 1891, **24**, 2086—2089.

According to the author, Heymann's explanation of the synthetic formation of Indigo-carmine is incorrect (this Journal, 1891, 829). The synthesis takes place in two stages, and is analogous to Heumann's synthesis of indigo (this Journal, 1890, 1121). In the first stage of the reaction the fuming sulphuric acid abstracts the elements of water, and a leuco-compound is produced, and this becomes sulphonated. The second stage consists in the conversion of the leuco-compound into indigo-sulphonic acid by the action of atmospheric oxygen. The leuco-compound is very unstable in acid solution, and if left for a few hours at the ordinary temperature it is no longer capable of yielding indigo; its oxidation to Indigo-carmine only takes place when the excess of sulphuric anhydride is removed by dilution. According to Heymann the sulphuric anhydride acts as an oxidising agent, but the author states that this is not the case, and that the amount of sulphur dioxide is not greater than is usually the case in such reactions.

—A. K. M.

Isolation of Aromatic Sulphonic Acids. L. Gattermann. Ber. 1891, **24**, 2121—2122.

The isolation of aromatic sulphonic acids from the mixed sulphonation product is generally effected by the addition of barium, calcium, or lead salts. The same result may be obtained with greater facility by saturating the sulphonation product dissolved in twice its volume of water with common salt. The resulting sodium salts are in most cases thrown out in well crystallised forms, and the yield is frequently quantitative. The author has isolated in this manner the sulphonic acids of benzene, toluene, xylene, and mesitylene, also phenol-*p*-sulphonic acid, and metasulphobenzoic acid.

—D. B.

Hydroxy-azo (Oxy-azo) Compounds. H. Goldschmidt and R. Brubacher. Ber. 1891, **24**, 2300—2317.

The object of the experiments described in this paper was to decide whether the so-called hydroxy-azo compounds are really such, or whether they are hydrazones of the quinones (compare also this Journal, 1890, 1017). From the results obtained, the authors have decided in favour of the hydrazone formula.

I. *Orthohydroxyazo-Compounds.*—The acetyl-derivative of benzene-azo-paracresol was obtained by boiling the latter with acetic anhydride; it melts at 87°—88°, not at 67°—68° as usually stated. When an alcoholic solution of this acetyl-derivative is treated with zinc dust and a little dilute acetic or formic acid, reduction takes place, and acetanilide and amidoparacresol ($CH_3.NH_2.OH$ 1 : 3 : 4) are obtained.

II. *Parahydroxyazo Compounds.*—The acetyl- and benzoyl-derivatives of these give hydrazo-compounds on reduction with zinc dust and acetic acid.—A. K. M.

On the Tetrazo Dyes. P. Werner. Monit. Scient. 1891, **5**, 601—609.

The present paper forms the last of a series of articles (Monit. Scient. 1891, 22, 135, and 482) in which the author discusses the formation of various tetrazo dyes. The following conclusions were arrived at:—

In order that a tetrazo colouring body may act as an efficient substantive dye, it is essential that the two amido-groups be symmetrically disposed. The derivatives of diphenylene and ditolylene, for instance, possess scarcely any direct dyeing action. On the other hand, the colouring matter itself need not be symmetrically constituted. This is exemplified by Cassella's oxydiphenyl dyes, and the derivatives of benzidine-monosulphonic acid. As regards the benzidine series of dyes, the removal by substitution of a hydrogen atom occupying the meta position in respect to the amido-group, results in a decrease of tinctorial power. The latter is again increased, however, by the substitution of methyl for the ortho-hydrogen atom.

Diphenylene substituted in both meta positions (reckoning from the amido-groups) yields dyes which are practically valueless, owing to their feeble direct action on the fibre. This is probably so because, by the substitution of the two meta positions, the attraction between the benzene nuclei is diminished. The bases in which the meta positions are connected by means of a divalent atom or radicle, such as S, O, CH_2, or SO_2, yield substantive dyes; whilst bases in which the meta hydrogen atoms are replaced by monovalent atoms or radicles (Cl, Br, &c.) yield substances resembling the corresponding benzene derivatives. The above rule only applies to the diphenylene series of dyes. It does not hold good, for instance, in the case of the derivatives of diamidostilbene, the tinctorial power of which is unaltered by substitution of the meta hydrogen atoms. The tetrazo colouring bodies obtained from the more complex bases in which the benzene nuclei are separated by one or more other groups, may be divided into two classes—substantive dyes and dyes possessing no affinity for vegetable fibres; and it would appear that a species of condensation occurs between the benzene rings to which the amido-groups are attached, which determines this difference in behaviour. For example, the tetrazo derivatives of diamidodiphenyl, triphenylmethane, diamidosulphobenzide, and diamidodibenzyl have no dyeing action; whilst the colours obtained from diamidofluorene, diamidobenzophenone, diamidodiphenyleneketonoxide, benzidine sulphonic acid, diamidotolane, and diamidostilbene dye cotton without the aid of a mordant. The theory does not explain, however, why the derivatives of ethylenediparamidophenol—

$$(CH_2.O.C_6H_3.NH_2)_2$$

act as dyes, whilst those of diamidodibenzyl—

$$(CH_2.C_6H_3.NH_2)_2$$

do not.—H. T. P.

PATENTS.

Improvements in the Production of Blue Colouring Matters. D. Dawson, Milnsbridge. Eng. Pat. 17,195, October 28, 1890. 6*d*.

A process for obtaining colouring matters by the action of a salt of dimethylaniline on diphenylamine, benzil-diphenylamine, methyl- or ethyl-diphenylamine in presence of salt and copper sulphate, phenol being used as a diluent. The melt is stirred for several hours at 95°—100° C., or the reaction may be allowed to take place in the cold, but a much longer period is necessary for completion. In place of copper sulphate, potassium ferricyanide may be employed, but in this case a large quantity of the latter is required, and the melt must be kept at 100° C. for two days. The subsequent treatment is in both cases the same. The melt is washed first with cold water, and afterwards with hot water containing acid. After purification the colouring matters may be employed for dyeing in the same way as the "spirit blues" from rosaniline, or they may be sulphonated giving wool dyestuffs. Other colouring matters are obtained by passing bromine or chlorine into dimethylaniline hydrochloride, mixing the product with diphenylamine and heating the mixture until no more colour is formed. The dyestuff is then purified as above.—T. A. L.

The Manufacture and Production of New Derivatives of Alizarine or its Analogues. B. Willcox, London. From the "Farbenfabriken vormals F. Bayer und Co.," Elberfeld, Germany. Eng. Pat. 17,712, November 4, 1890. 6*d*.

This is an extension of Eng. Pats. 8725 and 12,715 of 1890 (this Journal, 1891, 537 and 739). The methods employed for producing "Bordeaux" from the di- and trihydroxy-anthraquinones there described also yield colouring matters when applied to quinizarin and xanthopurpurin according to the present application. Moreover the purpurin Bordeau described in the first-named patent may, on oxidation with manganese dioxide in a sulphuric acid solution be converted into a Cyanin identical with that derived from alizarin. It has also been discovered that these oxidations may be performed by means of sulphuric acid or sulphuric anhydride, the products obtained resembling the Cyanins very closely. The following process describes the production of a Bordeau and its oxidation in one operation. About 10 kilos. of dry purpurin are stirred into 150 kilos. of fuming sulphuric acid containing 80 per cent. of anhydride. The mixture is allowed to stand for some time at a temperature not exceeding 50° C., until a sample precipitated by water, dissolved in soda, decomposed with an acid and dried, dissolves in alkalis or concentrated sulphuric acid with a violet colour, and shows a strong fluorescence. The melt is subsequently treated in a manner similar to that described in Eng. Pat. 8725. The product obtained is a hexa-hydroxy-anthraquinone. In the formation of the cyanins from the bordeaux, intermediate compounds are formed, which yield valuable dyestuffs when treated with ammonia. A series of colouring matters similar to the cyanins are obtained by oxidising with sulphuric acid and manganese dioxide, the dyestuffs described in Eng. Pat. 12,715, produced by the action of ammonia on the bordeaux intermediate products of alizarin purpurin, flavo- and anthra-purpurin. All these colouring matters dye mordanted wool blue, greenish-blue, or violet-blue shades according to the particular dyestuff and mordant employed.—T. A. L.

Improvements in the Manufacture of Colouring Matters. H. H. Lake, London. From A. Leonhardt and Co., Mühlheim-on-the-Maine, Germany. Eng. Pat. 18,623, November 18, 1890. 6*d*.

The greenish-blue dyestuffs described in Eng. Pat. 13,565 of 1890 (this Journal, 1891, 760), can also be obtained according to the following methods:—

(1.) By oxidising a mixture of dimethyl-*m*-amidocresol with an aromatic *p*-diamine (preferably *p*-phenylene diamine or *p*-amido-dimethylaniline). Instead of using ordinary oxidising agents such as bichromates, manganese dioxide with acetic acid or ferric chloride, the oxidation can be effected by means of amido-azo-compounds; in this case the azo-dyestuff (such as amido-azo-benzene or benzene-azo-di-methylaniline) is heated with the amidocresol preferably in a glycerol or phenol solution.

(2.) Nitroso-dimethylaniline hydrochloride when condensed with dimethyl-*m*-amidophenol yields a greyish-blue dyestuff consisting of a mixture of a grey and a blue colouring matter. These two products can be separated either by fractional precipitation with salt and zinc chloride or with sodium acetate or carbonate. The grey product under these conditions is first precipitated.

(3.) Di-alkylated nitroso-*m*-amidophenols do not form blue dyestuffs when condensed with aniline or dimethylaniline. They are, however, obtained from a salt of nitroso-dimethyl or diethyl-*m*-amidophenol when condensed with *m*-toluylene diamine, *m*-amidodimethylaniline or *m*-amidodiethyl-*o*-toluidine. The condensation is performed by heating the components in a dissolving or "distributing" medium, such as spirit or acetic acid, and the dyestuff is purified as described above.—T. A. L.

The Manufacture of New Derivatives of Anthraquinone. B. Willcox, London. From the "Farbenfabriken vormals F. Bayer und Co.," Elberfeld, Germany. Eng. Pat. 18,729, November 19, 1890. 6*d*.

The processes for obtaining dyestuffs from alizarin and its analogues according to Eng. Pats. 8725, 12,715, and 17,712 of 1890 (see above), can be applied according to this patent to oxyflavopurpurin and oxyanthrapurpurin, substances which are obtained by the action of oxidising agents on flavo- and anthrapurpurin in presence of concentrated sulphuric acid. These bodies are also dyestuffs, and give much bluer shades than the original compounds. The methods for producing the Bordeaux previously described have also been applied to anthrarufin, which does not itself possess colouring properties. Furthermore, the hexahydroxyanthraquinone described in Eng. Pat. 17,712 of 1890 can be obtained directly from anthraquinone by the action of pure sulphuric anhydride at a temperature not exceeding 50° C.
T. A. L.

The Production of Sulphonated Thionines and Dyestuffs therefrom. S. Pitt, Sutton. From L. Cassella and Co., Frankfort-on-the-Maine, Germany. Eng. Pat. 19,065, November 24, 1890. 4*d*.

An extension of Eng. Pat. 4596 of 1890 (this Journal, 1891, 357). Blue colouring matters are obtained by oxidising ethyl- or methylsulphobenzyl-*p*-phenylenediamine sulphonic acid together with certain naphthalene derivatives. The following derivatives are mentioned:—α-naphthylamine, methyl-α-naphthylamine, 1:2-naphthylamine sulphonic acid, α-naphthol, α-naphthoic acid, and 1:2 α-naphtholsulphonic acid. A colouring matter dyeing wool a deep blue is obtained as follows:—A solution containing 42 kilos. of the thiosulphonic acid mentioned above, and 18 kilos. of α-naphthylamine hydrochloride is treated with a solution of 30 kilos. of potassium bichromate and 100 kilos. of a concentrated solution of zinc chloride. A dark green-coloured indamine separates, and the whole solution is heated for an hour to 100° C., when the thionine is obtained in the form of its insoluble chromium lake. The dyestuff is extracted by sodium carbonate or acids, and being only sparingly soluble in water, requires sulphonation for use as a colouring matter.—T. A. L.

The Preparation of Colouring Matters with Gamma-amidonaphtholsulphonic Acid. S. Pitt, Sutton. From L. Cassella and Co., Frankfort-on-the-Maine, Germany. Eng. Pat. 19,330, November 27, 1890. 6*d*.

An extension of Eng. Pat. 16,699 of 1889 (this Journal, 1890, 935). One molecular proportion of diazotised benzidine or other *p*-diamine is combined with one molecular proportion of γ-amidonaphthol sulphonic acid in an alkaline solution. The resulting compound is then diazotised and combined with two molecular proportions of γ-amidonaphthol sulphonic acid. The dyestuff separates as a black precipitate, and gives black shades on unmordanted cotton fast to light and washing. Similar dyestuffs result by using one molecular proportion of α-naphthylamine in the first stage of the above process (Eng. Pat. 9214 of 1885; this Journal, 1889, 701). Another modification of the process is to combine equal molecular proportions of a diazotised *p*-diamine and γ-amidonaphthol sulphonic acid, re-diazotise, and combine with two molecular proportions of an amine or phenol or their sulphonic acids.—T. A. L.

Improvements in the Manufacture of Colouring Matters. H. H. Lake, London. From Kalle and Co., Biebrich-on-the-Rhine, Germany. Eng. Pat. 20,845, December 20, 1890. 6*d*.

The Rosinduline described in Eng. Pat. 15,259 of 1888 (this Journal, 1889, 877) has been found to belong to a new class of basic colouring matters of the general formula $C_{22}H_{14}N_3R$, which on sulphooation yield valuable dyestuffs. The *Rosinduline* $C_{22}H_{15}N_3$ is prepared by heating a salt of

benzene-azo-α-naphthylamine with aniline in presence of alcohol. It crystallises in reddish-brown plates melting at 199° C. The Rosindulines $C_{22}H_{17}N$ C_4H_2 and $C_{22}H_{17}N_3C_{10}H_7$ are prepared by heating the chlorhydrates of benzene-azo-*o*-tolyl-α-naphthylamine or benzene-azo-di-α-naphthylamine with aniline at 130—150° C. The two bases obtained crystallise in reddish-brown plates and melt at 228° and 256° C. respectively. The Rosinduline obtained from aniline and benzene-azo-*p*-tolyl-α-naphthylamine melts at 233°. The salts of all these compounds dye mordanted cotton. To prepare the sulphonic acids, 1 part by weight of the base is dissolved in 4 parts of sulphuric acid containing 24 per cent. of SO_3, and the mixture heated for 4—5 hours at 80° C. The melt is then poured into water, filtered, dissolved in ammonia, and the solution evaporated to dryness.—T. A. L.

Improvements in the Manufacture of a New Amido-naphtholsulphonic Acid and Colouring Matters therefrom. S. Pitt, Sutton. From L. Cassella and Co., Frankfort-on-the-Maine, Germany. Eng. Pat. 1742, January 30, 1891. 6*d*.

The new acid is obtained from α-diamidonaphthalene disulphonic acid of Eng. Pat. 15,346 of 1890 (this Journal, 1891, 761) by heating it with dilute mineral acids, when one amido group is replaced by a hydroxy group according to the following equation:—

$$C_{10}H_4(NH_2)_2(SO_3H)_2 + H_2O = C_{10}H_4.NH_2.OH(SO_3H)_2 + NH_3$$

The new amido-naphtholdisulphonic acid is termed "acid H." It combines with diazo- or tetrazo-compounds, and with diazotised benzidine gives a colouring matter which dyes unmordanted cotton a pure blue. A bluish-black dyestuff for unmordanted cotton is obtained by combining 21 kilos. of diazotised tolidine with an alkaline solution of 32 kilos. of the "acid H." The intermediate compound thus formed is combined with 27 kilos. of γ-amidonaphthol sulphonic acid, and the whole allowed to stand for 48 hours at 15° C. The action of nitrous acid on the acid itself forms a diazo compound which separates in fine yellow needles and turns violet by the action of alkalis.—T. A. L.

V.—TEXTILES: COTTON, WOOL, SILK, Etc.

PATENTS.

Improvements in the Method of and Means for Removing Grease and Fatty Matters from Textile Fabrics. T. J. Hutchinson, Manchester. Eng. Pat. 10,285, July 3, 1890. 8*d*.

This invention consists of a continuous process of passing the fabric through a suitable volatile solvent contained in a tank or series of tanks, within a closed chamber, the tanks being so arranged that between each tank and the next and at the end of the last tank there is a pair of squeezing rollers. Leaving these, the fabric is passed over a series of drying rollers (within a second chamber), heated by steam or otherwise, and the vapours rising from this chamber are condensed and employed over again for cleansing, together with the whole of the remaining liquid, which is allowed to flow from one tank to the other, and is then distilled for use again.—H. S.

Improvements connected with the Mixing of Natural or Artificially Short-staple Vegetable Fibres, so that they will Spin more Easily than when Spun together Unprepared. K. T. Sutherland and G. Esdaile, Manchester. Eng. Pat. 12,643, August 1, 1890. 4*d*.

This is an application of the inventors' previous patents, Eng. Pats. 15,333 and 18,932 of 1889 (see this Journal, 1890, 856 and 1033), for the purpose of mixing natural or artificially short-staple vegetable fibres, *e.g.*, vegetable silk, cotton, china-grass, &c.

The claims are: (1.) "That yarn, thread, or strand spun from partly or wholly prepared fibres will be stronger than that spun from unprepared fibres, and be more useful." (2.) "That it will allow of different fibres in combination being spun on a commercial scale successfully." (3.) "That cloth woven from such yarn will be better, and can be applied to new purposes."—H. S.

Improvements in Rendering Canvas and other Fabrics Rot-proof. J. Williams, London. Eng. Pat. 12,513, August 11, 1890. 4*d*.

See under XIII., *page* 937.

Improved Treatment of Long-staple Stalk-Fibres as China-Grass, Flax, and such like Fibres, by which they will have a more even Staple when Artificially Shortened. K. T. Sutherland and G. Esdaile, Manchester. Eng. Pat. 13,965, September 5, 1890. 4*d*.

This invention refers to the treatment of stalks when gathered and denuded of their leaves in either of the following ways. The fibre is stripped from the stalk, and while moist and supple straightened out and pressed into bales. Or, the stalks are baled with the fibre on. Both are then cut into the requisite lengths necessary for working on cotton or woollen machinery by any effective cutting machine. A more even staple is thus obtained than from the dry article.—H. S.

Improved Process for the Production of Dyed Cotton Yarns or Threads. T. Salzmann, Vorarlberg, Austria. Eng. Pat. 17,872, November 6, 1890. 4*d*.

Cotton roving or twisted sliver in the form of hanks is bleached, dyed, and then spun and doubled to produce yarns or threads of uniform colour or of shaded or mixed colours.—E. B.

Improvements in and connected with Carbonisers, applicable for the Destruction of Vegetable Matter mixed with Wool, and for other Purposes. B. Bellerstein, Neuss, Germany. Eng. Pat. 1372, January 24, 1891. 6*d*.

For this invention there is employed a drum, revolving on hollow trunnions and containing the material to be carbonised. Through the hollow trunnions carbonising gases (sulphuric or muriatic acid, &c.) are led into the drum after they have been superheated by means of a special heating chamber. Owing to the high temperature the gases or vapours act on the raw material more vigorously and rapidly than usual.—H. S.

Improvements in Cleansing Wool and similar Materials. A. George, Puteaux, France. Eng. Pat. 6663, April 17, 1891. Under Internat. Conv. October 31, 1891. 4*d*.

This process is based upon the fact that, while the fatty or waxy matters, or such as are soluble in water, or the sandy and earthy ingredients in wool and similar materials can be removed by the ordinary cleansing method, the pitchy and glutinous matters, insoluble in the usual solvents, remain. The wool is therefore subjected to the effects of gases by which these deleterious substances are decomposed; owing to its not injuring either the wool or the fatty substances, carbonic acid gas is claimed as being the most suitable.

The wool is subjected to this treatment either before or at the same time as it is treated with the solvents, and does not undergo "any injurious wear and tear, or alteration in its nature."—H. S.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

Researches on the Formation of Pigment Lakes. C. O. Weber.

See pages 896—902.

The Treatment of Leather for Dyeing and Colouring Purposes. E. M. Shaw. J. Soc. Dyers and Colourists, November 15, 1891.

Having glanced over the formation of skin, the author next considers the methods usually adopted to divide and remove such portions as are known to be useless for the production of suitable leather for the purpose of dyeing and colouring. These portions comprise the whole of the cuticle, including the malpighi network, with the hair or wool, with their roots, and an albuminoid fluid cementing together the fibrous tissue of the corium, and known as coriin.

The removal of the cuticle is effected by macerating the skin for some time in water, whereby the mucous layer dividing the malpighi net and the grain is dissolved, thus rendering the epidermis loose, which then speedily separates, carrying with it the hair.

It is found in practice that this result may be attained much quicker by the aid of alkali added to the water. Various alkaline salts have been proposed and tried with more or less satisfactory results, but the one generally used, either alone or in conjunction with some other, is lime. For our purpose of dyeing it is found that a skin receiving careful attention in the lime solutions is better for having a prolonged stay than a too short one. Of course it may be allowed to remain far too long, and will then be rendered useless, but a definite stay is necessary for the removal of the coriin. This is an albuminoid fluid binding together the fibres of the coriin, and supplying also the fluid to the cells of the cuticle. It is insoluble in water, but soluble in alkaline solutions or strong hydrochloric acid. It is precipitated from an alkaline solution by adding a small quantity of acid. Advantage is taken of lime for the removal of coriin, and to accomplish that end the skins are placed in large tanks or pits filled with water, and into which a large excess of lime has been thrown. The use of a more caustic alkali has often been suggested, but there is always the danger of partially or wholly destroying the papillæ, or grain of the skin, by their use.

Lime also swells or plumps the skin to a great extent, which is advantageous for some purposes, while for others no advantage may be claimed.

When the skin is considered to have had sufficient lime it is bated, as a means to entirely remove the coriin remaining.

Bating is a most disagreeable and nauseous process, and is still the subject of a great amount of research to discover why certain results are obtained by this means which other processes have so far failed to give.

Bating is accomplished by the use of certain animal dung. A bath is prepared containing the required quantity, partly in suspension and partly in solution, in water at about 90° F. In this the skins are placed after liming, and macerated a given time, when they are removed and submitted to a mechanical action called slating, which is a method of applying a moving pressure over each skin separately and evenly to press out the foreign matter. This matter was supposed to be lime, but newer evidence demonstrates the following as the more correct view.

Dung contains pepsin and pancreatin, which are formed in the system of the animal; and as there is generally an over-production, the excess passes away with the excrement.

Pepsin transforms albumen to peptones, which are partially soluble and insoluble in water. This, then, is a digesting process, which may be prolonged or shortened, intensified or weakened, at the will of the manufacturer.

The milky liquid forced out of the skin in slating, and which was and still is supposed by some to be lime, contains peptones, insoluble in water.

Immediately following the bating is the drenching or fermentation process. A bath is prepared at about 90° F., composed of water and bran, to which is added occasionally a little wheat or rye flour: this is, however, quite optional, and depends in a great measure on the seasons of the year. After the skins have been placed in this bath, fermentation takes place, accompanied by the formation of the usual vegetable acids, principally acetic acid. The effect of this is to open the skin fibres and swell them, rendering them less compact and dense, and thereby permitting the tannin solutions to act more rapidly and effectively. Should there be any lime present in the skin, by this process it becomes neutralised.

Tanning.—With tanning, practically dyeing commences, because by using separately or combined the various materials for converting skin into leather, shades of colour may be produced from a yellow tint of white to a deep brown.

The lightest shade obtainable is produced by the use of sumac. It is also necessary that the sumac should not contain any trace of metallic salts, especially iron, as these, and particularly the latter, are apt to leave stains which are often troublesome to remove. A yellower tint is imparted to leather when using fine-ground sumac. Sumac gives a soft mellow tannage, not cementing the fibres of the skin together, but leaving them rather isolated. It is a very quick tanning agent, skins being converted into leather by its use in the course of 12 hours. It is absolutely a necessity, where colour is required as white as possible, that the sumac bath should not be allowed to remain too long idle, as the result would be leather of a dark brown shade, consequent on the presence of gallic acid, arising from the conversion of the tannic acid into gallic acid and glucose through fermentation.

Leather tanned with sumac possesses but little capacity for resisting water, but is especially adapted for colouring purposes.

Skins tanned with oak bark are solid and rather hard, and thus more difficult to dye.

Where solidity and wear are required, such being the case where leather is used for binding large heavy ledgers, then oak-tanned leather must be used. One great difficulty confronting the dyer when bark-tanned leather is to be dyed, is the "bloom" on the grain. This is caused during tanning by the infusion of the bark, after exposure to the air, depositing a drab-coloured powder known as ellagic acid upon the skin. Its removal requires the utmost care and attention to safeguard the grain. The use of moderately hard brushes, with warm water in which has been dissolved a small quantity of an alkaline salt, will accomplish all that is needed.

With regard to the application of colour to leather. This material cannot be placed in a dye-bath applied to leather at a heat higher than 110° F., without endangering the existence of the grain in a sound state.

If the skin is left with the grain exposed to the rays of the sun, a dry wind, or frost, before it is tanned, the exposed portions are blasted—that is, the grain is dried and shrivelled up, and a succeeding process probably removes the damaged part, thus exposing the fibre.

Leather to be dyed is usually well washed in a machine adapted for that purpose, and afterwards "cleared" in a solution of acid, preferably sulphuric acid, and water.

The sulphuric acid bath removes to a considerable extent stains from the skin, and precipitates the excess of tannic acid contained in the fibrous portion. It renders the grain more sensitive to the action of most colouring matters by imparting to it a degree of roughness which it did not previously possess. For the vegetable colouring products the skins are washed in several different baths of clean water until no trace of acid is discernible. For very delicate shades requiring the whitest leather, a difficulty often arises from the fact that a satisfactory method of bleaching leather has not yet been discovered.

The process of so-called bleaching in general use consists in depositing lead sulphate on the grain and in the fibre of

the skins. For this purpose a bath is prepared, containing a strong solution of lead acetate, into which the wetted leather is placed and continuously moved for a few minutes. It is then lifted out and put into a bath of sulphuric acid and water. The leather assumes a yellowish colour and harsh touch the moment it comes in contact with the lead acetate, but as quickly becomes almost white, very soft and silky, after immersion in the acid bath. Leather treated by this so-called bleaching process, is, when dry, mellow but firm, and for this latter reason skins are submitted to this treatment to produce a certain finish otherwise not attained.

Leather bleached by this process more rapidly changes to a brown colour when exposed to the atmosphere and sunlight than it otherwise will if left unbleached.

The author has on many occasions attempted to bleach leather by means of hydrogen peroxide in conjunction with ammonia, and although he has not yet succeeded, he thinks it probable that the hydrogen peroxide may be used with fair results if used without ammonia. Ammonia combines with the tannic acid, forming a dark-coloured precipitate, which gives rise to the brown colour appearing on leather which has come in contact with alkali. It causes also the grain to be contracted and very hard and brittle; so much is this the case that leather so treated may, when dried in the open air, be easily broken.

Generally all alkalis have this defect, which is detrimental to their use in leather tanned with vegetable agents.

The use of permanganates proved unsatisfactory.

It is the author's opinion that nature assists the leather manufacturer in a manner in which science has not yet been able to do. As an instance, we find that a cold frosty air produces a decidedly white colour in sumac-tanned leather, and for that reason only, skins have often been dipped in hot water and hung up on cords in such a way that the frost may have full power over them to freeze them. It is found that cold alone practically bleaches sumac-tanned leather; and not only is it bleached thus, but rendered very soft. When the water contained in the fibres of the skin becomes ice, the fibres are stretched by reason of the expansion of the water freezing, and so the fabric is softened. Afterwards, as the skin dries slowly, the fibres are not contracted rapidly; while, if the skin is dried quickly, the fibres become contracted and brittle.

Dyeing.—The objects desired are to apply colour to the grain in such a manner that it will not easily rub off by various finishing processes into which friction enters largely; that the colour when applied shall be solid and fairly fast to light.

To attain these points many have been the plans adopted to accomplish good results. In dyeing with cochineal it was customary to take the skins just before tanning, therefore in a most critical condition, and after what was called rinsing them with sodium chloride, to sew them together in pairs so arranged that the grain was outside and the fibrous portion inside. After dyeing the skins were tanned. The expense was heavy and the result sometimes disastrous, the skins becoming damaged in the operation.

Of course the fibre side of the skin was not dyed, and retained its tanned colour. The next step was to dye skins tanned, but in such a way as to give the idea of dyeing before tanning. The reason for this was that the skin is in a very perishable condition before tanning, and cannot be held over indefinitely awaiting orders. This was accomplished by sewing the skins together as before tanning, but still many thought the colour not so good as when dried by the old method. Gradually these ideas changed, until the sewing was dispensed with altogether, and the fibre side, which always takes up the colour very much more rapidly than the grain side, got partially dyed.

The mordants used were also detrimental to a great extent to the leather, and this might be, and doubtless was, lost sight of by the employment of dyers who had previously been engaged in dyeing fabrics. The great aim was to produce fast colours, and in many cases success attended the efforts, but in others the leather was rendered almost useless by using strong alkaline salts. Certainly the size of the skin in almost all instances was reduced through a shrinkage of the fibres caused by mordants. Two agencies appear to work almost exactly opposed to each other, one being that leather exposed to light gradually becomes darker, the change taking place more rapidly as the light is stronger. Of course it would never become black, but assumes a dark brown shade, especially in sunlight. The other agency is that the dyed colour may with the same treatment become much lighter. The consequence of this dual action is generally that the shade is changed, but to an ordinary observer is not what would be termed faded.

Vegetable Colours.—They do not act too quickly, which may be sometimes an advantage, but their scope is limited. When dyeing with woods, only the clear liquor may be used, otherwise small pieces of wood adhere to the skin and cause dark spots which must be avoided.

Indigo.—Its colour is good, and will not easily be superseded by other colours for some purposes. In dyeing it is used cold, the skins being suspended in the vat for varying periods with repeated exposures to the air to oxidise the indigo. The colour naturally is fixed slowly, but is a good one.

Coal-tar Colours.—The basic colours are not as a rule colours to be depended upon.

Chrysoidine is perhaps the worst in this respect, but still the others are liable to the same faults in a less degree. Another difficulty to be met with is the fact that, excepting chrysoidine, the others have a tendency to bronze.

The colours most useful to the leather-dyer are those which may be worked with a small percentage of acid. About 100° F. is a safe temperature for all leather generally, although with sheepskin a higher temperature may be used—up to, say, 110° F. With calfskin a lower one is preferable. This arises from a different formation of the grain of the respective skins.

The coal-tar colours generally have a strong affinity for the fibre portion of the skin—much more than for the grain—and this presents one difficulty in making use of some shades. Even where precautions are taken to mordant only the grain, the fibre will take up the colour—in fact absorb all the colour in the bath—if exposed to its action.

Great trouble arises when colours are used which are with difficulty soluble in water, or only partially soluble. The small undissolved particles attach themselves to the skin and produce spots which are afterwards difficult to remove.

Where the grain has been blasted or damaged, these particles are to be found firmly rooted, and impossible to remove, while the grain may be somewhat improved by careful washing. It is therefore absolutely necessary that dyes should be perfectly soluble.

There is a point to be arrived at in the use of dyes when the leather will take up no more of one certain colour, but where a different shade will be taken up or combined with the one already used. Advantage is taken of this to cover some defects in the skin, one colour being used which will not show those defects, and when the leather is saturated, then the other colour is used to produce the desired shade. In this way defects may be covered to a considerable extent; but this is one of the most delicate operations of the dyer's art, and one requiring much skill and a great amount of knowledge to accomplish.

If skins are taken when ready prepared for tanning and placed in a dye-bath composed of aniline colours, they rapidly absorb the colour, which will penetrate through the skin. But two reasons present themselves which are obviously sufficient why skins should not be dyed before tanning. The skins are in a critical state of existence, and if submitted to a temperature too hot will dissolve into a jelly known as gelatin or glue; but the principal cause is that the shade may not be sufficiently regulated to match patterns, as the tanning would very materially change the colour lighter or darker.

Staining.—This is another method of applying colour, and one where the coal-tar colours are best adapted of any. In this case, the skin, dry or damped, is laid on a table, all creases or unevenness in the surface of the skin having been previously removed.

The mordant is then applied with a brush, and afterwards the colour, gradually increasing the strength of the latter at each application until the required shade is obtained. Under such treatment the colours must of necessity be quite

soluble in water, otherwise satisfactory results will not follow. The grain is thus not always properly coloured, as a quantity of the dye may be invariably rubbed off the dried surface of the skin by the use of a damped piece of white cotton or other material.

Chamois leather is produced from the fibrous portion of sheep or lamb skins which have had the grain removed by splitting machinery while in the process of liming. Instead of being tanned, as before described, chamois leather is dressed in cod-liver oil; afterwards the oil is removed by maceration and pressure, either in warm water only or by the use of an alkaline bath.

This leather must always retain its softness and flexibility; when coloured, the usual method being to mix colour and clay to a moderately thick consistency, which is then applied with a brush. When dry, the leather is beaten to remove the clay, of course removing also a large amount of colour. But the leather always was dusty and disagreeable.

For several years the author tried to dye this leather without producing harshness, and at the same time at a less cost than was considered necessary, and he accomplishes that end in both directions. The method for dyeing chamois leather madder red is now given, and afterwards the method the author adopts, but without the minute details.

Madder Red.— Dissolve for every 10 or 12 skins, 2 lb. 3 oz. white sugar and 13 lb. of alum free from iron in the required quantity of water, and add 4½ pints of spirit of wine, and tread the skins in the solution for two hours.

Before submitting the skins to the process, they should be thoroughly fulled with lukewarm water and washed with boiling water, and after passing through dilute sulphuric acid (1 part in 60 of water) subjected to a final washing. After working the skins thoroughly in the solution, remove from the vat, wring slightly, rinse in water, and dry in the shade. After partial drying replace them in the same bath, to which in the meanwhile has been added warm water and about one quart of spirit of wine; allow them to remain one hour with occasional working. After the skins, by repeated wringing out and replacing in the bath, have been thoroughly soaked through, and passing them once more through the bath, spread them in piles upon a table for two or three hours.

The skins thus prepared are now mordanted for madder red. This is prepared by mixing 20 pints of the foregoing mordant with one pint of tin composition and 20 gallons of water. After stirring the mixture thoroughly, full or tread the skins in it for one hour.

Remove and allow to drain, and draw them from time to time through the mordant. Then hang the skins in the shade to dry, afterwards in a room heated to 86° F., where they should remain at least 12 hours. When dry, rinse in cold water, then full in cold water and rinse once more.

Prepare the madder bath by adding 8¾ lb. good madder to 37 to 42 gallons of water in a boiler heating gradually to a temperature not exceeding 122° F.

Place the skins in the bath one by one, and after allowing them to remain till the above temperature is reached, five or six hours being generally required, place them at once in running water, and after thoroughly rinsing and repeated fulling upon the stone, hang them up to dry. To give the leather lustre, it is placed in the fining bath, prepared by mixing 26⅔ gallons of water, half-pint spirit of wine, and one-third pint olive oil. Tread the skins thoroughly in this bath, rinse once more and dry.

To restore softness to the skins dyed, tread them in a mixture of 100 yolks of eggs, 1 lb. 2 oz. alum, and the necessary quantity of water, dry and work with a stretcher.

The method the author adopts to produce, not red only, but the majority of colours, is as follows: —

The skins are washed in warm water—say one dozen skins are washed in five minutes. They are then placed in a warm bath about 90° F., containing the mordant, where they remain with an occasional agitation for 10 hours. They are then taken out, allowed to drain awhile, and then placed in the dye-bath at 105° F. In 30 minutes they are dyed, washed through warm water and dried. If for a light colour, the skins are previously hung in the open air after mordanting, which bleaches them slightly. If a very light colour, the skins are bleached in the open air before mordanting.

The skins require no further treatment beyond the usual stretching in finishing.

The Colouring of Paper with Coal-Tar Dyes. Papier Zeitung, 1891, **16**, 2182—2183.

Of substantive dyestuffs the following are suitable for use in colouring paper: Congo, Congo RG, Congo 4 R, Brilliant Congo, Benzopurpurin, Rosazurin, Deltapurpurin, Hessian purple NB, Azo-orseillin, Chrysamine, Congo yellow, Brilliant yellow, Chrysophenine, Hessian yellow, Azo blue, Azo violet, Heliotrope, Rosazurin 2 B, Congo Corinth, Benzo brown, Violet black, and Benzo-black-blue. To apply them, the paper pulp is heated with a solution of 0·5 to 3 per cent. (calculated on the weight of dry paper) of the dyestuff, corresponding to the shade desired, and a small proportion of sodium carbonate, phosphate, or chloride, or a larger proportion of sodium sulphate. Thus, paper is dyed with Hessian purple by well mixing it in the state of pulp with a solution of from 0·5 to 2·5 per cent. of the dye, 1 per cent. of sodium carbonate, and 10 to 20 per cent. of sodium sulphate, and then heating the mixture for half an hour.

In the class of basic dyes the following are commendable: Magenta, Cerise, Grenadine, Safranine, Rhodamine, Pyronine G, Acridine orange, Auramine, Phosphine, Malachite green, Brilliant green, Azine green, Victoria blue, New blue, Methylene blue, Muscarine, Neutral blue, Basle blue, Soluble blue, Capri blue, Methyl violet, Crystal violet, Hofmann's violet, Vesuvine. These are fixed on a mordant of tannate of antimony:—A solution of the necessary quantity of dye (0·5 to 2 per cent.) to produce the desired shade, is first thoroughly incorporated with the pulp (which is heated to a temperature of 50°—80°), then a solution of tannic acid is added and mixed, and finally a sufficiency of an antimony salt to precipitate the tannic acid.

Eosin, Erythrosin, Phloxin, Rose Bengale, Alizarin, and Victoria blue B, are employed in conjunction with an alumina (aluminium acetate, basic alum, aluminium basic sulphate, or aluminium sulphite) or tin oxide (from stannous chloride) mordant.—E. B.

The Permanence of Colours used in Printing towards Light. G. Fritz. Papier Zeitung, 1891, **16**, 2213—2214.

Carmine when used in thin consistence is somewhat sensitive towards light, but in thick consistence it is very permanent. Tints such as "rose" from Carmine, and white lead become reddish-grey after a long period, this being due to the action of the air on the white lead; and, although Carmine is itself very permanent, the tints obtained with it in admixture with other substances, invariably become darker after a time. The most permanent violet is that from Carmine and Ultramarine, but it ultimately becomes bluish. Natural madder-lake exhibits the same behaviour as Carmine, whilst the artificial from anthracene is much more fugitive. Cinnabar with the addition of a suitable varnish is very permanent, but with a varnish containing lead it soon becomes black on exposure to the air. The so-called "Carmine-cinnabar" becomes lighter or darker according to the material of which it is made. Minium changes to a brownish colour in the air, but becomes black in the presence of sulphuretted hydrogen. Ultramarine is by itself very permanent, but when mixed with lead compounds undergoes change; in order to obtain a blue tint from Ultramarine, it is best to mix it with zinc white. Prussian blue and other similarly constituted compounds when used in thick consistence retain their colour for a long time, but in thin consistence soon become greenish, the latter change being hastened when rosin varnish or rancid oils are used conjointly. Cobalt blue is very permanent both towards light and air, and Carmine yellow is but slightly altered; lead dryers cannot however be used with the latter. Chrome yellow becomes darker with age, and finally loses its original colour entirely. White lead becomes yellow on exposure to the air; and greys formed by mixing it with blacks become brownish; it quickly turns brown when mixed with rosin varnish. Zinc white is much more permanent than white lead, and it can be used in admixture with any of the numerous sulphuretted colouring

matters. Despite its advantages however, it is not largely used in printing; it does not possess so great a covering power as white lead. Baryta-white is extremely permanent, but its covering power is only very small. Paper containing free acid or chlorine should not be employed for colour printing.

The author considers that the nature of colouring matters used in printing may be determined by treating a small quantity with alcohol, which dissolves all the coal-tar colours that are employed, and observing the colour of the solution, or by igniting a portion in the blow-pipe flame. In the latter case cinnabar volatilises completely, zinc-white shows the well-known change of colour, and lead compounds usually leave granular residues of metallic lead; the presence of these metals can then be confirmed by dissolving the residues and applying the known tests.

The editor points out in a note that alcohol is not an infallible test for coal-tar colours, inasmuch as a not inconsiderable number of the colouring matters obtained from dye-woods are also soluble in it; whilst very many coal-tar colours dissolve in alcohol with tints other than their own. He appends a table showing the colour of the solutions which result when certain colouring matters are treated with nitric acid, hydrochloric acid, sulphuric acid, ammonium sulphide solution, and solutions of caustic alkalis.

—A. R. L.

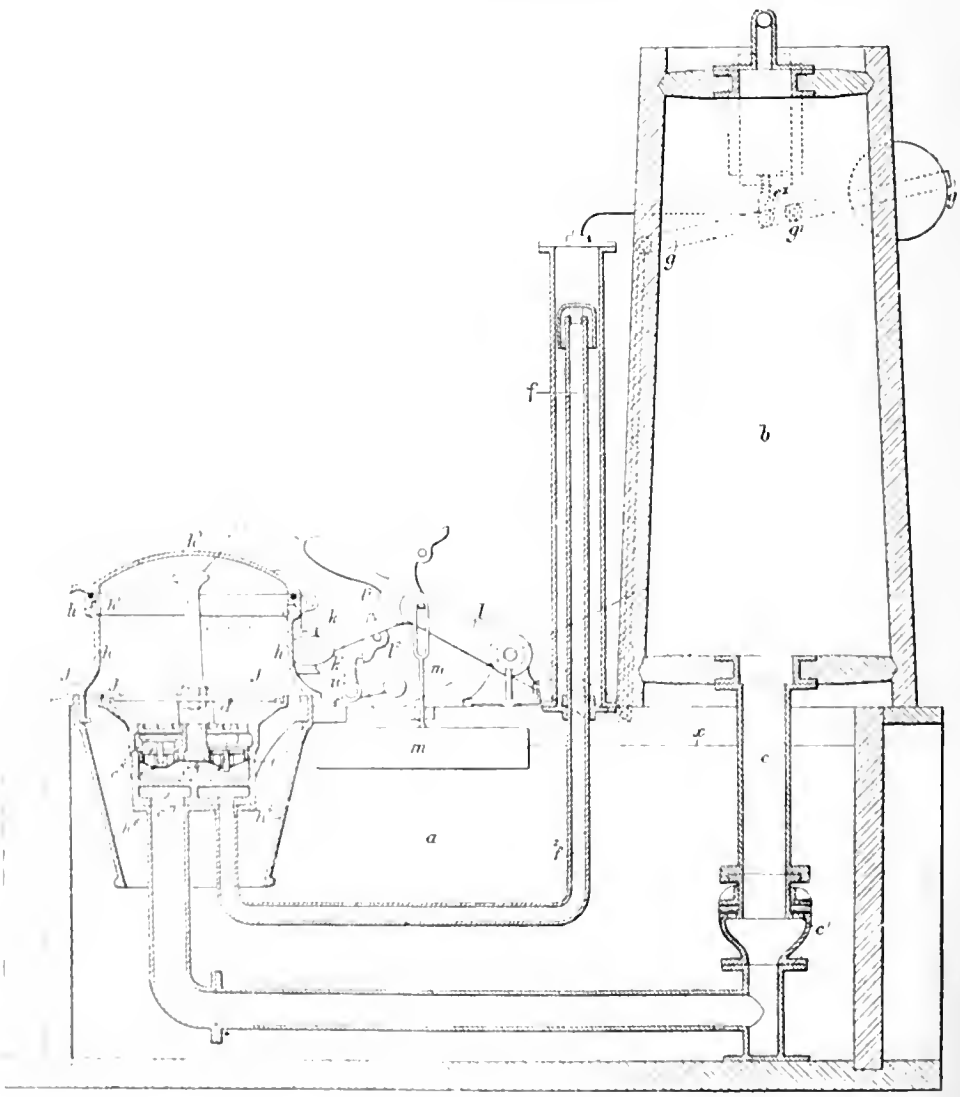
PATENTS.

Improvements in the Extraction of the Extraneous Matters from and in Bleaching Vegetable Fibres. J. Smith and P. W. Nicolle, Jersey. Eng. Pat. 17,083, December 31, 1884. Amended November 19, 1890. 6*d*.

The use of alum and other double sulphates for ungumming China grass (rhea), Manilla, or other textile fibres, is disclaimed, the claims being confined to the employment of alkaline sulphates for that purpose (see this Journal, 1885. 733).—E. B.

Improvements in Mechanism or Apparatus for Dyeing and Bleaching Cotton, Wool, Silk, and other Fibrous Materials in the Raw and Manufactured or partly Manufactured State. G. Young, Winton; F. Pearn, Gorton; and W. Crippin, Patricroft. Eng. Pat. 1157, January 22, 1890. (Second Edition.) 1*s*. 1*d*.

The mechanism forming the subject of this invention is employed for bleaching and dyeing textile fibres in the unmanufactured, manufactured, or more especially, partly manufactured state. The figure below shows a sectional elevation of one modification of the apparatus, which is used in bleaching, &c. yarn in the form of cops.



Apparatus for Dyeing and Bleaching.

It consists of a vat a, supporting a larger chamber b, smaller chamber f, and treating chamber h. The chambers h and b are connected by the pipe c, and the chambers h and f by the pipe f^2. A slide valve (not shown in Fig.), opened or closed by the movement of a rod e^x, puts the chambers b and f alternately into communication with an exhausting apparatus. The movements of this rod are controlled by a lever g (pivoted on a braeket g^1 fixed outside the chamber b) which is connected by a rod g^2 with a beam lever l. The latter, which is automatically depressed by a slotted rod m^1, when the float m on the surface of the liquor x falls, is provided with two pins l^2 which, with the rise or fall of the lever, move the handle k^2 of the three-way tap k through an arc of 60°, and thus admit either steam or air through a passage in the wall of the chamber h into an annular recess h^1, whence it issues into the chamber through a perforated ring h^2. The other passage in the tap serves for the admission of gas into the chamber h, when required. A pawl n catches in a notch l^3 in the lever l, when the lever and the slide of the slide valve are in their middle position (in which case the tap k and the ports in the slide valve are closed), and arrests the automatic action of the machine. The cops to be dyed are wound on perforated hollow spindles which are placed in holes in a circular plate j, which rests on an india-rubber ring j^1, and is provided with a handle j^2 for facilitating its removal with the cops from the chamber h. (During the operation of the machine this chamber is closed by a hinged lid h^3.) Underneath the plate j are two mushroom valves: one of these, e^5, opens when the receiving chamber b is being exhausted, and allows the liquor to pass towards this chamber, but closes against its return; the other, f^6, similarly allows steam, air, or gas to pass from the chamber h to the receiving chamber f, but not vice versâ. The end e^9 of the pipe e communicates by a lateral passage with the space e^7 above the valve e^5, and thence with the passage e^8 which is common to both valves. This passage e^8 communicates directly with the cavity d under the stationary plate j, on which the cop spindles are placed.

The cops are dyed by pumping the air out of the chamber b, which causes the dye-liquor to be drawn up the wide conical pipe h^6 into the space surrounding the cops, whence it passes through the cops into the pipe c, and thence into the chamber b. After the liquor has been drawn for some time through the cops in this fashion, the slide of the slide valve is automatically moved, and air admitted into chamber b, whilst chamber f is exhausted, and steam or air is drawn through the cops, the liquor in b passing back into the vat through a valve arrangement at c^1. This alternate treatment with dye-liquor and steam or air is repeated until the cops are sufficiently dyed.—E. B.

Machine for Printing Floor-Cloth and similar Material by means of Flat Blocks. T. Dale, Kirkealdy. Eng. Pat. 1210, January 23, 1890. 8*d*.

The chief feature of this invention is the employment, in connexion with the printing blocks, of one or more cylinders with pistons operated by compressed air or steam, but preferably by the former, so dispensing with the usual gearing shafts or cams. A second feature is the employment of such cylinders in connexion with mechanism for giving a longitudinal motion to the linoleum which is being printed. Details of the mechanical arrangements cannot be properly given apart from the drawings which illustrate the specification.—E. B.

Improvements in the Method of and Apparatus for Mordanting and Dyeing Wool, Cotton, and other Fibre, and also for Extracting or Separating Animal from Vegetable Fibre. John Smith, I. Smith, and Joseph Smith, Halifax. Eng. Pat. 1607, January 30, 1890. 8*d*.

The wool, &c., to be dyed or otherwise treated is introduced into a long shallow vat, which is supplied with a continuous stream of liquor, in the form of a spray, from a tank fixed above it at the end where the wool enters, the liquor flowing away over a bridge at the opposite end of the vat. The wool is carried along in the stream of liquor, but is, at intervals in its course, caught and dipped below the surface of the liquor by perforated "dipping-rollers or other mechanical equivalents;" or it may be carried through the vat on an endless perforated sheet; or, again, it may be placed on a stationary perforated tray underneath the tank. Further, the employment is claimed in combination with the above mechanism of a pump for raising the liquor from a low-level tank, into which it flows from the vat, into the tank above the vat. Two sheets of drawings accompany the specification.—E. B.

Improvements in Compositions for Renovating the Faded Colours of Plush, Velvet, Cloth, or other similar Material. W. P. Thompson, London. From A. Mautner, Vienna, Austria. Eng. Pat. 1717, February 1, 1890. 6*d*.

The colour of faded plush, &c., is completely restored by the application of one of the under-mentioned mixtures, which is spread over the faded parts by means of a brush or "mop," allowed to dry, and then well brushed, the material thus being renovated without being removed from furniture, &c. A "basis" is prepared of yolk of egg (0·4 part), caseme (4), ammonium hydrate (8), tartaric acid (2), gelatine (1), Venetian soap (1·5), alum (2), distilled water (80), egg albumen (1), and sodium nitrate (0·1). In this mixture appropriate dyes are dissolved; thus, there are added:—

For the renovation of red materials, 0·1 to 1·0 part of "pure red."

For the renovation of blue materials, 0·1 to 1·0 part of Lyons blue and 0·1 to 0·5 part of "nigrysin."

For the renovation of brown materials, 0·1 to 0·1 part of pure genuine brown and 0·1 to 0·5 part of "nigrysin."

For the renovation of green materials, 0·1 to 0·5 part of Lyons blue, 0·1 to 1·0 part of "nigrysin," and 0·1 to 0·4 part of "Martin's yellow."

For the renovation of yellow materials, 0·1 to 1·0 part of "Martin's yellow."—E. B.

Improvements in Dyeing Cotton. T. Ingham, Manchester. Eng. Pat. 2411, February 14, 1890. 4*d*.

A black is produced on cotton materials by passing the same through an oxidising bath of sodium dichromate, after impregnating them with a solution of logwood extract at 3° Tw. (1 gallon) to which there are added Alkali blue (2 oz.) and crystallised sodium carbonate (4 oz.) Instead of, or along with, the Alkali blue in this bath, Alkali yellow, bark liquor, or fustic liquor, may be used. The composition of the (logwood) colouring bath is alone claimed.—E. B.

Improved Method or Process of and Apparatus for Bleaching, Dyeing, or otherwise Treating Fibrous Materials. S. D. Keene, Providence, U.S.A. Eng. Pat. 3009, February 25, 1890. 8*d*.

This invention relates to the bleaching and dyeing of cotton or other vegetable textile fibre, more especially when in the form of yarn or cops, spools or bobbins, or in a loose state. The material is enclosed in a keir from which the air is exhausted; then the air-exhaust passage leading from the keir is closed, and the bleaching, &c., liquors admitted into the keir and forced into and through the yarn by a force-pump or by means of compressed air. The apparatus in and by which these operations are successively performed is described in the specification by the aid of a drawing.

—E. B.

Improvements in Expediting and Improving the Process of Bleaching Linen, Cotton, and other Textile Fabrics, and Linen, Cotton, and other Yarns in the Hank. R. T. Webb, Newtownards. Eng. Pat. 6612, April 30, 1890. 8*d*.

In this process a pair of squeezing rollers is arranged above the vat containing the boiling lye or other chemical solution used in the process of bleaching the material, and the

latter is passed between the rollers and through the liquid a sufficient number of times to ensure the proper action on it by the liquid.—H. S.

Improvements in the Method of and in Means and Appliances for Tarring, Colouring, and otherwise Preparing Thread, Hemp, Jute, or other Twine for Sewing, and in Feeding or Supplying the same to Sewing Machines. W. Peters, London. Eng. Pat. 7423, May 13, 1890. 8*d*.

This invention has for its subject an apparatus which enables the use of thread in sewing machines direct from the tarring, colouring, or preparing tank, this tank being water-jacketed and heated. The thread is passed through suitable rollers as it is withdrawn from the liquid, and these rollers are geared to run at a speed corresponding to that of the sewing machine. The motion is derived by means of a band off the motion-shaft of the sewing machine.—H. S.

Process for obtaining Designs or Patterns in Red Colour, on Textile Fabrics Dyed with Indigo. W. Elbers, Hagen, Germany. Eng. Pat. 7522, May 14, 1890. 8*d*.

The indigo-dyed cloth is prepared with sodium β-naphtholate, dried, printed with a colour-mixture of sodium chromate, sodium nitrate, stannous chloride, acetate of alumina, acetate of lime, and diazoazobenzene chloride, again dried, aged for 12 hours, passed through a bath of oxalic acid and dilute sulphuric acid at 44° C., and finally well washed and dried. Sodium nitrate and stannous chloride are added to the printing-mixture for the purpose of increasing the intensity and brilliancy of the red, and acetate of alumina and acetate of lime to protect the same against the action of soap.—E. B.

Improvements in and in the Preparation of "Wash Greys" or Back Cloth used in Printing Woven Fabrics. G. B. Behrens and J. C. Watson, Castleton. Eng. Pat. 9417, June 18, 1890. 4*d*.

Grey cotton cloth is treated with caustic soda and then with a preparation of albumen and zinc sulphate solution in order to fill up the interstices of the cloth and at the same time render it more durable and waterproof. The material so produced is said to be cheaper and an improvement on the ordinary "wash grey" at present in use in the process of printing woven fabrics.—H. S.

Improvements in Apparatus for Boiling, Scouring, or Cleansing Textile Fabrics. W. Hutchinson, Salford. Eng. Pat. 10,323, July 3, 1890. 8*d*.

This apparatus consists of a vat or tank containing the scouring liquid, kept boiling by perforated steam pipes, and is fitted with five sets of rollers or pulleys; the two upper sets may either consist of rollers or a number of pulleys, and between them is passed the cloth, the liquid being pressed therefrom by flat weights resting on the journals of the uppermost pulleys. The other sets are arranged under the first set, and near the bottom of the tank. They serve to guide the cloth through the scouring liquid, repeating this operation before the material is again passed under the rollers. The object of this invention is to enable the repeated removal from the liquor of textile fabrics which are treated with a boiling alkaline or other liquor in the process of bleaching, and to remove the scouring liquid with which the cloth is saturated before it re-enters the main body of the liquor.—H. S.

Improvements in Dyeing Cotton. T. Ingham, Manchester. Eng. Pat. 14,302, September 11, 1890. 4*d*.

Cotton cloth or yarn is dyed black by the following process:—

The material, after being scoured, is passed through a bath composed of logwood liquor at 3° Tw. (1 gall.), copper sulphate (4 oz.), and acetic acid at 8° Tw. (1 pint). It is then dried and the black produced by passing it through a solution of sodium or potassium dichromate. To modify the shade of black, a certain proportion of a yellow colouring matter (fustic, bark, Persian berries, or gallollavin) may be added to the logwood bath.—E. B.

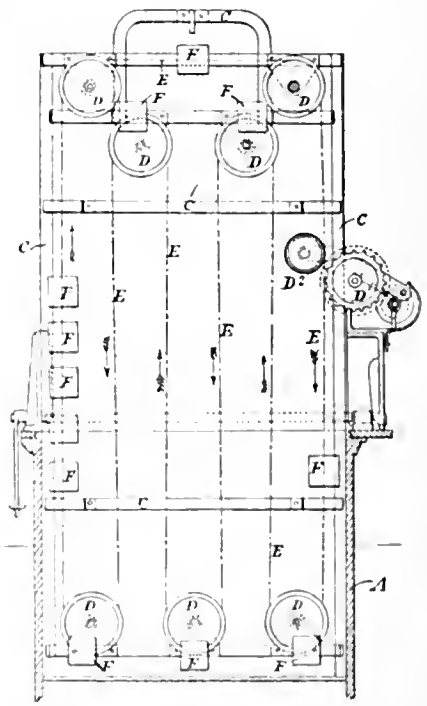
Improvements in Oil-cloth and other Fabric Printing Presses. W. H. Townsend, New York, U.S.A. Eng. Pat. 14,699, September 17, 1890. 1*s*. 1*d*.

This invention, which cannot be intelligibly described apart from the drawings given with the specification, relates to improvements in mechanism for printing oil-cloth, more especially in the mechanism patented in the United States of America by C. Rommel (U.S. Pat. 137,962 of 1873.)

—E. B.

Improvements in the Method of and Apparatus for Scouring and Dyeing Yarns, Tops, and the like. W. Laidlaw, Hawick. Eng. Pat. 16,751, October 21, 1890. 8*d*.

The yarn, &c. is loosely packed in perforated cages F (see figure) attached to endless pitch-chains E, which pass over pulleys D.



Apparatus for Scouring and Dyeing.

The framework C, on which the pulleys are mounted, is so constructed that it may be raised from, or lowered into, the vat A, whilst the chains are in motion.

One advantage attending the use of this apparatus is, that the yarn, after being scoured, may be dyed without being removed from the cages, this being accomplished by simply emptying the vat of the scouring liquor and filling it with dye-liquor.—E. B.

Improvements in Machines for Imparting to Paper and other Sheet Material a Variegated or Marble-like Appearance. C. H. Bellamy, South Hadley Falls, U.S.A. Eng. Pat. 16,795, October 21, 1890. 1*s*. 3*d*.

The object of this invention is to provide suitable mechanism for performing the "marbling" of paper, which has hitherto been chiefly done by hand. It comprises a tank for holding a solution of gum or other "colour-supporting

liquid;" an apparatus for distributing the colour on the surface of the gum solution; and mechanism for conveying the paper to, and removing it from, the colour. Eleven sheets of drawings, aiding the description of the mechanical arrangements, accompany the original specification. There are 31 claims.—E. B.

Improvements in or Relating to Photo-Mechanical Colour Printing. F. J. Upton, London, and G. Stephens, Walthamstow. Eng. Pat. 1793, January 31, 1891. 8*d*.

See under XXII., *page* 947.

A Process of Imparting a Permanent Colouring to Torquoises and other Precious Stones. A. J. Boult, London. From A. Kühne, Dresden, Germany. Eng. Pat. 14,385, August 25, 1891. 4*d*.

Turquoises and other similar precious stones are frequently defective in colour, exhibiting in some parts spots of a different hue to other parts; moreover, in course of time their colour fades. To remedy these defects the stones are coloured by means of "aniline colours." The stones are first immersed in a dilute solution of tartaric acid (20 grms. per litre) or in a solution of tartaric acid (10 grms. per litre), and copper or iron sulphate (40 grms.). They are then placed in a bath of alcohol, to which the dye, dissolved in a little water, is gradually added. In this bath the stones are left for 24 hours, after which the colouring matter will be found "to have permeated them not only on the surface, but a certain distance inwardly, so that they may be cut or ground without losing any of the uniformity of their colouring."—E. B.

VII.—ACIDS, ALKALIS, AND SALTS.

Action of Heat on Solutions of Salts of Chromic Oxide. A. Recoura. Compt. Rend. 1891, **112**, 1439—1442.

Solutions of normal salts of chromic oxide, as is well known, become green on boiling, and on standing for some time at the ordinary temperature, re-assume their purple colour. The cause of these changes has been variously explained. Berzelius, Loewel, and Fremy have stated it as their opinion that chromic oxide in the form of a dissolved salt, is modified by heat, but have given no explicit reason for this belief, except that the base precipitated from green chromium salts possesses different properties from that precipitated from purple salts. Schrötter considers the change of colour from purple to green to be due to a partial dehydration of the chromic salt in solution. This hypothesis, however, has been refuted by Loewel. The theory which at the present time is held by the majority of chemists is that a normal chromic salt in solution is decomposed by heat into a soluble, green-coloured, basic salt and free acid or an acid salt. Krüger and Siewert support this theory on the ground that certain bodies, such as alcohol, precipitate green basic salts from chromium solutions of the same colour, but overlook the fact that the formation of these salts may be due to an interaction of the precipitant employed. The strongest evidence in favour of this view is, however, afforded by the discovery, made by Van Cleef, that the green solution of a chromium salt is separable by dialysis into two portions, one of which (passing through the dialyser) contains more acid, and the other less acid, than a corresponding solution of the normal salt. That such a decomposition of the normal chromium salt takes place, was indeed to be expected, seeing that Berzelius has shown that the analogously constituted ferric salts undergo a similar change.

The author has made thermo-chemical determinations, which have enabled him to demonstrate with greater precision than has hitherto been done, the correctness of the last-mentioned theory. Chromium sulphate was the salt chosen for the investigation, since it is more stable in the green-coloured state than the chloride or nitrate. Various measured volumes of a solution of sodium hydrate were added to solutions of this salt, containing on an average one equivalent of the salt per six litres of water, and the heat evolved measured. Then the equivalent to the soda employed of dilute sulphuric acid was added to the solution, and the thermal disturbance again measured. In this way it was found that the green solution contained exactly half an equivalent of free H_2SO_4 per equivalent of $Cr_2O_3.3\,SO_3$. It thus appears that the basic green salt formed by the action of heat on a normal solution of chromium sulphate has the definite composition of $2\,Cr_2O_3.5\,SO_3$, and that it contains a modified form of chromic oxide which is incapable of combining with more acid than the formula indicates. This modified oxide, moreover, the author submits, is not capable of existence in the free state, for when the base is precipitated by an alkali, it combines with only two molecules of H_2SO_4, as the following experimental results show:—

Reaction.	Heat-Units Evolved or Absorbed.
Cr_2O_3 (precipitated from the green solution) + 2 H_2SO_4 (in solution) = $Cr_2O_3.2\,SO_3$ (in solution)	+ 17·4
$Cr_2O_3.2\,SO_3$ (in solution) + H_2SO_4	− 0·4

The presence of sodium sulphate in the solution accounts for the slight absorption of heat in the latter experiment, the acid reacting with this compound.—E. B.

Experiments on the Alterations undergone by Chloride of Lime. A. Boyer and L. Durand. Ann. Soc. Ind. de Lyons, September 1891.

Dry chloride of lime alters about twice as quickly in the open air as in a room; in the open air, also, the decomposition is quickest in a dry atmosphere with a high wind. In rooms, the alteration is slightly quicker in light than in darkness, about one-eighth being the exact amount. In an atmosphere containing H_2S, CO_2, and HCl, the alteration is about 3½ times as rapid as in ordinary atmosphere. A solution of chloride of lime alters about six times as rapidly in the open air as in a closed room. The method of titration by means of methylene blue has given very exact results. Solutions exposed in a dark room or in a yellow flask gave titrations identical with either sulphate of indigo or methylene blue; but with solutions exposed to light, the titrations given by sulphate of indigo are totally inaccurate, and entirely inadmissible. Solutions of chloride of lime alter twice as quickly in light as in darkness. A solution placed in an open vessel alters about 1½ times as quickly as one in a closed vessel. A solution placed in a room and receiving light through a curtain was altered just as quickly as one receiving the full light of the sun, but no oxides of chlorine were formed.

Preparation of Ammonium Sulphide. E. Donath. Chem. Zeit. 1891, **15**, 1021.

See under XXIII., *page* 949.

PATENTS.

Improvements in the Manufacture of Hydrate of Alumina from Silicates of Alumina or Clay. E. Meyer, Berlin, Germany. Eng. Pat. 14,084, September 8, 1890. 6*d*.

The patentee finds that aluminium silicate, or mixtures thereof with other silicates or oxides, is decomposed by means of superheated steam into silicic acid and aluminium

hydrate, whilst the oxides are transformed into hydrates. The finely-ground silicate may be suspended in hot water, through which superheated steam is caused to pass; the reaction is promoted by the addition of, say, 5 cc. hydrochloric acid per 10 grms. of clay. The silica is filtered off, and from the sufficiently enriched solution the alumina is precipitated by means of ammonia, preferably after the addition of sulphuretted hydrogen, for retaining the iron in solution. In an alternate way of working, the silicate is formed into porous bricks which are brought to a high temperature in a suitable vessel, whilst a current of steam is blown in. The resulting mass is treated with water and the solution treated as above.—H. A.

Improvements in the Preparation of Aluminium Fluoride and Double Fluorides, and in the Manufacture of Aluminium from Fluorides. T. S. Lindsay, London. Eng. Pat. 16,887, October 23, 1890. 6*d*.

The object of this invention is the preparation of a double fluoride of aluminium and alkali (or alkaline earth), which presents advantages for the production of aluminium, owing to the large proportion of aluminium fluoride contained in the same. Three alternate methods are given for the preparations. Alumina or its hydrate is dissolved in hydrofluoric acid, treated with 2 mols. of an alkali (hydrate or carbonate) or the equivalent of an alkaline earth, and sufficiently boiled for precipitating the new double fluoride; or the alkali may be substituted by an alkaline or alkaline earth chloride; lastly, any of the above mixtures of alumina with an alkali, alkaline earth, or chloride, may be dissolved in hydrofluoric acid and treated as before.

Any of the new double fluorides may be directly treated with sodium in the usual way for the production of aluminium. When ammonium double fluoride is employed it is previously heated in order to drive off its ammonium fluoride which is collected for future use, the pure aluminium fluoride remaining behind being then reduced with metallic sodium.

The proportion of sodium used should be such, that the slag produced should have the composition of a potassium or sodium cryolite. This slag may be treated with sulphuric acid for the production of hydrofluoric acid, and the sulphuric acid can be used in such proportions that the product of the reaction, after washing out the sodium sulphate, should be an aluminium double fluoride, which returns in the process.—H. A.

Improvements in the Employment of Sulphuretted Hydrogen in the Manufacture of Alkali and Certain Bye-Products. J. Simpson, Liverpool. Eng. Pat. 17,765, November 5, 1890. 8*d*.

The object of this invention is the utilisation for the manufacture of alkali, of certain forms of neutral or acid sodium sulphate, such as cylinder cake, nitre cake, waste liquors from the wet copper process, or native sulphate. The free acid present in the saturated solution of these substances is first of all neutralised with calcium sulphydrate, the clear liquor separated from the precipitate consisting of gypsum and iron, and treated with sufficient calcium sulphydrate for conversion into sodium sulphydrate and gypsum. The reaction is facilitated by carrying it on in closed vessels, under a pressure of 60–80 lb. per square inch, under which conditions calcium sulphate is insoluble in the liquid. The clear liquor is carbonated in Solvay towers, the nitrogen which is given off at first allowed to escape, and the sulphuretted hydrogen is passed in milk of lime for the regeneration of calcium sulphydrate (see this Journal, 1891, 641).—H. A.

Improvements in Reverberatory Furnaces. F. Ellershausen, Hebburn-on-Tyne. Eng. Pat. 17,845, November 5, 1890. 6*d*.

In the manufacture of alkaline sulphides great difficulties have been experienced owing to the corrosive action of the sulphides on the bed and lining of the furnace, more so when the temperature rises too high, which is apt to happen especially near the fireplace. To prevent overheating, the bridge of the improved furnace is elevated to about 2 ft. above the bed, and is provided with a horizontal air shaft for the cooling of the same; the neck tapers from the fireplace towards the hearth, by which means the flame is directed on the charge; finally the bed near the bridge is inclined to prevent contact of the alkaline sulphide and the bridge. The walls of the heating chamber are faced with fire bricks, tiles, or slabs, which can be easily removed and replaced.

Three sheets of drawings accompany the specification.

—H. A.

Improvements in Process and Apparatus for Procuring Cyanogen and its Compounds from Gases. H. H. Leigh, London. From J. Elsner, Paris, France, and R. Gasch, Mainz, Germany. Eng. Pat. 8293, May 14, 1891. 6*d*.

The waste gases from blast furnaces, or the gases from other processes involving the dry distillation of coal, contain ammonia and cyanogen compounds, the recovery of which has so far not been successful. It is proposed to scrub the gases in question with a solution of sulphate or oxalate of an alkali (or magnesia or alumina), holding iron sulphide (or another metallic sulphide) and lime in suspension. A weak solution of sodium ferrocyanide is thus obtained, whilst the lime is converted into calcium sulphate and sulphide, which in settling, carry down the "brown bodies" and other impurities of the solution. In order to enrich or concentrate the solution, one part of it is acidified and precipitated with a soluble iron salt; the neutral or basic Paris-blue so formed is dissolved in the remaining part of the solution, whereby it is not only enriched, but gives rise to the formation of iron sulphide which can be used over again. The operation is repeated until the solution of sodium ferrocyanide is of the desired concentration.—H. A.

Improvements relating to the Extraction of Carbonic Acid from Minerals, and to Apparatus therefor. A. L. H. Knoop, Minden, Germany. Eng. Pat. 13,334, August 6, 1891. 6*d*.

The finely-ground mineral is charged in the annular space formed by two tubes; the fire-gases are passed in the shorter inner tube, from whence they are conducted by means of flues round the outer tube, in such a manner that the layer of mineral is heated from both sides. Under the influence of heat the particles of carbonate lose their power of adhesion, and on a valve or door fixed to the bottom of the apparatus being opened flows out like dry sand, whilst the insufficiently heated particles remain between the tubes.

—H. A.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

PATENTS.

Improvements in the Treatment of Minerals used in the Manufacture of Glass, China, Earthenware, and similar Goods. G. L. Schultz, London. Eng. Pat. 16,629, October 20, 1890. 4*d*.

The object of the patentee is to remove from the raw materials used in the manufacture of glass, china, and earthenware, by treatment with an acid, preferably hydrochloric acid, followed by washing and the addition of a small quantity of alkali to remove the remaining traces. The process "has special reference to a material called granulite, Meldon stone, found in the neighbourhood of Okehampton, Devon, and elsewhere, but has reference also to the treatment of other stone, such as Cornwall stone clays, and sand."—B. B.

Improvements in Machinery for making Fireclay Retorts, Slabs, Sanitary Pipes, and other like Articles. T. C. Fawcett, Leeds. Eng. Pat. 16,808, October 22, 1890. 8*d*.

The process patented has reference to vertical hydraulic presses for making fireclay goods, water pipes, and the like, in which the upward stroke of the piston of the ram, (which is so arranged that the quantity of water used in the upstroke is small compared with that needed for the down stroke), forces the water that has been used for the down stroke back into an auxiliary overhead tank, which is used to supply water to send the ram the greater part of the way on its downstroke without having recourse to the high pressure supply from the accumulator or pumps. The downstroke of the ram is then completed by water from a high pressure supply in the ordinary way. When used to press bricks or slabs the upper end of the vertical hydraulic cylinder is provided with a second piston actuating a cross-head connected by long vertical bolts to a second cross-head below the hydraulic cylinder, which brings pressure to bear on the moulding die, and thus presses the brick at the bottom at the same time that it is being pressed by the ram proper on the top.—B. B.

Improved Means of Manufacturing Glass Vessels and Adapting the same for the Storage and Conveyance of Compressed Gases, and for similar purposes. D. Rylands, Stairfoot. Eng. Pat. 17,117, October 27, 1890. 8*d*.

The object of the patentee is the manufacture of glass vessels for use in bottling compressed carbonic acid gas, oxygen, &c., and for allowing the easy withdrawal of the contents when required, and for providing the vessels with a suitable protecting cover. The method of manufacture consists essentially in pouring the "metal" into a mould and making it into the form of a tube by means of a pressing plunger, the exterior mould and the pressing plunger being afterwards withdrawn and the tube made to assume its final shape by blowing until it fits an exterior mould, the closed end being simultaneously formed by the use of a separate mould bottom brought into place before the blowing is begun.

The tube is formed with a screw thread, internal or external, complete or interrupted, as may be desired, by which it may be attached by a cap carrying a valve or cock. The tube is protected by an outer case of wood or similar material well packed with sawdust and strengthened by iron bands.—B. B.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

Asphaltum and Ozokerite in the United States. E. W. Parker. Eng. and Mining J. 1891, 193—194.

See under III., *pages* 910—912.

Portland Cement. Dingl. Polyt. J. **281**, 114—116, 138—141, 163—167.

Cement Testing.—The rules for testing cement in Austria are practically identical with those employed in Germany. The method of ascertaining whether a cement is free from any tendency to blow or expand in air consists in the employment of the firing test in conjunction with the wet pat test. The first is carried out as follows:—The cement is gauged with water to the normal consistency and spread out upon two glass or metal plates in the form of pats 10 cm. in diameter, and 1 cm. thick. In order to avoid shrinkage cracks, the pats are protected from draughts and direct sunlight, preferably by being kept in a moist chamber. After 24 hours they are gradually heated in an air oven to a temperature of 120° C., for two or three hours, until all perceptible water vapour has been driven off. Should radial cracks appear at the edge of the pat, the cement is unfit for use in air; these cracks must be carefully distinguished from mere shrinkage cracks which do not make their appearance at the edge. The cracking of cement due to the presence of calcium sulphate is not detected by this test, but becomes evident from the result of the wet pat test; when both tests are satisfactory the cement may be considered sound. The suitability of cement for use under water is best gauged by its behaviour under the wet pat test; the same precautions to avoid the formation of shrinkage cracks as are necessary in the firing test should be taken. The pat, after being allowed to set for 24 hours, is kept in water for 27 days. The tests for fineness and strength in tension and compression call for no special remark.

A. Foss has experimented with the apparatus devised by J. Holmblad for determining the percentage of lime in mortar at the actual place of building. The process consists essentially in titrating a measured quantity of mortar with hydrochloric acid, the vessel from which the latter is poured being graduated so that one division equals one per cent. of calcium hydrate calculated on the dry mortar. The assumption is made that mortar contains on an average 14 per cent. of water. Ordinary good mortar contains 8 to 10 per cent. of calcium hydrate.

The following are some of the results given by cements examined for the Association of German Cement Makers by Fresenius:

Specific Gravity.		Loss on Ignition.	Magnesia.	Strength; Kilos. per Sq. Cm.		Residue left on		Behaviour on Setting.
Unignited.	Ignited.			Compression.	Tension.	5,000 Mesh.	900 Sieve.	
		Per Cent.						
3·011	3·166	3·371	1·46	212·5	18·4	27·0	6·3	Slow-setting.
3·126	3·185	1·606	0·80	212·5	21·3	27·5	8·0	Quick-setting.
3·083	3·118	1·565	1·05	190·0	20·9	27·2	6·0	Slow-setting.
3·130	3·150	1·15	1·705	170·0	17·1	28·7	7·5	Slow-setting.
3·055	3·131	2·05	3·064	160·0	17·4	20·5	4·7	Slow-setting.
3·103	3·219	1·19	1·194	210·0	20·4	18·0	3·5	Quick-setting.
3·076	3·176	2·77	1·69	202·5	20·6	20·5	2·7	Quick-setting.
3·072	3·175	2·45	1·92	220·0	21·8	23·2	3·0	Slow-setting.
3·144	3·234	1·43	2·036	182·5	18·1	22·7	3·5	Quick-setting.

Dyckerhoff points out that one of the indications of the figures in this table is that the specific gravity of the cement before ignition is on an average somewhat lower than that of the samples examined by Fresenius in 1884, a result due to the fact that these samples were bought in open market and had absorbed more water and carbonic anhydride than those previously tested, and further to their being, in some cases, at least, slightly underburnt. Merz has pointed out that in the determination of the time of setting of the cement, the practice of using a fixed percentage of water gives rise to errors, inasmuch as each cement should be gauged with the quantity of water proper to it; this view is endorsed by Meyer, Schiffner, and Bohme, who further insist on the large personal equation due to the operator himself.

Durand-Claye has found that the shape of the test piece has an influence on the result of compression tests. Thus 7 cm. cubes show a strength of 78 kilos. per sq. cm.; prisms of the same section, but 10 cm. long, give a result of 58, and those 30 cm. long one of 50 kilos. per sq. cm.

Edmenger's high-pressure test (see page 931) is said not only to be suitable for the detection of magnesian cements, but of those unsound from other causes. For example, cements containing too much lime or imperfectly mixed cements in which a portion of the lime occurs as isolated granules (many English cements are said to be of this character) can be detected by its means. An industrial application of the high-pressure method has been suggested, namely, for rapidly maturing articles composed of cement with much inert aggregate such as sand and gravel; for instance a mixture such as 1 part of cement with 10 of sand soon attained considerable strength when exposed to steam at 10 or 15 atmospheres; test pieces of 1 part of cement and 11 of sand, after having been allowed to set for two days and then exposed to steam at 20 atmospheres for 24 hours attained a strength of 13—16 kilos. per sq. cm., while if allowed to harden in the ordinary way they would not have exceeded 4—5 kilos. per sq. cm. at the end of one month.

Some properties of Cement.—The method of cooling Portland cement clinker by means of water or steam, lightens the subsequent labour of grinding by causing a considerable previous disintegration. According to Erdmenger the operation is particularly advantageous in the case of clinker with a tendency to "fall" as if plunged under water even in the very act of falling the change is arrested and hard strong clinker results. Water is preferable to steam, as it acts with greater certainty. He further considers that this treatment diminishes the tendency of such cements to blow, particles of free lime being thereby slaked. As an example of the use of a stream of water the figures in the following table may be quoted:—

	A.	B.	C.	D.
	Per Sq. Cm.	Per Sq. Cm.	Per Sq. Cm.	Per Sq. Cm.
After two days	4·5	8·3	8·0	9·0
After three days	5·0	9·4	10·0	11·3
After one week	8·0	15·0	17·3	17·1
After four weeks	13·7	22·7	21·1	25·2
After three months	16·8	28·0	30·6	31·1

Sample A. was cement allowed to "fall"; B. had been subjected to the water treatment; C. had been broken down to a coarse powder by the quenching process; D. a sample of sound clinker similarly disintegrated. In the observer's opinion the changes caused by quenching are analogous to those occurring in the granulation of blast-furnace slag (this Journal, 1890, 863).

Certain experiments were carried out on cement concrete at Ymuyden, some of the results being as follows. The blocks were 1 m. in length and 0·2 m. in width (thickness not stated), and after five days' hardening in the air had been buried in a sand hill. The strength in compression was 7—10 times the strength in tension, a granite aggregate made into concrete with a mortar consisting of three parts of sand and one of cement, had a strength in tension of 12 kilos. per sq. cm.; clinker concrete gave a result of 10·9 kilos. per sq. cm., while a result of 9·44 was obtained when sandstone was used.

Schiffner catalogues the deteriorating influences to which Portland cement mortar is subjected, under the following heads: (1) the hardening may be hindered by the character of the sand used; or (2) by the action of foreign bodies such as acid liquors and solutions containing tannic acid or the soluble substances present in bricks, or the soil itself upon the cement while in the fresh state. (3) Improper treatment of the cement while being made into mortar, such as working it after setting has begun, or the use of too much or too little water may have a bad effect upon its hardening.

The combination of cement with water takes place *pari passu* with its hardening. Feichtinger has proved this by the following set of figures:—

Immediately after gauging	0·39
After 4 hours	1·41
After 20 hours	2·29
After 3 days	5·62
After 7 days	6·85
After 14 days	7·96
After 18 days	8·45
After 21 days	8·91
After 24 days	10·40
After 28 days	10·52
After 35 days	11·34
After 42 days	11·35
After 49 days	11·50
After 56 days	11·60
After 80 days	11·56

Schiffner's experiments give figures corroborating those of Feichtinger. The combination with water takes place somewhat more slowly in air than under water. A further series of experiments in which the amount of water provided for the cement was purposely inadequate, showed that under severe conditions the test pieces were weaker than where ample water was present, and that they absolutely disintegrated in some cases. As the quantity of water absorbed by the cement while setting averages 10—12 per cent., it is plain that if the amount of water used in gauging (about 27 per cent.) be prevented from escaping during hardening, more than sufficient will be present to effect the requisite chemical changes; indeed, even with a minimum of 7 per cent. retained during hardening a product of satisfactory strength resulted. The premature drying of the cement is favoured by its exposure in thin layers, by its use with dry bricks, or during the prevalence of a keen wind. The practical deduction that all precaution should be taken to keep cement moist during the early part of its existence is obvious.

Schott has observed in the case of cements which disintegrate when tested dry, that an early sign of mischief is to be found in the formation of sundry small eminences which occur on the lower smooth surface of the pat; a thin crust is easily detached from these spots with the point of a knife and beneath it lies a lightish granule of feeble consistency. Such disintegrated pats often contain as much as 30 per cent. of calcium carbonate.

The circumstance that the cracking of cement in air is effected by the same means as the blowing that occurs under water, has led Tetmajer to believe that the difference between the two phenomena is one not of kind, but of degree. The same experimenter quotes the case of a cement which when stored for two months developed the property of bursting the casks which contained it. Two samples were taken from such a cask, one near the outside, the other from the centre. The cement on the outside complied with all the usual tests, while that from the centre failed when thus tested, beginning to go to pieces after the lapse of six months and eventually becoming completely disintegrated. After exposure to the air for 18 months the test pats from the centre contained 4·77 per cent. of water and those from the outside 6·43 per cent. Either, therefore, they had originally absorbed different amounts of water in spite of similar treatment, or the sample which contained less water originally absorbed as much as the other, but suffered the loss of a portion of it by the action of the carbonic anhydride from the air.

The Expansion of Cement.—Schumann, continning his earlier researches, has shown that a prism 10 cm. long, composed of one part of cement and three of normal sand increases in length on an average 0·0088 mm. in one week and 0·002 mm. in the next three weeks. The following results were obtained with various cement materials, the test pieces being kept in water for the first week and for the remaining three weeks in air:—

		Mm.
Portland cement A.	1 cement, 3 sand	0·0490
Portland cement B.	1 cement, 3 sand	0·0405
Portland cement C.	1 cement, 3 sand	0·0410
Portland cement D.	1 cement, 3 sand	0·0455
Hydraulic lime	1 lime, 3 sand	0·0540
Puzzuolana, 1	1 cement, 3 sand	0·1050
Puzzuolana, 2	cement, 3 sand	0·1100
4 trass, 3 lime, 2 sand		0·1330

Further discussion has occurred concerning the failure of the cement on Stephans-dom (this Journal, 1889, 781). Schott has examined two samples taken therefrom, one of which was a dense, hard, grey mass, the other yellowish-grey, soft, reticulated with cracks, and considerably laminated. The analyses of these samples showed a considerable difference in respect of the amount of carbonic anhydride and water that they contained, the grey containing 14·8 per cent. of the former and 11·4 per cent. of the latter, while the lighter samples gave the figures 24·5 per cent. and 9·0 per cent. When calculated back to the original cement, the composition of the samples showed them to be of identical origin. From these results Schott arrives at the following hypothesis:—Cements used 30 years ago contained a considerable amount of underburnt material. When such a cement is brought into contact with a considerable excess of water the heavily burnt part sinks to the bottom, while the lighter floats, and thus two layers of different quality are formed. This is borne out by the amount of lime combined with carbonic anhydride in the two samples, 18·8 per cent. out of a total quantity of 42·8 per cent. being thus united in the hard sample (less than one-half the possible amount) and 33·7 per cent. out of 36·2 per cent. in the soft yellowish sample (*i.e.*, 95·7 per cent. of the total lime).

According to Dyckerhoff, all cement, even well-burnt, if used neat and exposed to weather influences, is apt to form shrinkage cracks which permit the entrance of water and carbonic anhydride, and would account for many of the phenomena observed in the case of Stephans-dom.

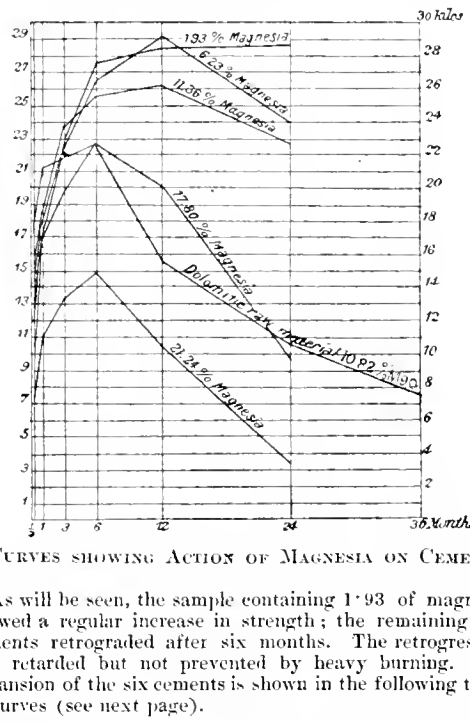
Miscellaneous Observations.—Goslich calls attention to the fact that lead pipes and zinc channels imbedded in Portland cement are considerably attacked, a result due to the alkalinity of the cement, in Laube's opinion. Seger points out that the zinc used in a building in Berlin for which stone containing sulphates had been employed, was corroded where it came in contact with the latter (this Journal, 1890, 1037). Lieven states that iron imbedded in cement exfoliates, a result which he attributes to the presence of sulphur in the cement. Delbrück, on the contrary, recommends the preservation of steam boilers from rust, when they are set in damp masonry, by the interposition of a layer of cement.

Some facts concerning "floating cements" are given by Goslich. Certain cements mix with difficulty with water, and even after admixture has been effected the mass is lumpy and sets badly. This condition appears to be due to the presence of a small quantity of oil. "Floating cement" cannot be produced by merely triturating cement and oil together at the ordinary temperature, but may be obtained by heating cement to 40°—50° C. previous to the addition of the oil. That the explanation is correct appears probable from the fact that floating cement gives off an empyreumatic smell on heating, and then has no further tendency to float. The oil causing this peculiar behaviour is generally derived from the lubrication of the grinding machinery, but not invariably so. Cement taken direct from the stone-breaker and ground in a porcelain mortar has been known to float, the oil in this case having been derived from the fuel.

Dyckerhoff has made a series of experiments bearing on the question of the influence of magnesia on cement, the results of which have been already given briefly (this Journal, 1890, 1037). The composition of the mixtures used is shown by the following table:—

	(1.)	(2.)	(3.)	(4.)	(5.)
Insoluble residue	0·7	0·47	0·79	1·14	1·41
$Fe_2O_3 + Al_2O_3$	10·74	10·25	10·54	9·37	8·67
CaO	62·50	59·12	55·44	50·56	47·28
MgO	1·93	6·23	11·36	17·80	21·14
Loss on ignition	0·8	1·24	1·11	1·16	1·50
SiO_2	21·46	20·48	19·42	18·31	18·71
Specific gravity	3·159	3·169	3·219	3·251	3·251

The mixtures were the more refractory as the percentage of magnesia (and indeed the total basicity of the mixture) increased. The specific gravity rose in a corresponding manner. The attainment by the samples of their full strength and their subsequent retrogression are shown by the curves of the following table:—



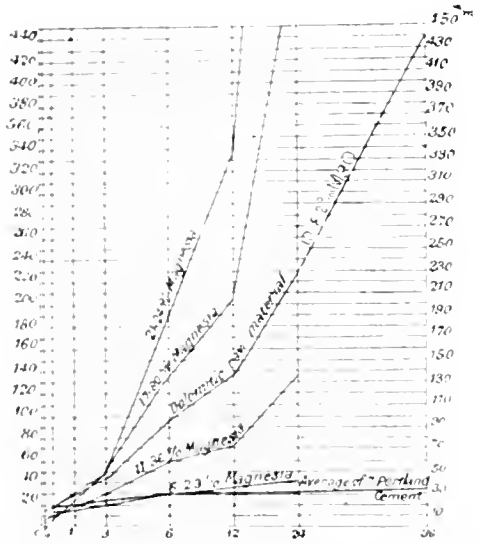
Curves showing Action of Magnesia on Cement.

As will be seen, the sample containing 1·93 of magnesia showed a regular increase in strength; the remaining five cements retrograded after six months. The retrogression was retarded but not prevented by heavy burning. The expansion of the six cements is shown in the following table of curves (see next page).

Taking the case of the cement with only 6·23 per cent. of magnesia, the continued increase of its expansion is notable when compared with normal cement. Although this expansion might not be dangerous when the cement was used with a large amount of inert aggregate, yet it might easily be objectionable in "fat" mixtures.

Dutoit has made experiments on the influence of the size of grain of the sand on the hardening of cement. It appears that the use of coarse sand gives a stronger product for mixtures of 1:4 and 1:5. Further experiments confirmed the well-known fact that coarse sharp sand gives a higher strength than small rounded sand. Moreover, the permeability of mortar made with coarse sand is lower than with fine; the reason for this is that the quantity of water used

in gauging is smaller, and also that the cement occupies about five-sixths of the space left by the sand instead of only two-thirds.



Curves showing Expansion of Cement by Influence of Magnesia.

Journet has examined the behaviour of cement gauged with salt water at low temperatures (compare this Journal, 1889, 393). He obtained smaller tensile strengths than when working under normal conditions, but this might well be due to the low temperature rather than the salt water hindering the hardening of the cement.

The addition of soda to cement mortar has been proposed by Bernhofer to aid the hardening of cement exposed to frost, but the suggestion must be received with some reserve until corroborated by further experiment.—B. B.

Proceedings of the Association of German Cement Makers. Fourteenth Annual Meeting, 27th and 28th February 1891.

The first matter of importance was the announcement that the limits for Portland cement laid down by Erdmenger, some years ago, as the result of an investigation undertaken on behalf of the Association, had been definitely abandoned as valueless, and omitted from the section on testing cement of the work about to be issued under the auspices of the Association.

The report of the committee on improved methods of testing was received and discussed; the chief points of interest being:—

1. *Investigations as to the possibility of substituting Sieves made of Metal Plate with circular Holes for those of Wire hitherto used, for the preparation of Normal Sand.*

The reason for the suggested change was that the size of the hole resulting from the crossing of wires, as in an ordinary sieve, is liable to vary on account of the displacement of the wires in use, an inconvenience avoided by the adoption of the proposed perforated plate. Experiment, however, showed that it was impossible to construct sieves of this kind which gave a sand identical with the normal sand prepared by means of the standard wire sieves at present in use. Although the sand thus differed, test pieces made with it gave results nearly identical with those obtained with normal sand. A certain discrepancy was observed by Delbrück, while Dyckerhoff found almost no variation, but in all cases the differences were not large. The latter experimenter also communicated figures obtained with Freienwalde sand and Rhine sand, showing but little divergence. Tomei also communicated some results which are recorded in the following table:—

Cement.	Days.	Strength in Tension. Cement 1 : Sand 3. Kilos. per Sq. Cm. Normal Sand.	Plate Sieves. 0·7.	Plate Sieves. 0·6.	Strength in Compression. Cement 1 : Sand 3. Kilos. per Sq. Cm. Normal Sand.	Plate Sieves. 0·7.	Plate Sieves. 0·6.
A.	7	16·6	18·0	18·4	136·8	142·8	138·6
	28	21·3	22·9	22·9	204·6	216·0	206·0
B.	7	13·1	14·4	14·6	103·6	97·8	94·2
	28	16·1	15·5	15·9	176·4	174·0	179·4

The chief objection to the new form of sieve lies in the fact that it soon becomes blocked, and is cleaned with difficulty. The general opinion was therefore against its adoption, but the suggested use of wire sieves with 64 and 144 meshes per sq. cm., instead of those with 60 and 120, met with little opposition, no important alteration in the character of the product resulting from the change.

2. *The Influence of the presence of Magnesia in Cement.*

The commission appointed to examine into the question consisted of Dyckerhoff, Schott, and Arendt. A difference of opinion as to the way in which the work of the commission was to be carried on arose, and the conclusions arrived at are accordingly recorded separately. Dyckerhoff, in continuance of former work (this Journal, 1890, 1037; also page 929), has made further experiments with cement containing 1, 3, 4, 5, 6, and 8 per cent. of magnesia, which proved that those containing 4 per cent. and over shewed expansion after one year, increasing with the proportion of magnesia, the expansion being greater in the time included between the end of the first and the twelfth month than in the first month, a result precisely the reverse of that obtained with normal cement. Even with as little as 5 per cent. of magnesia, the strength decreased after one year. The retrogression in strength and the tendency to show cracks developed very slowly, particularly in specimens kept in air instead of water. Even in the latter case two or three years often elapsed before cracks became apparent. In consequence of this, Dyckerhoff rejected the conclusions of Schott as to the reliability of cements containing magnesia based on observations extending over only four months. He also dissented from Erdmenger's view that such cements can be detected by the high-pressure steam process of the latter (compare this Journal, 1890, 511) on the ground that other cements containing a normal percentage of magnesia similarly disintegrate or decrease in strength. He demurred to Arendt's statement that certain tests carried out by Bauschinger proved that cements containing as much as 7·15 per cent. of magnesia expand no more than do normal cements, because of the expansion of one of the cements used for comparison being altogether abnormal in spite of the fact that it was otherwise normal.

Arendt objected to this conclusion, considering that the cement in question (which was of the well-known "Stern" brand) should be included in the comparison, in which case the magnesia cements could not be condemned out of hand.

Schott pointed out that the raw materials used by Dyckerhoff had been passed through a sieve with only 900 meshes per sq. cm., whereas the commission had used one with 1,600 meshes, and considered the failures observed with cements made with the former, due to the comparative coarseness of their raw materials preventing sufficiently intimate admixture. He further contended that the cements used in the law courts at Cassel, the failure of which was the immediate cause of the resurrection of the magnesia question, was not true Portland cement at all,

not even a magnesian Portland cement. It was made from a natural deposit of mixed chalk and clay, similar to many other cement stones, and far from intimately mixed, pieces of limestone as big as peas being scattered throughout the mass. On burning, this limestone became converted into caustic lime, and inevitably caused considerable blowing. This was demonstrated at the meeting by the exhibition of a piece of the material containing a fragment of calc spar. The extreme importance of the proper admixture of the raw material was proved by experiments made on the cement stone in question, which had been (1) burnt direct, (2) burnt after powdering and passing through a sieve having 1,600 meshes per sq. cm. When tested by Bauschinger's expansion apparatus, the former showed an expansion of 543 (expressed in $\frac{1}{2000}$ mm.), while the latter gave a result of only 16, the time in both cases being 14 days,—a difference amply sufficient to account for the blowing observed. To this view Dyckerhoff objected, on the ground that expansion caused by the presence of free lime would show itself soon after the cement had set, whereas that of the cement at the law courts of Cassel became evident after a longer lapse of time.

Meyer called attention to the fact that the composition of cements rich in magnesia might easily exceed the limits laid down by Le Chatelier's equation, $\frac{CaO + MgO}{SiO_2 + Al_2O_3} = 3$, and in consequence such cements would inevitably blow. He considered that the analytical difficulties encountered in the determination of magnesia in cement were great, and in the event of a limit being fixed, a method should also be prescribed. That some such difficulty is apparent to German chemists, is shown by a communication by Prüssing, who sent two portions of a well-mixed sample to two Government testing stations, with the result that the percentages of magnesia returned differed by 30 per cent. of the amount of the smaller from each other. The net result of the discussion as regards any proposed alteration of the permissible percentage of magnesia was negative, the quantity which was considered harmless being taken as $3\frac{1}{2}$ per cent., but no definite ruling that amounts in excess of this were injurious being made.

3. *Rapid Methods for ascertaining the Soundness of Cement.*

Schumann stated that he considered the rules already in use sufficed to discriminate between sound and unsound cements (the crucial test adopted by the Association consists in the observation of the behaviour of a pat kept in water for 28 days). Rapid tests depending on the exposure of the cement to a temperature higher than that which it would have to encounter in practice, sometimes condemned a sound cement (contrast Le Chatelier's opinion on this point, this Journal, 1891, 255), but had the advantage of detecting free lime. On the other hand, inferior cements, poor in lime, might pass them without condemnation. With regard to Erdmenger's high-pressure test (subjecting test pieces to the action of steam at 10—20 atmospheres), it was too troublesome ever to come into extended use. The method of exposing the cement to the action of a water-bath at an elevated temperature had the objection that small fluctuations in the temperature caused considerable variations in the results, and moreover the right temperature and time of exposure were at present undetermined (this Journal, 1891, 255). He considered that though tests of this kind might be useful for manufacturers, yet the test prescribed in the rules of the Association (*v.s.*) was the only one which would prove free from ambiguity for the consumer. Schiffner pointed out that the normal test occasionally failed, inasmuch as pats which had remained perfect when kept under water for 28 days were nevertheless so far from sound that they went to pieces afterwards when exposed to air, a statement corroborated by Schott, who had observed a similar phenomenon. The chemical composition of cement showing this property had unfortunately not been determined. According to Schott, the occurrence is rare, and only takes place with cements that are quite fresh; aëration prevents it.

Heintzel, Schumann, Schott, and Dyckerhoff called attention to the fact that pats of neat cement when removed from water and dried rapidly sometimes showed cracks from mere shrinkage and not from unsoundness; the tendency of Portland cement when used neat on the large scale and freely exposed to drying influences, to develop cracks, was due to the same cause. According to Dyckerhoff, this tendency is more marked the finer the cement is ground, and the more water it therefore takes up in gauging. The sense of the meeting on the matter was summed up by the president, Dr. Delbrück, as follows:—

That no results had been advanced invalidating the normal test, and that the various quick tests for soundness that had been proposed, though useful to the maker to check the process of manufacture, were not suitable for basing the decision of the consumer upon.

4. *Erdmenger's High-Pressure Test.*

The process consists, as mentioned above, in exposing test pieces of a mixture of sand and cement to a steam pressure of 10—20 atmospheres.

With some samples, a high tensile strength is attained in a few days or hours, even when the mixture is poor in cement. An amount of magnesia equal to 11 per cent. in the cement itself is detectable by the tendency to blow observed, and in Erdmenger's opinion, 5 per cent. is as high as it is safe to go. His experience, extending over 12 years, has led him to believe that the presence of any considerable amount of magnesia can always be detected by this test. In judging a cement by this method it must be remembered that the blowing of a cement containing much magnesia, but otherwise sound, is not apparent in mixtures poor in cement, owing to the greater space afforded by the inert aggregate for the expansion of individual particles. The destruction of a cement or its attainment of a low tensile strength when tried by the high-pressure test, may proceed from other causes than the presence of magnesia.

The following are some results obtained by the test:—

(1.) Cement A.—Neat test pieces much increased in volume, but free from cracks and fairly resistant; tensile strength of sand tests 9 kilos. per square centimetre.

(2.) Cement B.—Neat test pieces much swollen and very friable; tensile strength of sand tests 11 kilos. per square centimere.

(3.) Cement C.—Neat test pieces strongly swollen, very friable and much cracked; sand tests in a similar state.

The magnesia in these samples amounted to 2, 4, and 7 per cent. respectively.

In the course of the discussion upon the question of the quantity of magnesia permissible in cement, it was stated that the limit adopted officially in Russia would in future be 3 per cent., though 5 per cent. was allowed until the end of the present year.

5. *The Monier System of Building Construction.*

Tomei read a communication dealing with the above system of building. It had its origin in the desire of Monier, a Paris gardener, to obtain flower tubs stronger than wood and less weighty than artificial stone. He therefore used a framework of iron covered with cement mortar. The development of the system is largely due to G. A. Wayss. The low tensile strength of cement is supplemented by the high tensile strength of the iron. The method as usually carried out consists in forming a framework of iron rods 5—25 mm. in diameter, enclosing it in a wooden mould of appropriate shape, and filling in the interstices with a mortar consisting of three parts of sand to one of cement. The iron part of the structure is only held together by thin wire, the adhesion of the cement to the iron, which, according to Bauschinger, amounts to as much as 40—47 kilos. per square centimetre, sufficing to give strength to the structure. Bauschinger also finds that the difference of the coefficient of expansion of the cement and the iron is not so great as to overtask the elasticity of the former. The material is suited to the construction of roofs, cellars, and vaults, especially where it is required that the building shall be fireproof. Its excellence in this respect has been proved by actual experience. A list of

important buildings in which it has been employed is given. An experimental bridge of 10 m. span having proved successful, others of larger size, up to 42 m., have been constructed with a similar result. It has been also found suitable for water tubes and tanks. A tube 2 m. in diameter and 100 mm. in thickness first showing cracks when subjected to a strain of 12,000 kilos. per sq. m. It allowed but little water to percolate through it under a head of 7·5 m. The piece of work which is at once the oldest and most important that has been executed on the Monier system is a water course in Offenbach 1·5 m. in inside width and 1,000 mm. in length, which dates from 1886. Water reservoirs and gas-holder pits have been made by this method in large numbers.

Dyckerhoff, in criticising the paper, related experiences tending to show that if cracks appeared in the cement, water and air would obtain access to the iron, resulting in its corrosion and ultimate destruction, and considered that the use of the Monier system should be confined to structures not exposed to the weather.—B. B.

Practical Observations on the Preparation of Weather-Proof and Water-Tight Coatings for Buildings. T. Koller. Abs. Proc. Inst. Civil Eng. **105**, 1891, 5, and Glaser's Annalen f. Gewerbe. und Bauwesen, Aug. 15, 1891, 79.

In 1883, in consequence of the upsetting of a vessel containing kitchen salt, a workmen, in order to conceal the effects of the accident, brushed up some of the spilled salt into his whitewash pail, the result was the production of a wash as hard as cement, and which could not be removed by scrubbing. The author considers that this is due to the hygroscopic action of the salt, which absorbs water and permits of the speedy combination of the lime with the carbonic acid of the atmosphere. A trial of this composition upon the brick wall of a well-hole or shaft for light, in which case it was applied with a syringe to save scaffolding, stood extremely well, and after the lapse of four years the coating was as good as ever. The use of three parts of quicklime to one of common salt is recommended.

On the use of paraffin and water-glass, the latter of which has latterly lost all credit in the building trade, it is pointed out that a solution of melted paraffin in three parts of heavy coal tar oil, kept fluid while being applied by immersion of the containing vessel in hot water, forms a most excellent wash or paint for buildings very much exposed to atmospheric influences.

For the successful employment of water-glass, two conditions are essential, the stucco must be uniform in texture very hard and very thin, and the solution must not be applied while the plastering is "green," for in that case the calcium hydrate at once decomposes the silicates. Sufficient time must be allowed for the combination of the atmospheric carbonic acid with the free lime. The water-glass may be used as follows. 10 parts of sharp dry sand, 4 parts of air slaked lime, 2 parts of chalk or pulverised limestone, and soda water glass of 33° B. are taken. The sand, lime, and chalk are first passed dry through a sieve, and the ingredients are then mixed with the water glass, diluted with twice its weight of water into the consistency of mortar, and used as a setting coat over the wall-surface to be protected. This coating, in the course of a day or two, sets as hard as a stone, and may then be repeatedly saturated with dilute soda water glass. Various other recipes are given for coloured solutions, and for varnishes or lacquers to serve as coatings for paper and felt roofings.

PATENTS.

A Process for Manufacturing from Roman Cement a Composition similar to Portland Cement. C. von Forell, Brunswick, Germany. Eng. Pat. 14,398, September 12, 1890. 6*d*.

The process patented consists in adding slaked lime to Roman cement or hydraulic lime in such proportion that the ratio of the total lime to that of the total silica, alumina, and ferric oxide is about 1·7. Granulated, dried, powdered, blast-furnace slag, may be substituted either wholly or partially for slaked lime. The advantage claimed is that a material similar to Portland cement may be produced with small expenditure of fuel, seeing that it is necessary only to burn a portion of the ingredients, namely the Roman cement or hydraulic lime, and that moreover at a lower temperature than is needful in the case of Portland cement. —B. B.

Improvements in the Manufacture of Fire-Proof Plastic Material for Cement; also applicable to Smelting and various other Useful Purposes. R. Stone, London. Eng. Pat. 16,789, October 21, 1890. 6*d*.

Granite, slate, shale, lava, marble, clay, or analogous materials are mixed with a "flux" such as "petroleum spirit, petroleum, or vitriol, or oils of an inflammable nature" in the proportions of 1 cwt. of flux to 1 ton of the granite, &c., burnt and ground, preferably hot. About 12·5 per cent. of sodium silicate may be added, with or without the addition of 5 per cent. of lime. The material is shaped by moulds while fused, or in a plastic state, and may be used for general structural purposes. "The aforesaid process will also have the effect of removing any metals which may be found in the materials such as iron, gold, lead, copper, zinc, tin, which can be run into moulds or dies, it being injurious to cement." The material may be ornamented by glazing.—B. B.

X.—METALLURGY.

On the Compounds of Platinum Carbonoxide. F. Mylius and F. Foerster. Ber. 1891, **24**, 2424—2443.

See under XXIII., *pages* 955—956.

Experiments in Desilverisation by Means of Zinc. H. Rossler and B. Edelmann. Berg-und Hüttenmännische Zeit. 1891, 123—125, and Eng. and Mining J. May 16, 1891, 582. (See also this Journal, 1890, 1130—1134, and 1891, 550.)

The authors found that upon further trials with Mazarron lead in larger quantities, the method employed in which all the zinc was stirred into the red-hot lead, saturating it as far as possible, gave unsatisfactory results, in spite of the use of aluminium-zinc. The high temperature and the necessary stirring, even if only briefly kept up, caused a heavy oxidation as before, while the main skimmings, forming not less than 15 per cent. of the total weight were entirely oxidised, so that it was out of the question to melt out an alloy; on an average the silver contents did not exceed 1 per cent. Thus the result showed scarcely any advantage whatever over the usual method of desilverisation.

As in all the experiments success had proved to depend on avoidance of all oxidation during the process, the authors were prompted to repeat the whole series, since they had succeeded in the subsequent work, by means of improved heat-measuring apparatus, in controlling the temperatures with greater precision and in dispensing with some of the zinc, thus reducing the time of the operation.

The object of these experiments was, as before, to avoid the formation of any zinc scum whatever, in the ordinary meaning of the word, and to segregate a zinc-silver alloy which should contain all the silver, not more than four parts of zinc for every part of silver, and be fit for electrolytic or other rational method of treatment. Sufficient inducement to continue the experiments was, however, held forth by the prospect, alone, of conducting the desilverisation in such a manner as to lessen the time, save zinc, fuel and labour, and obtain directly a skimming with 3 per cent. and upward of silver, besides dispensing with liquation.

To determine the temperatures of the molten lead baths, the authors used Dr. Alefeld's method, whereby temperatures of even more than 500° C. can be measured by means of a quicksilver thermometer filled with nitrogen. This is not used in direct contact with the bath, but is suspended in a sheet-iron flask which is immerged up to a marked line in the lead bath, thus allowing the air to circulate around the bulb. The Wiborgh pyrometer, which is placed directly in the bath and is particularly adapted for measuring temperatures obtaining in these experiments, invariably gives higher readings than the quicksilver thermometer just described, the difference increasing with the rise in temperature, and amounting here to between 70° and 110° C. This pyrometer, however, can be dispensed with when a scale of difference has once for all been provided, the readings of the nitrogen thermometer being sufficiently accurate up to about 500° C. This substitution has the advantage that any labourer can at any time ascertain the temperature. For these experiments the following scale was used:

	°	°	°	°	°	°	°
Wiborgh's.....	330	360	390	420	450	480	510
Quicksilver.....	260	285	310	334	357	379	400

The object in view can, as proved by the experiments, be best attained if the necessary zinc, in the form of a concentrated solution in lead, is poured red hot into the less hot lead bath and stirred only very briefly; or still better, if this zinc solution be passed from below into the argentiferous lead, which has a temperature of about 500° C.; or if the latter be poured into the red-hot zinc solution with no stirring whatever. In that case, the zinc remaining dissolved and no longer able to separate out and rise, is uniformly distributed through the entire lead bath, combines with all the silver, and when cooling carries this with it to the surface, forming skimmings which are rich in silver, contain very small quantities of oxides, and hence can easily be liquated and smelted out. The first experiment, performed on a small scale, following this plan, was made with impure lead of commerce and proved a complete success. 10 grms. of aluminium-zinc were melted in the bottom of a small iron crucible, and when it became red hot, 250 grms. of silver-lead in small lumps were gradually thrown in, so that the mass constantly remained at red heat; afterwards the temperature was kept unchanged for some time, and the crucible slightly shaken once in a while, but stirring was avoided in order to decrease the danger of burning the zinc; finally the mixture was added to 750 grms. of silver-lead, melted at 500° C. After gradually cooling and removing the scum, the residual lead proved free from silver. Thus, Spanish argentiferous lead containing about 1,500 grms. per ton was completely desilverised by a single addition of 1 per cent. of zinc, with no stirring and almost entire absence of oxidation.

For the saturation of the zinc at a red heat, it is desirable to use the lead which, in the previous operation, came out of the bath as the last part of the skimming, as that lead taken from the bath when the latter is quite cooled is least liable to be oxidised, and, besides, is rich in zinc, poor in silver, and also free from copper, which last, if present, promotes the oxidation in the red heat. The results of this experiment were as follows:—

		Grms. Silver.
100 parts of lead were melted with		150
Added 1·6 parts of fresh zinc.		
0·6 „	zinc from last skimmings with	50
1·6 „	zinc with	200
Skimmed (1)	0·5 parts of zinc with.....	150
(2)	0·5 with.....	50
Remained	0·6	
	1·6 parts of zinc with.....	200

200 kilos. of pure argentiferous lead worked on this plan gave first skimmings that contained 4 per cent. silver and were not at all oxidised, so that they could be very well liquated, and, under the application of salt slags, melted into a silver-zinc alloy with 20 per cent. of silver. The solution of zinc in lead, for which purpose the last skimmings were used, was also highly successful.

The only thing remaining, then, was to try the method with the impure silver-lead of commerce, and here, too, the result with quantities of 200 kilos. was favourable in contrast to the previous experiments on the unimproved plan; the first skimmings were relatively rich and only very slightly oxidised, and the lead was entirely desilverised. Thus, it seems scarcely subject to doubt that this method may be introduced to advantage into industrial works. It requires no essential changes in the usual arrangements in desilverising works; it saves in time, fuel, labour, and zinc, gives rise to fewer by-products, and makes it possible to regain more zinc than before.

Coal in the Lead Blast Furnace. Arthur S. Dwight. Eng. and Mining J. 1891, 162.

It may be interesting to note the results of an experiment to replace coke with anthracite in a lead blast furnace. The credit for this experiment is due to Alfred Ropp, at present connected with the Selby Smelting and Lead Company, of San Francisco.

In 1887, while Ropp was in charge of the Tomichi Valley Smelter, at Gunnison, Colo., the supply of Crested Butte coke got very low. Some selected anthracite, of about goose egg size, from the neighbouring mines of Crested Butte, was on hand in the works, and as coke was very dear, he decided to try replacing some of the coke on his charges with this anthracite. It is important to note that *no charcoal* was used. Ten per cent. of the coke was first replaced with anthracite. The smelting capacity of the furnace was slightly reduced: the slag, however, remained clean, *i.e.*, it carried 0·4 per cent. to 0·8 per cent. lead and was low in silver. The percentage of anthracite was gradually increased until 60 per cent. of the original charge of Crested Butte coke had been replaced with anthracite. The smelting capacity of the furnace diminished as the proportion of anthracite increased. The slag remained about the same in lead and silver, likewise the matte, the latter containing about 8 per cent. lead and 4 per cent. copper.

During the whole of the experiment the speiss was of the coarsely crystalline variety, showing that plenty of iron was reduced. The top of the charges remained cool and the crucible free. The tuyeres seemed to darken and get somewhat harder as the percentage of anthracite was increased. There was about 7½ per cent. of zinc in the charge during the experiment, but it seemed that less zinc accretion was formed on the walls than when coke alone was used. As to the manner of feeding, the charges of ore and fluxes and the fuel charges were distributed in even layers over the whole section of the furnace.

The experiment lasted 12 days, and at length when 60 per cent. of anthracite was used the capacity of the furnace was decreased one-third.

Under the conditions prevailing at Gunnison, particularly on account of the high cost of labour, the experiment was not a commercial success. The furnaces employed were water-jacket furnaces 80 in. × 37 in. in section at the tuyere level, and 9 ft. from tuyeres to feed floor. Had they been higher it is very likely that the results might have been better. Another condition that made the furnaces run more slowly was the extreme fineness of the charges, which became more and more effectively troublesome as the coke was cut down.

In both of the experiments, one with bituminous coal and one with anthracite, there are several advantages that command notice: (1) Cool tops; (2) open crucibles; (3) good reduction, with clean slags and mattes low in lead; (4) less zinc accretions.

The fact that Ropp used no charcoal and worked with a very low furnace and a charge less coarse than the average, should be borne in mind, in comparing the results of the two experiments.

The common points of advantage demonstrated in both cases are of sufficient importance to justify very extended experiments by lead smelters with the use of coal in their shaft furnaces.

The Siemens Furnace. R. Addie. A Paper read before the City Analysts' Society, Glasgow. Engineering, 1891, **52**, 103—104.

After describing the ordinary open-hearth Siemens furnace, the author gives analyses of the silica blocks, bricks, &c., used for its lining, which are appended below:—

—	Eglinton Silica Blocks.	Glenboig Silica Brick.	White Sand.
Silica	96·72	96·16	96·22
Alumina	1·50	1·96	1·64
Oxide of iron	1·36		
Lime	Trace.	1·88	Trace.
Magnesia	Trace.	Trace.	Trace.
Combined water	..	..	2·14
Total	99·58	100·00	100·00

The furnace bottom is put in by placing a layer of ganister and fine fireclay, often mixed with powdered silica bricks, upon a layer of brick resting upon the top of the cast-iron plates which form the lowest point of the melting chamber. The furnace is then heated up until this is dry and the true bottom put in, consisting, in the acid process, of the white sand of which the analysis is given above, mixed with a certain proportion of red sand, which, containing rather more iron, alumina, and magnesia, is less refractory than the white, and acts as a binding material. The usual process of making Siemens steel with pig iron, scrap, and iron ore is described, and analyses are given of the producer-gas as it leaves the producer and at the bottom and top of the regenerator. The chief points shown by these are that the methane has been partly decomposed by the heat to which it has been subjected, and the percentages of hydrogen and carbonic acid have been slightly increased; the changes are, however, so small that for practical purposes it may be considered that the only alteration the gas has undergone is its rise of temperature.

The chemical changes occurring during the operation are thus traced. During the first process of melting the pig iron and scrap together, $\frac{1}{3}$—$\frac{1}{2}$ of the silicon and about $\frac{1}{4}$ of the manganese are oxidised; $\frac{1}{3}$—$\frac{1}{2}$ of the carbon is also oxidised, while the remainder of the graphitic carbon combines with the iron. On adding the ore, the manganese and finally the rest of the carbon and silicon are oxidised. The appearance of the bath on the addition of the ore is described as follows:—The surface of the charge froths up, and reddish fumes, due to the oxidation of the manganese, are given off. The frothing recurs on adding more ore, and when the charge is "coming through the boil" the surface of the molten mass begins to circulate from the cooler to the hotter end. When the manganese is high, as in Scotch pig, longer time is taken and more ore used before the charge boils than when pig poor in manganese, such as is made from Cumberland ores, is employed. The process of oxidation previous to and during the boil therefore takes place as follows:—

1. Most of the manganese is oxidised in the stage known as "coming through the boil," and all of it is oxidised before boiling actually takes place.

2. Most of the silicon is oxidised, forming silicates.

3. No carbon is oxidised until the boil is thoroughly begun.

The following analyses show the composition of the metal when coming through the boil and when the boil is completed:—

—	Per Cent.	Per Cent.
Carbon	1·655	0·155
Silicon	0·296	0·004
Sulphur	0·022	0·024
Phosphorus	0·045	0·048
Manganese	Nil.	Nil.
Iron (by difference)	98·082	99·769

After the completion of the boil a sample is taken, tested chemically and mechanically, pig iron added if necessary to raise the percentage of carbon, and finally ferromanganese to deoxidise the metal and remove sulphur. The effect of the manganese is also to remove slag from the molten steel and neutralise to some extent the bad effects of phosphorus. Silicon is also sometimes added, in the form of silicon pig, to quiet the metal in the ladle. The final composition of the typical charge quoted would be as follows:—

	Per Cent.
Carbon	0·170
Silicon	0·004
Sulphur	0·023
Phosphorus	0·048
Manganese	0·346
Iron (by difference)	99·409

— B. B.

Process for Utilising Zinc-Blende Fume. Krause. Berg. und Hüttenm. Zeit. 1891, 246, and Abs. Proc. Inst. Civil Eng. **105**, 1891, 56—57.

The fume from zinc-blende roasting containing sulphate of zinc and iron have not until lately been successfully recovered, although suggestions and experiments have not been wanting.

Some years ago the fume from smelting works on the Rhine was leached in water and the solution treated with lime, the zinc being thus precipitated as hydroxide. Profitable results, however, were not obtained by this method, *firstly*, because the precipitation was imperfect, and *secondly*, because the lime was very destructive to the furnaces.

A new process, patented by G. Krause, of Cöthen, has achieved better results. It consists in leaching the fume in water and precipitating by sodium carbonate or similar agent, producing an artificial calamine containing 45—50 per cent. of zinc. Lots of 1,000 kilos. are leached, preferably hot, and sodium carbonate is added in excess. The mixture is filtered, and the filtrate contains, besides the zinc and iron carbonates, sodium sulphate. The Glauber's salt can be recovered by treatment with sulphuric acid and evaporation. The remainder is dried at the ordinary temperature, calcined, and smelted.

1,000 kilos. of fume containing 11 per cent. of zinc, 2 per cent. of iron (both in form of sulphate), gave 200—250 kilos. of calamine, containing 45—50 per cent. of zinc and 260 kilos. of anhydrous Glauber's salt.

190 to 200 kilos. of sodium carbonate was used, the cost of which was covered by the production of the Glauber's salt.

A modification of this method is to treat the leached fume with barium nitrate, causing the formation of a barium sulphate, which is marketable as blanc fixe. The calamine is formed by sodium carbonate, potassium carbonate, or ammonium carbonate. The filtrate will also contain ammonium nitrate, which can be recovered by evaporation. 1,000 kilos. of fume, containing 11 per cent. zinc and 2 per cent. iron treated in this way gave 200—250 kilos. of calamine, 475 kilos. of blanc fixe, whilst 350 kilos. of potassium nitrate (Chili saltpetre), 350 kilos. of barium nitrate, and 200 kilos. of carbonate of soda were consumed.

PATENTS.

Improvements in the Manufacture of Steel. J. F. Hall, Sheffield. Eng. Pat. 14,658, September 17, 1890. 4*d*.

An electric current is passed through molten iron or steel, either during or after casting, in order to "induce the molecules to arrange themselves in such a manner as to condense and consolidate the metal." The current may be passed by fixing one electrode in the bottom of the mould, whilst the other is held in the stream of metal issuing from the ladle. —H. K. T.

An Improved Powder suitable for Use in Coating the Interior of Steel and other Moulds. D. Stephens, Kidwelly. Eng. Pat. 16,549, October 17, 1890. 4*d*.

A silicious rock known as "Dinas" silica stone and containing about 98 per cent. of silica, 1 per cent. of alumina, 0·5 per cent. oxide of iron, and 0·5 per cent of lime, is washed and calcined. The stone is then ground until of the consistency of wheat-flour, contact with metal being avoided in the grinding. Sometimes 0·5 per cent. of aluminous clay is added. The above powder is mixed with water or sour beer and used as a lining for steel or other moulds. It is preferably toughened by coating with tar and firing. When used for green mould steel coatings the paint is dusted on the mould out of a coarse bag.—H. K. T.

Improvements in Refining Copper. J. C. Bull, Erith. Eng. Pat. 17,173, October 27, 1890. 8*d*.

In the purification of copper by the Bessemer process the heat furnished by the combustion of the impurities is not sufficient to maintain the metal at a suitably high temperature. In order to secure this high temperature the patentee introduces an oxidising substance, such as Chili saltpetre, into the molten metal. This is effected by providing a cavity at the bottom of the converter in which the nitrate is placed, and which communicates by perforations with the body of the condenser. When the molten metal is poured into the converter, some of the metal finds its way through the perforations into the cavity beneath, and the heat from the metal decomposes the nitrate and causes a stream of oxidising gases to rise through the metal in the converter. Or the nitrate in a fused state may be forced by air pressure into the perforated cavity. Or, lastly, an ordinary Bessemer converter may be used, the nitrate, in a powdered state, being supplied by an automatic feeding arrangement to the current of air. The converter is lined with ganister, or a mixture of sand and clay, and the metal is covered with a suitable silicious slag.—H. K. T.

Improvements in the Separation of Gold from Ores or Materials containing it. W. D. Bohm, Acton. Eng. Pat. 18,235, November 12, 1890. 8*d*.

In this process the crushed and roasted ore is mixed with dry bleaching-powder, and is placed in a vat provided with a false bottom. Dilute sulphuric acid is then continuously pumped through the ore until the gold is extracted. It is then precipitated in the usual way. Instead of the above combination of bleaching-powder and acid, a solution of bromine ($\frac{1}{8}$ to 2 per cent.) in water may be circulated through the ore. Or the latter may be soaked with nitric acid and hydrochloric acid pumped through it. A combination of leaching vat, force pumps, and waste chlorine absorber is described in the specification.—H. K. T.

Improvements in the Manufacture of Iron and other Metals, and Apparatus therefor. J. Y. Johnson, London. From A. Imbert and G. Jullien, Lyons, France. Eng. Pat. 19,734, December 3, 1890. 8*d*.

Powdered iron or other metallic ore mixed, if necessary, with suitable fluxes, is reduced with gaseous fuel in a rectangular furnace. The spongy mass is then allowed to fall into a mould, fresh ore taking its place. The spongy metal is then pressed into an ingot or bloom. These blocks or blooms are now ready for treatment in a Martin furnace, or for other manufacturing process. The mode of production enables purifying agents to be added such as would be required in a subsequent treatment in a Martin furnace, or the ingot may be reheated and hammered or rolled. A combination of furnace, press, &c. is described in the specification.—H. K. T.

Improvements in Process and Apparatus for Procuring Cyanogen and its Compounds from Gases. H. H. Leigh, London. From J. Elsner, Paris, France, and R. Gasch, Mainz, Germany. Eng. Pat. 8293, May 14, 1891. 6*d*.

See under VII., *page* 926.

An Improved Method or Process for the Production of Zinc or Spelter from Ores or Compounds containing the same. C. James, Swansea. Eng. Pat. 11,563, July 7, 1891. 6*d*.

The ore, consisting chiefly of sulphide, is partially roasted or is mixed with roasted ore or with native carbonate or oxide in suitable proportions, and is then heated in a reverberatory furnace in a reducing atmosphere. The mixture of zinc vapour, sulphur dioxide, products of combustion, &c. is led into a separate and easily accessible condensing chamber or through tubes surrounded with water where the zinc is deposited.—H. K. T.

XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

Production of Ozokerite in the United States. E. W. Parker. Eng. and Mining J. 1891, 127.

Asphaltum and Ozokerite in the United States. E. W. Parker. Eng. and Mining J. 1891, 193—194.

See under III., *pages* 910—912.

Researches in Electro-Chemistry. F. Exner. Monatsh. Chem. 1891, **12**, 276—303.

The authors made experiments on the differences of potential produced at a contact of metals with various liquids. The method used was a modification of W. Thomson's dropping-electrode method, carried out as follows:—The dropping-electrode is connected with the electrometer, and from it mercury drops into the inside of a cylinder which is saturated with the liquid under investigation. The best material for such cylinders is hard gas-coke, and the small correction required to allow for production of electricity by friction is determined beforehand by a blank experiment, in which the mercury is allowed to drop into a clean cylinder connected to earth.

It is generally allowed that the differences of potential produced by the contact of a metal with a liquid, or of one liquid with another, are related in a definite way to the thermo-chemical value of the reaction which is thereby produced. But the exact nature of this relation has never been definitely ascertained, even in the cases which have already been investigated, viz., batteries in action and galvanic polarisation. There are many discrepancies between the observed values and those calculated from thermo-chemical data. The cause of these discrepancies has never been satisfactorily explained. W. Thomson first propounded the view that the electrical energy produced by any chemical reaction is exactly equivalent to

the thermo-chemical value of that reaction. More recently belief has gained ground that it can only represent a portion of this value, inasmuch as heat cannot be completely converted into electrical or mechanical energy. This portion is called by Braun the useful effect, and by Helmholtz, free energy. The author is inclined to return to Thomson's original theory and believes that the newer views have no real basis either in theory or experiment.

As far as experiment is concerned there are two things to be determined; the electrical energy, which is easily measured; and the thermo-chemical, which can only be measured when the chemical reactions which come into play are completely known. The latter is seldom the case, even with well-known batteries, like Bunsen's; and it is noticeable that the largest discrepancies occur in cases where the nature of the chemical reaction is doubtful. This is especially true in combinations which contain silver or lead as the negative pole, for here there are unknown quantities of peroxides formed, and the negative heat of combination of these cannot be allowed for in the calculation. Indeed, there are cases in which the electrical energy exceeds the thermo-chemical; and these would appear to offer insuperable difficulties to the advocates of the "useful effect" theory. All heats of reaction are really functions of temperature, and hence the electrical and thermal measurements should be made under similar circumstances; that this is not an unimportant matter is shown by the large temperature coefficients of many galvanic cells. It is also to be remarked that in all cases where the nature of the chemical reaction is thoroughly understood, there is agreement between theory and calculation; for example, in the elements investigated electrically as well as thermally by J. Thomsen, in the combinations between bromine and iodine investigated by the author, and also in the measurements of galvanic polarisation. We ought also to consider that theory indicates the advisability of returning to Thomson's view, and regards the action of a cell as consisting in the (complete) transformation of electrical energy into heat, rather than as a (partial) transformation of chemical energy, primarily into heat, and secondly into electrical energy. The latter is the usual view, but the author's experiments do not support it. According to his theory of galvanic polarisation, the electro-motive force produced in any case depends upon the value of the heat of combination of the separated ions. This, however, must be a function of the temperature which would approach to zero at the temperature of dissociation of the substance; hence, also the electro-motive force of polarisation ought to diminish with temperature, and should become zero at this particular temperature. Poincarré has completely verified this in a recent research, in which he has shown that in the case of fused salts polarisation actually diminishes to zero when the temperature is raised to the dissociation point.

—D. E. J.

Giraud's Thermo-Electric Stove. E. Hospitalier. Le Genie Civil, **19**, 1891, 30—46, and Abs. Proc. Inst. Civil Eng. **105**, 1891, 83—84.

See under II., *pages* 926—927.

Effects of High Temperatures on the Insulation Resistance and Inductive Capacity of Vulcanised India-Rubber. W. Mayer, jun. The Electrical Engineer, New York, 1891, **12**, 159, and Abs. Proc. Inst. Civil Eng. **105**, 1891, 89.

See under XIII., *page* 937.

PATENTS.

Improvements in the Manufacture of Steel. J. F. Hall, Sheffield. Eng. Pat. 11,658, September 17, 1890. *4d.*

See under X., *page* 935.

Improvements in and Apparatus for the Separation of Gold and Silver from Ores or Materials containing them. W. D. Bohm, Acton. Eng. Pat. 21,221, December 30, 1890. *8d.*

A solution of common salt of sp. gr. 1·15 is prepared, to which is added ½ to 20 per cent. of barium or calcium acetate, 1 to 10 per cent. of oxalic acid, and ½ to 2 per cent. of potassium cyanide. The powdered ore, either roasted or not, is supported on a porous diaphragm placed in a vat, and the above solution is pumped through it until the gold and silver are extracted. The solution may be assisted by an electric current passing between a carbon anode placed beneath the diaphragm and a copper cathode placed in the liquid above the ore.

The dissolved gold and silver are separated by passing the liquid through shavings of an alloy of zinc with some electro-positive metal such as potassium or sodium (2½ per cent.). A trace of cadmium may also be added.—H. K. T.

XII.—FATS, OILS, AND SOAP MANUFACTURE.

Some Experiments on Petroleum Solidification. S. Rideal.

See pages 889—892.

Effect of Cooling on the Viscosity of Oils. Bender. Mitth. Konig. techn. Versuchs. Berlin, 1891, **9**, 100—135.

The experiments, the results of which are detailed in this paper, were undertaken with a view to ascertaining what effect the cooling of mineral oils has on their viscosity at 20° C. Theoretically a considerable effect is conceivable, inasmuch as at lower temperatures a separation of paraffinic constituents may occur which may not be capable of satisfactory detection in dark-coloured oils when in a state of solution at higher temperatures, but may nevertheless affect the viscosity. The investigation was carried out as follows:—

A.—The determinations of viscosity at 20° C. were made after the oils had stood for several days at a temperature of − 20° C., and then—

1. After standing for a day and careful warming to 20° C.
2. After heating to 50° C., and slowly cooling to 20° C.
3. After heating to 100° C., and slowly cooling to 20° C.

B.—For control purposes the experiments under *A.* were repeated with the corresponding samples after these had been once more cooled to − 20° C.

The determinations were made in Engler's apparatus, and the oils examined consisted of mineral oils and mixtures of mineral oil with fat oils.

Tables are given which show that after cooling the degree of viscosity has increased, and this increase is more marked in the case of thick oils than in that of thin oils. Of the oils heated to 50° C. and 100° C., the thick ones showed a higher state of fluidity, whilst the condition of the thin oils was very little affected. After the second cooling the differences became even more marked.—T. L. B.

XIII.—PAINTS, PIGMENTS, VARNISHES, RESINS, INDIA-RUBBER, Etc.

Researches on the Formation of Pigment Lakes. C. O. Weber.

See pages 896—902.

Manganese Oxalate as Drier. Chem. Trade J. Nov. 7, 1891, 284.

(See this Journal, 1889, 123—124.)

The Restoration of India-Rubber Articles that have become Brittle. Beibl. zu den Ann. d. Phys. u. Chem. **14**, 514.

The articles are placed in a mixture of two parts of water and one part of ammonia. After from a few minutes to half an hour they will have recovered their former elasticity.

The Resin of Doona Zeylanica Thw. E. Valenta. Monatsh Chem. 1891, **12**, 98—106.

At the Colonial International Exhibition of 1887 there was exhibited a colourless resin, of which it was stated that its solution in turpentine or spirits makes an excellent and useful varnish. The author has proved that this resin is obtained from the *Doona Zeylanica Thw.*, a tree which grows to a very considerable height in the central province of Ceylon; it is closely related to, but not identical with, the gum known as doona, and also with the chaï-resin obtained from *Shorea rubifolia*.

Doona resin is generally yellowish and transparent, but sometimes translucent owing to the presence of small air bubbles and globules of a strongly refractive liquid; it has a slight pleasant smell, but no taste. Its specific gravity is 1·1362 at 17·5°, the error due to the presence of air bubbles being eliminated; when heated it softens and becomes sticky, then melts and turns brown, and finally takes fire and burns with a smoky flame, leaving 0·007 per cent. of ash, which consists principally of calcium carbonate, alkalis, and a small quantity of oxide of iron. It is completely soluble in toluene and xylene, and partially soluble in methyl alcohol, alcohol, amyl alcohol, oil of turpentine, and acetone, yielding lustrous varnishes of varying consistency; it dissolves in cold concentrated sulphuric acid, giving a granite-red solution which turns brown after some time.

By treating doona resin successively with various solvents it can be resolved into an acid α-resin, and two (β- and γ-) indifferent resins. The α-resin (about 65 per cent. of the original substance) can be obtained by digesting finely divided doona resin with 90 per cent. alcohol at 30°—35°, and evaporating the filtered solution; it is a brittle, yellow substance, melts at 115°, and gives on analysis numbers which agree well with those required by a compound of the composition $C_{24}H_{39}O_2$.

The β-resin (about 15 per cent. of the original substance) is obtained when the portion insoluble in 90 per cent. alcohol is extracted with ether, and the extract mixed with alcohol. It softens at 120°, melts at 150°—160°, and seems to have the composition $C_{21}H_{33}O$; it gives good varnishes with benzene, toluene, carbon bisulphide, &c.

The γ-resin (about 20 per cent. of the original substance) is a colourless, transparent substance, which seems to have the composition $C_{31}H_{49}O$; its solutions in toluene and xylene give, on evaporation, a very solid, colourless layer of varnish which is highly resistant towards acids and alkalis.—F. S. K.

Effects of High Temperatures on the Insulation Resistance and Inductive Capacity of Vulcanised India-Rubber. W. Maver, jun. The Electrical Engineer, New York, 1891, **12**, 159, and Abs. Proc. Inst. Civil Eng. **105**, 1891, 89.

Some of the underground street-ducts in the city of New York, owing to defective pipes of a steam company, are exposed to temperatures ranging as high as 200° F., and it was found that in such localities the lead-cased cables with impregnated fibrous dielectric rapidly fell in insulation. Experiments on the electrical qualities of india-rubber cores submerged in water raised to boiling point showed that this material was better adapted for such high temperatures. The observations obtained on three samples of core are plotted in a diagram, with the temperature and resistance as abscissa and ordinate, and show that at 212° F. the resistance was 12·4 megohms per statute mile, and one-eleventh of the value at 150° F., while the capacity at the former temperature was 2·4 times that of 100° F., the material returning also to its original values on re-cooling.

As in general only a small portion of a cable would be exposed to such excessive heat, the lowering therefrom of the total insulation of the circuit would be comparatively slight.

It is of interest to note that these cores have withstood such temperatures in actual use on high potential circuits for more than a year without deterioration.

PATENTS.

Improvements in the Method of and Apparatus for Rendering Textile Fabrics Waterproof by One Treatment or Process. J. Miller, sen., and J. Miller, jun., Manningham. Eng. Pat. 9711, June 23, 1890. 11*d*.

This invention relates to a machine for the continuous manufacture of waterproofed and stiffened textile fabrics, using ingredients soluble and insoluble in water. A series of tanks and rollers is so arranged that the cloth in passing from one kind of liquid to the other is freed from the former by nipping rollers and dried, if necessary, on heated cylinders.

The waterproofing ingredients soluble in water are preferably the acetates of aluminium, zinc and calcium along with albumen, mixed in certain proportions according to conditions. The insoluble ingredients are paraffin wax, Japanese wax, and beeswax.—H. S.

Improvements in Rendering Canvas and other Fabrics Rot-proof. J. Williams, London. Eng. Pat. 12,513, August 11, 1890. 4*d*.

The fabric is first soaked in any suitable salt of copper and then passed through a solution of any "convenient sulphocyanide, such as sulphocyanide of ammonium and sulphurous acid, or a bisulphite." Other reducing agents may also be employed. After sufficient treatment the fabric is passed through a tank of running waters and dried. By this means the fabric is coated or "its surface impregnated with subsulpho-cyanide of copper," and thereby rendered rot-proof."—H. S.

Improvements in Colours or Pigments for Making Imitation Metallic and Coloured Enamels, Paints, and Printing Inks. W. Davison, London. Eng. Pat. 15,743, October 4, 1890. 4*d*.

The inventor uses "oils, pitch, picric acid, nitrobenzole, aniline, luteccine rosin, gums, shellacks, varnish, spirits, naphtha, and other cosine analine products, by-product of soaps, tar, ammonia, and turpentine" mixed in suitable proportions for the desired purpose.—E. G. C.

Improvements in the Preparation of Colours for Distempering. J. Haake, Dresden, Germany. Eng. Pat. 17,346, October 30, 1890. 4*d*.

The inventor prepares a "binding material" by boiling with water 2 parts of rye-husks and one of potato starch. One part of this size is required for about 3 parts of pigment. The size has the following advantages: it does not gelatinise or thicken in cold weather; when applied to walls it is unaffected by damp air; it is not liable to decompose; the colours mixed with it may be dried and sold in that condition, merely requiring mixture with water to render them fit for use.—E. B.

Improved Waterproof Paper. A. A. Haigh, Manchester. Eng. Pat. 18,838, November 21, 1890. 4*d*.

This inventor employs resin and a substance possessing the trade name "almedina" (known also as "potato-rubber"), dissolved in naphtha; and colouring matters may be added. Various methods of applying it to the paper may be adopted, but "spreading" is preferred.—E. G. C.

XIV.—TANNING, LEATHER, GLUE, AND SIZE.

The Treatment of Leather for Dyeing and Colouring Purposes. E. M. Shaw. J. Soc. Dyers and Colourists, November 1, 1891.

See under VI., *pages* 919—921.

PATENTS.

Improved Process and Apparatus for Tanning Hides and Skins. L. A. Groth, London. Eng. Pat. 18,385, November 14, 1890. 8*d*.

This invention relates to improvements in the process and apparatus for tanning hides with or without the aid of electricity, in which agitation of the tan-liquor and hides is employed. In apparatus of the kind referred to, it often happens that the whole mass of tan-liquor is carried round in the tan-pit or vat with the hides so that both the liquor and hides rotate together in the same direction, the practical effect being much the same as if both were stationary in the pit or vat, the desired effect being thus more or less hindered. To effect the agitation of the tan-liquor independently of the motion of the hides, the inventor employs paddles or stirrers, or causes the liquor to circulate by means of a pump which draws the liquor from the lower part of the pit and returns it to the upper, or similar device. For drawings and particulars of the apparatus employed, the specification must be consulted.—B. H.

An Improvement in or relating to the Manufacture or Treatment of Size, the same being also applicable to the Manufacture or Treatment of Glue or of Gelatin. B. Cannon and W. J. Cannon, Lincoln. Eng. Pat. 10,596, June 22, 1891. 4*d*.

The object of this invention is to obtain a product free from the disagreeable odour inherent to such substance as at present produced, and pervaded with an aromatic or aromatic and antiseptic odour. To effect this, the material from which the size, glue, or gelatin is prepared, or the size, glue, or gelatin itself is incorporated with a suitable proportion of "nitro-benzene" or "other suitable deodorising, aromatic, or antiseptic substances, such as benzoin, camphor, myrrh, olibanum, and other gums; eucalyptus, lavender, mint, rosemary, bergamot, cedar, cloves, peppermint, rose, lemon, and other essential oils; or musk, castor, civet, ambergris and other animal perfumes." The quantity of any such substance required depends on the result required. As an example, one part of musk would suffice for about 7,000 parts of size.—B. H.

XV.—MANURES, Etc.

The Treatment of Phylloxera with Carbon Bisulphide and Vaselin. L'engrais and Chem. Trade J. November 7, 1891, 283—284.

See under XVIII. *C., page* 943.

Memoranda of the Origin, Plan, and Results of the Field and other Experiments conducted on the Farm and in the Laboratory of Sir J. B. Lawes, at Rothamsted. June 1891.

Experiments on Permanent Meadow Land. Thirty-sixth Season (area under experiment about 7 acres).—The land is an old meadow, and no seed has been artificially sown within the last 50 years, perhaps not since grass was first laid down. The manuring has been, with some exceptions, the same for each plot year after year, since the commencement of the experiments. For the first 19 years only the first crop was mown, the second crop being generally fed off by sheep. The highest average yield over the 14 years, 1876—1889, taking both crops, was over 86 cwt. per acre, and this was obtained with an application of potassium sulphate (500 lb.), sodium sulphate (100 lb.), magnesium sulphate (100 lb.), superphosphate (3½ cwt.), sodium silicate (400 lb.), and ammonium salts (600 lb. per acre). The plot which had the same mineral manure (without the silicate), and sodium nitrate (550 lb.) instead of the ammonium salts, yielded 65 cwt. per acre or 2 cwt. more than the plot with the same minerals and 400 lb. of ammonium salts. The average results with ammonium salts alone (400 lb.), and with sodium nitrate alone (275 lb.), were respectively 29 cwt. and 40 cwt. per acre. With regard to the plots receiving mineral but no nitrogenous manure, the highest average yield (45 cwt.) was obtained with the complete mineral manure; another plot which had all the minerals gave 41 cwt., whilst the omission of potash brought the yield down to 30 cwt., which is not much higher than that of the unmanured plots (26 and 29 cwt.). With regard to the amounts obtained in 1890, the yield was generally lower than the average over the preceding 14 years.

Experiments with Barley. Fortieth Season (area under experiment about 4·25 acres).—The continuously unmanured plot gave an average amount (for the 38 years) of nearly 17 bushels of dressed grain per acre, and 13 bushels in 1890. Where there was an application of mixed mineral manure (without nitrogen) the average yield was 22·5 bushels and the yield in 1890 nearly 18 bushels. Dividing the mixed minerals into superphosphate on the one hand, and potassium, sodium, and magnesium sulphates on the other, far more effect is produced by the application of superphosphate alone than by the other minerals; in fact, the average yield of grain and the yield in 1890, in the plot which had superphosphate alone, were nearly equal (21·75 and 16·75 bushels) to the plot treated with the complete mineral manure. The same relative effect is shown where the respective minerals are given in conjunction with nitrogenous manure. The average yields with ammonium salts alone (200 lb.) and sodium nitrate alone (275 lb.) were 29·25 and 32·75 bushels, the produce in 1890 for the two plots being 20·5 and 29·5 bushels. The greatest yield, 53 bushels per acre, was obtained where 14 tons of farmyard manure is applied yearly (the average yield was 48·6 bushels). The next highest yield (average 46·25; 1890, 46·6 bushels), was from the plot which had the mixed minerals (with sodium silicate) and sodium nitrate (275 lb.); but nearly the same amount was obtained on the plot which had superphosphate (and silicate) and sodium nitrate alone.

Experiments with Wheat. Forty-eighth Season (area under experiment about 11 acres).—The average yield per acre of dressed grain during the 38 years previous to 1890, on the unmanured plot was 13 bushels, and the yield in 1890, 12·4 bushels. The plot which had farmyard manure (14 tons) gave an average yield of 34 bushels, and in 1890

50 bushels per acre. The next highest average yield, 36·5 bushels, was obtained from the plot manured with potassium sulphate (200 lb.), sodium and magnesium sulphates (each 100 lb.), superphosphate (3·5 cwt.), and ammonium salts (600 lb. per acre). The plot which received the same minerals and 400 lb. of ammonia gave an average yield of 32·8 bushels, and in 1890, 44·3 bushels; whilst the plot manured like the last, but on which the ammonia salts were sown in the autumn instead of in the spring, gave an average yield of 30·5 bushels, and 48 bushels in 1890. The mixed minerals alone (without nitrogen) gave an average yield of 15 bushels, and in 1890, 19·3 bushels, nearly exactly the same as the yield of the unmanured plot. The high yields in 1890 were partly due to the season and partly to the fact that the half of the field from which the results were obtained was thin sown and therefore partially fallow the year before, in order to clean the land.

Experiments on Mangel-Wurzel. Sixteenth Season (*area under experiment, about 8 acres*).—The highest yield of roots (36 tons 4 cwt.) was obtained on the plot which received farmyard manure (14 tons), superphosphate (3·5 cwt.), and a cross dressing of rape cake (2,000 lb.). The plot which had the same manures with the addition of ammonium salts (400 lb.) gave only 30 tons 13 cwt. Of the plots which had no dung or rape cake the highest amount of produce (27 tons 1 cwt. of roots) was yielded by the plot manured with superphosphate (3·5 cwt.), potassium sulphate (500 lb.), sodium chloride (200 lb.), magnesium sulphate (200 lb.), with a cross dressing of sodium nitrate (550 lb.). Where no nitrogen but only minerals were given the yield varied from 5 tons 13 cwt. to 7 tons 1 cwt.; the yield on the unmanured plot was 6 tons 5 cwt. The importance of potash is shown by the fact that when superphosphate was applied with a cross dressing of nitrogenous mineral or organic manure (except sodium nitrate), the yield varied from over 10 tons to over 17·5 tons; whilst superphosphate and potassium sulphate with the same cross dressings gave yields varying, according to the cross dressing, from over 19·5 tons to nearly 31 tons. The plots which had superphosphate alone, and superphosphate and potassium sulphate, and were cross-dressed with sodium nitrate, gave very similar results, the yields of roots being respectively 21 tons 18 cwt. and 21 tons 12 cwt. The average results for these plots were also very close. The produce in 1890 was on every plot greater and generally much greater than the average produce of 1890 and the four preceding years.

Experiments on Potatoes. Sixteenth Season (*area under experiment 2 acres*).—In 1890 the produce was on each of the plots higher than the average of the five years 1886–90. The greatest weight of tubers was obtained from the two plots which received, since 1883, 14 tons of farmyard manure, the yield being 6 tons 15¼ cwt. and 6 tons 17 cwt. The next highest yields were obtained on the plots which had mixed minerals (this Journal, 1890, 871) together with ammonium salts (400 lb.) or sodium nitrate (550 lb.), the yield on these two plots being 6 tons 7·75 cwt. and 6 tons 3·75 cwt. respectively. With the same amounts of ammonia or nitrate, but without the minerals, the produce was only about 2 tons and 2·5 tons, whilst with superphosphate alone, and with mixed minerals alone, the yields were respectively 2 tons 12·5 cwt. and 3 tons 3 cwt.

The following papers have been published since June 1890 (compare this Journal, 1890, 871):—

Series I.—Reports of Field Experiments, &c.

42. On Nitrification. Part IV. (Chem. Soc. J. 1891).

84. Results of Experiments at Rothamsted on the Question of the Fixation of Free Nitrogen. (Agric. Students Gazette, N.S. **5**, 1890–91.)

85. Observations on Rainfall, Percolation, and Evaporation, at Rothamsted; with tabular results for 20 harvest years (September 1 to August 31), 1870–1 to 1889–90, inclusive. (Proc. Inst. Civil Eng. **105**, 1891).—N. H. J. M.

Comparative Influences of Ferrous and Calcium Sulphates on Nitrification and on the Conservation of Nitrogen. P. Piehard. Compt. Rend. 1891, **112**, 1455—1458.

Experiments were made with soils composed of (1) pure sand; (2), sand and $\frac{1}{10}$ part of clay; (3), sand and calcium carbonate; and (4), sand, clay, and calcium carbonate, these soils being mixed with organic nitrogen (cotton oil-cake) at the rate of 1 grm. per kilo. and kept of a proper degree of humidity during the progress of the experiments.

With the addition of $\frac{1}{1000}$ part of ferrous sulphate, the production of nitric nitrogen during a period of seven months, was increased in the case of soil (1) from 1·43 (without such addition) to 10·40 per cent. of the nitrogen added, and in that of (2) from 5·10 to 15·92 per cent., but was reduced in the case of (3) from 5·10 to 2·55, and in that of (4) from 7·14 to 6·43 per cent. The addition of $\frac{1}{2000}$ part of calcium sulphate, under the same conditions, increased the formation of nitric nitrogen to the extents of 11·43 (1), 13·67 (2), 23·67 (3), and 34·48 (4) per cent.

As regards the prevention of loss of nitrogen, ferrous sulphate was found highly efficacious with soil (1), less so with (4), and indifferent with (2) and (3). Compared in this respect with ferrous sulphate, calcium sulphate was superior in its action with soils (2) and (4), little different with (3), and inferior with (1).

From the results obtained it would seem that, as a manure, ferrous sulphate is beneficial with soils which contain an excess of silica and are deficient in humidity, clay, calcium carbonate, and iron oxide, but with other soils, the addition of calcium sulphate is more advantageous.

Ferrous sulphate is useless, if not indeed injurious, as an addition to ferruginous soils. It may, however, be employed with advantage for fixing the ammonia of manures in which the formation of that substance takes place rapidly, but its antiseptic properties unfit it for admixture with manures which decompose slowly.

Chlorosis, when due to defective nutrition and not to meteorological or cryptogamic influences, is combated quite as well by calcium sulphate as by ferrous sulphate.—E. B.

PATENT.

The Manufacture of Artificial Manure or Manures from the Dross or Refuse of Esparto and other Grasses, Straw, Rags, Wood, and other Materials used in the Manufacture of Paper. E. Pearman, Hemel Hempstead. Eng. Pat. 14,587, September 16, 1890. 4*d*.

This invention consists in mixing together the dross or refuse of esparto, straw, and other materials used in paper-making, with sand, charcoal, soda, nitric acid, sulphuric acid, spirits of salts, ammonia, and several other salts "in such or any proportions as may be required."—E. J. B.

XVI.—SUGAR, STARCH, GUM, Etc.

Xylose from Maize Cobs. W. E. Stone and D. Lotz. Ber. 1891, **24**, 1657—1658.

Xylose can be obtained by extracting maize cobs with boiling 2 per cent. soda, precipitating the gum from the alkaline solution by the addition of alcohol, and then hydrolising it with 2 per cent. sulphuric acid. The yield is small.—F. S. K.

A New Isomeride of Mucic Acid and the so-called Paramucic Acid. E. Fischer. Ber. 1891, **24**, 2136—2143.

Heating with quinoline or pyridine at 140—150° converts mono- and di-basic acids of the sugar group into optical isomerides, which differ from the original acid in having the carboxyl attached to the neighbouring asymmetric carbon atom. Under similar treatment mucic acid yields a new isomeride, to which the name *allomucic acid* has been given; but owing to the insolubility of mucic acid in quinoline, aqueous solutions and closed vessels have to be used, and pyridine is found to be the more convenient base, the chief function of the base is to prevent the formation of lactone, which would interfere with the desired transformation.

The results obtained dispel the opinion hitherto entertained that mucic acid is chacterised by yielding no lactone, and moreover provide a valuable step towards the synthesis of members of the dulcite group.—D. A. L.

PATENTS.

Improvements in the Production of Invert Sugar. A. Wöhl and A. Kollrepp, Berlin, Germany. Eng. Pat. 17,557, November 1, 1890. *6d.*

The invention relates to the production of a pure tasting invert sugar from inferior raw sugars; the process is a modification of that previously described in Eng. Pat. 16,540 of 1889 (this Journal, 1890, 878).

The sugar solution is made of a concentration of about 85° B., and is inverted with very dilute acid at 110° C. To determine the amount of acid necessary, a portion of the raw sugar is ignited, and the amount of acid which is necessary to neutralise the alkali in the residue is sufficient to invert the sugar. During the progress of the inversion air or air and steam are blown through the solution; this treatment expels the greater portion of the volatile acids. The inversion is completed in about one hour, and very little colour is produced.—A. L. S.

Improvements in Apparatus for Washing Sugar. E. F. Cordero, Rubio, Venezuela. Eng. Pat. 12,808, July 28, 1891. *8d.*

The sugar to be washed is placed in a conical-shaped vessel, and "alcohol of about 38°" poured over it. The alcohol which issues from the bottom of the cone is received in a closed receiver, and the process of washing continued until the alcohol passing into the receiver is colourless; the supply of alcohol is then stopped, and air pumped through the sugar until all alcohol is removed from the sugar; the air is washed to remove the alcohol. The alcohol containing the molasses is distilled in special apparatus, which yields a spirit of the original strength, and the molasses remain behind in the boiler.—A. L. S.

XVII.—BREWING, WINES, SPIRITS, Etc.

PATENTS.

Improvements in and relating to the Manufacture of Yeast. H. H. Lake, London. From A. Brunn, Rodstrup, Denmark. Eng. Pat. 15,352, September 27, 1890. *6d.*

The sweet wort is prepared from 75 per cent. of barley, rye or maize, which has been washed, malted, and ground; 5 per cent. of barley, and 20 per cent. of rye or maize; the latter are soaked previous to grinding. The grain thus divided is soaked in water for 24 hours, a little muriatic acid being added. It is then mashed in the usual way, and the wort filtered through animal charcoal or other substances, whereby an almost colourless fluid of 10 per cent. by the saccharometer is obtained.

The wort is fermented at a constant temperature of 30° C., and with frequent aëration. The fermentation is concluded in 10 hours, and the yeast is then separated either by precipitation or centrifugal separation.—A. L. S.

Improvements in Brewing Beer. J. Cox, Greenwich. Eng. Pat. 18,708, November 19, 1890. *4d.*

A saccharine decoction of hops is fermented with a solution of raisins, currants, or sultanas which has stood at 25—40° C. until fermentation has set in.—A. L. S.

Improvements in Pneumatic Malting Drums. J. Y. Johnson, London. From "Berliner Actiengesellschaft für Eisengiesserei und Maschinen-Fabrikation, vorm. T. C. Freund and Co.," Charlottenburg, Germany. Eng. Pat. 3666, February 28, 1891. *8d.*

A number of perforated metal tubes are contained in the drum, by means of which air of suitable temperature and moisture may be passed through the grain to be malted.

By an arrangement which is particularly described in the specification, as the drum is rotated the air is always introduced by the lowest of the tubes, and passing through the body of the grain is withdrawn by the uppermost of the tubes.—A. L. S.

Process for the Preparation of Wort from Malt, alone or Mixed with Unmalted Cereals. C. Rach, Chicago, U.S.A. Eng. Pat. 12,506, July 23, 1891. *4d.*

When using malt alone, the ground malt is mashed at about 145° F., and allowed to stand 15—20 minutes. The clear supernatant solution is then drawn off, and the thick mash remaining heated in a steam cooler to 246°—268° F. for 45 minutes. This is then cooled and mixed with the clear solution previously drawn off so as to produce a final temperature of 165° F. After 30—40 minutes the taps are set in the usual way.

If unmalted cereals are also used, they are mixed with about one-sixth their weight of crushed malt and mashed at 122° F. The temperature is then gradually raised to 268°—291° F., and, after standing 45 minutes at this temperature, the raw cereal mash is mixed with the malt mash prepared as above; the temperature of the final mash is to be about 165°, and after standing 30 to 40 minutes, the wort is drawn off as usual.—A. L. S.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

(A.)—CHEMISTRY OF FOODS.

On Roasting, Malting, and Drying Processes, with special reference to Cocoa. A. Stutzer. Zeits. f. angew. Chem. 1891, 368—375.

This paper deals with the changes effected by roasting and drying processes as applied to food-substances, with especial reference to cocoa.

The author is of the opinion that more care should be exercised in the roasting of cocoa than has hitherto been the case, and considers that if this operation be properly performed, the use of alkalis to "open up" the material, or the addition of essences, is unnecessary. A roasting apparatus is described, in which the heat can be very carefully regulated and evenly applied.

Analyses are given of a sample of cocoa prepared by roasting alone and of ordinary commercial samples. The following are the methods of analysis:—

Fat.—In the manufacture of cocoa this substance is reduced by hydraulic pressure to 25—30 per cent. The temperature should be kept as low as is practically feasible during this operation, and the material should be protected from the air. The percentage of fat is determined in the usual way by extraction with anhydrous ether.

Nitrogenous Matters.—The nitrogenous constituents of cocoa are ammonia, theobromine, amides, digestible albumen, and undigestible substances. The author has already shown (Report, 1882, 169) that a very small proportion (about 42 per cent.) of the nitrogenous constituents of cocoa are digestible. The nitrogenous constituents of cocoa fall into three groups. The first, non-proteids (ammonia, theobromine, and amides), are soluble in water in the presence of cupric hydrate. The second, digestible albumens, are insoluble in this solvent, but dissolve in acid gastric juice or alkaline pancreatic juice. The third, consisting of undigestible constituents, are insoluble in these reagents. The total nitrogen is first determined in 1 grm. of the cocoa powder by Kjeldahl's method. Two grms. are then mixed with freshly precipitated cupric hydrate, washed with water, the filtrate distilled with magnesia, and the ammonia titrated. The ammonia should not exceed 0·1 per cent. A greater amount shows that this substance has been added during the manufacture. Addition of ammonia, as also of potassium and sodium hydrates, has the effect of making the ash of cocoa less soluble.

Theobromine ($C_7H_8N_4O_2$) is an important constituent of cocoas. Raw cocoa beans contain on an average 1·5, crude cocoa 1·6, cocoa-powder 1·8—2·0 per cent. of theobromine. Together with this is 0·15 to 0·20 per cent. of theine. Theobromine is best determined by the method of Weigmann, in which 20 grms. of cocoa are boiled out with water, the albumen precipitated with ferric acetate, and the filtered liquid mixed with phospho-tungstic acid. The nitrogen in the resulting precipitate is then determined.

The nitrogen due to amides is found by deducting the theobromine- and ammonia-nitrogen from the total non-protein nitrogen. The following factors are used:—

Ammonium (NH_4)	1·28
Theobromine ($C_7H_8N_4O_2$)	3·15
Amides.....	6·25

The factor for amides is that usually used for proteids.

The determination of the digestible albumen was effected by treating the cocoa powder first with acid pepsin solution and afterwards with alkaline pancreatic fluid. The insoluble residue was washed with water and its nitrogen determined. This, deducted from the total albuminous nitrogen and multiplied by 6·25, gives the digestible albumen. In order to render the determination more exact, the cocoa powder should be first freed from fat, since the author has previously shown that the latter offers a mechanical resistance to the action of the digestive fluids.

In order to determine the effect of heat upon the digestibility of the albumen of cocoa, samples of Ariba, Bahia, and Machala cocoa beans were powdered, the fat extracted with ether, and the residue again powdered and the digestible albumen determined. The extracted samples were then roasted and the digestible nitrogen again determined.

In 100 parts of total nitrogen the following quantities were undigestible:—

—	Raw.	Roasted.
Ariba beans	23·2	39·7
Machala beans.....	22·8	40·3
Bahia beans	19·3	40·3

Experiments were made on the rate at which the cocoa powder dissolved in acid pepsin solution, but without noteworthy result. The analysis of cocoa also involves the determination of starch and sugar, of woody fibre (in the samples examined the latter varied from 3·36 to 5·75), and of the amount of organic matter soluble in cold water and of the nitrogen which it contains.

The analysis and properties of the ash of cocoa also give important information as to the treatment which the cocoa has undergone in the course of manufacture. Dutch cocoa usually contains potash or soda, whilst the German varieties frequently contain ammonia. The effect of these reagents is to render the ash, especially the phosphates, less soluble.

The following conclusions were arrived at:—

The present methods of roasting are unsuitable, the duration of the operation is too long, the temperature variable, and provision is not made for the escape of evil-smelling, combustible vapours. The use of potash, soda, and ammonia, to "open up" (*ausschliessen*) the cocoa is unnecessary if the roasting is properly conducted. The presence of these reagents can be detected by analysis. The use of essences and perfumes is injurious and only necessary to disguise defective roasting. The percentage of theobromine in different varieties of cocoa bean is practically constant and is not greatly influenced by the method of preparation. The value of cocoa as a food-substance depends upon the amount of digestible albumen. The ratio of this to indigestible nitrogenous matter is usually 4:3, but with too high a temperature during the roasting it may become 4:4 or 4:5. The percentage of cocoa-butter should not exceed 30 per cent.—H. K. T.

The Proteids or Albuminoids of the Oat Kernel. T. B. Osborne. Amer. Chem. Jour. 1891, **13**, 327—347 and 385—413.

The author draws the following conclusions from the results of his researches on the proteids of the oat kernel:—

The proteid removed from freshly-ground oats by extraction with dilute alcohol (Norton's *glutin*), when dehydrated by absolute alcohol and dried over sulphuric acid, is a light yellowish powder, insoluble in pure water, as well as in absolute alcohol, although soluble in mixtures of alcohol and water; it dissolves also in dilute acids and alkalis, and from these solutions it is precipitated by *exact* neutralisation. From its solution in 60 per cent. alcohol it is obtained as a yellowish slimy mass by evaporating off the alcohol. It is remarkable for the large amount of sulphur which it contains. Its composition is given in analysis No. I. If heated for some time with dilute alcohol, it coagulates and is no longer soluble in that liquid, although its composition remains apparently unchanged. The analysis of this coagulated modification is numbered II.

If, instead of extracting the oats directly with dilute alcohol, they are first treated with water, or 10 per cent. sodium chloride solution, the proteid soluble in alcohol undergoes change and the resulting substance has different properties. It is much more soluble in dilute alcohol than proteid No. I. and is not coagulable. If wet with absolute alcohol the moisture absorbed from the atmosphere renders it gummy and tenaciously adhesive, unlike No. I. Its analysis is numbered III.

The principal proteid extracted by 10 per cent. alcohol behaves towards reagents like the myosin-globulin of animal muscle, first noticed by Weyl. The author finds its coagulation temperature to be much higher (80°—100°), however. This proteid appears to be the result of a transformation similar to that by which myosin is formed from myosinogen. The largest amount of this proteid obtained amounted to 1·3 per 100 parts of oats. Its analysis is numbered IV.

The proteid extracted, after complete exhaustion of the oats with dilute alcohol of 0·9 sp. gr., by 10 per cent. sodium chloride solution, and that obtained by extraction with dilute potash ($\frac{2}{10}$ per cent.), also after exhaustion with alcohol, are regarded by the author as identical with that obtained by extraction with sodium chloride directly. These are numbered V. and V*a*.

If the ground oats are extracted with $\frac{2}{10}$ per cent. potash without previous treatment with alcohol, nearly the whole of the proteid bodies are removed, and if, after precipitating

these, they are exhausted by alcohol in order to remove the proteid soluble in that liquid, the remaining substance is regarded by the author as probably Johnson and Norton's *avenine*, which they obtained by extracting with dilute ammonia. Its analysis is numbered VI.

If, instead of extracting the oats directly with potash, they are first digested in water, the amount of proteid soluble in potash is much smaller, one hour's treatment with water rendering one-half, 24 hours' treatment, two-thirds, insoluble. What is then dissolved out by potash is the same as No. IV. Its analysis is numbered VII.

When ground oats are extracted with 10 per cent. sodium chloride solution, at 65°, a proteid separates, on cooling the extract, in the form of spheroids. It differs from all other proteids which have been described as yet. It is soluble in pure water, precipitated by the addition of a little sodium chloride, again dissolved by the further addition of sodium chloride, and finally precipitated completely by saturating the solution with salt. In the presence of a little sodium chloride and acetic acid it is soluble in alcohol of 0·9 sp. gr. It has been obtained crystallised in regular octahedra from its solutions both in water, as also in sodium chloride brine. The analysis of the spheroids is numbered VIII.

Water alone appears to dissolve very little protein substance, as Norton and Kreusler found, the three bodies so dissolved being (1) an acid albumen, (2) a globulin or globulins, (3) a proteose.

Composition of the Proteids from the Oat Kernel.

—	I.	II.	III.	IV.	V.
Carbon	53·06	53·10	53·70	52·31	52·48
Hydrogen	6·91	6·91	7·00	7·21	6·94
Nitrogen	16·38	16·49	15·71	16·88	16·85
Sulphur	2·26	23·50	1·76	0·88	0·57
Oxygen	21·38		21·83	22·69	23·16

—	Va.	VI.	VII.	VIII.
Carbon	52·45	53·49	52·49	52·22
Hydrogen	6·92	7·03	7·10	6·98
Nitrogen	16·63	16·39	17·11	17·85
Sulphur	0·81	0·99	0·80	0·77
Oxygen	23·19	22·12	22·50	22·18

—J. W. L.

(*B.*)—SANITARY CHEMISTRY.

Volatile Organic Matter in Potable Water and a Simple Method of Estimating Dissolved Fixed and Volatile Organic Matter in Water. W. C. Young.

See pages 883—887.

The Purification of Water by Metallic Iron. E. Devonshire. A Lecture before the Society of Arts, Mass. Inst. Techn., December 11, 1890. Techn. Quarterly, 1891, **4**, 113—121.

Although the action of the ordinary sand filter for purifying water is purely mechanical, yet on account of the formation of what Piefke terms bacteria-jelly, which is a sort of film formed on the surface after several days' working, it is capable of removing a considerable proportion of the bacteria present in the water before filtration. Sand filters do not, however, remove dissolved organic matter, nor the colour due to finely-divided clay or peat frequently met with in river or surface waters, even when the rate of filtration is as low as 30 galls. per square foot per day.

The necessity of removing the colour from the new water supply at Antwerp derived from the River Nethe caused the adoption of the process of filtration through the material known as Bischof's spongy iron. This method was efficient, but objectionable on account of its cost, and the rusting and clogging of the filter-beds which gradually took place. The difficulty was overcome by Anderson, the consulting engineer of the water company, who devised an apparatus consisting of a cylinder carried on hollow trunnions, one at each end, and capable of being revolved about its longer axis by spur gearing. A series of short curved shelves are arranged in steps at equal distances round its internal circumference; the sixth row of curved shelves being replaced by a set of small square plates set at an angle with the axis of the cylinder. Iron scrap (turnings, borings, &c.) is placed in the cylinder and is scooped up by the shelves and showered down through the water, which is introduced through the trunnion at one end where it is distributed by a baffle plate and finds its way out through the other, the mouth of which is bell-shaped and points vertically downwards so as to prevent the accidental exit of the finer particles of iron. The function of the small square plates is to direct the iron back towards the inlet end of the apparatus, and thus counteract the tendency of the current of water to carry the purifying material forward. By this means ample contact of the water with the iron is secured, while no rusting together is possible and the surfaces of the metal are kept continually clean by mutual attrition. The water, charged with a ferrous salt, comes in contact with the air on leaving the cylinder, ferric hydrate is formed and entangles the suspended matter and oxides the organic impurities. Micro-organisms are also removed either mechanically or by the direct toxic effect of salts of iron; the entire absence of free ammonia from the filtered water is characteristic of the iron process. Weekly analyses of the Antwerp water before and after filtration show that in actual practice on a large scale, the albuminoid ammonia is reduced to one-third of its original amount; free ammonia and nitrites entirely disappear, and nitrates are brought down to the smallest trace; the micro-organisms are reduced in number from 50,000—100,000 colonies per cc. to four or five, the highest number recorded being 20; the water is therefore practically sterilised.

The method has an important advantage over the high-pressure system, in conjunction with which alum has been generally used as a precipitant, inasmuch as the clogging of the filter throughout its depth that occurs with the latter, necessitating frequent washing by a reverse current, is avoided; the cost of the scrap iron is also less than that of the alum.

The actual cost of the process varies with the water to be treated, a water containing such organic matter or very finely-divided suspended matter, clogging the filters sooner than one containing an even comparatively large quantity of less finely-divided clay or mud. Thus the Antwerp water contains much organic matter both vegetable and animal, but little mud; before the introduction of settling reservoirs, the filters had to be scraped once a fortnight. At Dordrecht, on the other hand, where a water holding much fine clay in suspension but organically purer is treated, the filters run for five weeks.

The cost of the treatment at Antwerp for 1889 was 257 dols. for 234 million gallons pumped during the year,—a fraction over 1 dol. per million gallons, although the plant was working at half its capacity, a condition unfavourable to economy.—B. B.

Use of Galvanised Iron Pipes for Conveying Water. R. Haines. Proc. Chemical Section, Franklin Inst., Jan.—Dec. 1890, 69—77.

From analyses of samples of water taken from artesian wells lined with tubes of galvanised iron, the author finds that where nitrates are present in any considerable quantity in the water ammonia in quantity is obtained; in consequence a good deal of zinc is taken into solution, the nitrates disappearing to a great extent. That zinc has a cumulative action on the system seems tolerably certain, but it is also certain that its action is far from being so injurious as the

action of lead. In very small quantities the zinc is practically harmless, but he considers that if the water to be transported contains anya mount of ammonium salts, chloride of sodium and nitrates, as well as very small amounts of free mineral acids, &c. then zinc-coated pipes should most certainly not be used, but only pipes coated with a non-metallic interior surface.—T. L. B.

Local Standards in Water Analysis. R. Haines. J. Franklin Inst. 1891, **131**, 378—385.

One of the difficulties in the examination of drinking waters is the obtaining of a suitable standard with which to compare the results of analysis of any given water in order to form a correct judgment of its fitness for drinking purposes. A general standard is often misleading. Special local standards for each district are advised, and these may be obtained by collecting a considerable number of analyses of such well and spring waters as are in a natural uncontaminated condition; from these an average may be struck to form a standard of purity for the district in question. Such a "standard" cannot, however, be applied as a hard and fast rule to all waters in the locality, and for different classes of water different standards are necessary. Thus, river waters cannot be compared with well waters and so on. The author gives a number of results of analyses of well waters in the neighbourhood of Philadelphia, on the Pennsylvania side of the Delaware River.—T. L. B.

(*C.*)—DISINFECTANTS.

The Treatment of Phylloxera with Carbon Bisulphide and Vaselin. L'engrais and Chem. Trade J. November 7, 1891, 283—284. (Compare this Journal, 1891, 842 and 846—847.)

Bisulphide of carbon has proved, during recent years, to be the most certain insecticide, and its use has led to the preservation of a great part of the French vineyards.

Practice has made it apparent that bisulphide of carbon does not give quite such satisfactory results in very siliceous earth. Not easy to diffuse in some soils, and evaporating too rapidly in others, the sulphide does not so certainly produce its effect. Hence, has arisen the current opinion, that bisulphide of carbon suits certain soils and not others.

Since 1887, Dr. Albin Mennier has been endeavouring to render this action uniform, by assisting the diffusion of the carbon bisulphide in heavy soils, and preventing its evaporation in such as are too light, and finally by avoiding the injurious effect on the vine, produced by a considerable amount of evaporation in soil, heated by the summer sun.

The experiment was made of mixing bisulphide of carbon with petroleum oils, boiling at 300°—350° (vaselin), and of density 0·850—0·910, which are quite without injurious effect on the plants, even when present in large quantity. Numerous direct experiments have been made with these hydrocarbons on vines.

These high-boiling substances have the property of diminishing the evaporation of the bisulphide of carbon. Bisulphide of carbon, for example, can only be separated from ordinary alcohol by fractional distillation with great difficulty (Bertbelot). Methyl alcohol and acetone, benzene and tolnene are further examples which may be selected from many others.

Although carbon bisulphide can be separated from vaselin by fractional distillation, on account of the great difference in boiling point, yet the evaporation of the former, at all events, at the ordinary temperature, is considerably diminished by the addition of vaselin, which retains considerable quantities for days, in spite of a considerable surface of evaporation.

In very light sandy soils the use of vaselin should, *a priori*, be favourable. On the other hand, vaselin which physically resembles the fats, readily penetrates into clay, and its use should therefore be also found advantageous in heavy land (clay and clayey sand).

Five thousand seven hundred kilos. of carbon bisulphide mixed with an equal weight or half its weight, of vaselin were employed in the department of the Rhône at various places, Vangueray, Saint-Etienne-la-Varenne, Villié-Naorgon, &c.

In 1888, 2,500 kilos. were supplied to various proprietors in the Rhône disirict, who obtained such results that in 1889, 89,585 kilos., and in 1890, 242,392 kilos. were employed by a large number of vine-growers in the following departments:—Rhône, Isère, Ain, Saône et Loire, Côte-d'Or, Loire, Ardèche, and Drome.

From the indications given in the spring of the present year, the total amount of the mixture to be employed during 1891 may be estimated at 500,000 kilos.

The vaselin mixture is applied in the same manner as the pure sulphide. In practice it is found that the efficacy of the remedy is increased by inserting one portion at a distance, 10 or 12 cm. from the foot of the vine stock, and spreading the rest over the area of a hectare. Actually about 2,000—2,500 hectares of vineyard are under treatment in this way.

The increasing use of this remedy is obviously caused by its success in restoring diseased vines, and by the impression thus made upon the minds of the owners.

For four years this mixture has been employed over 15—20 hectares, situated at Saint-Etienne-la-Varenne (Rhône). This property was kept at the average rate of production by pure bisulphide, but its production has been increased three-fold by the new treatment. Phylloxera is no longer found on the roots, the vegetation is luxurious, and numerous rootlets, a sure sign of increased vitality, have appeared.

The manure has not been altered for 10 years, so that the marked improvement can only be ascribed to the use of a more rational insecticide.

These results reflect the opinion of M. Ballriani, stated in his memoirs on phylloxera (1876):—

"The germ or embryo is much less certainly attacked by large doses of a poisonous vapour acting for a short space of time, than by even very small quantities, the action of which is slow but continuous."

Bisulphide of carbon mixed with vaselin theoretically fulfils this requirement.

XIX.—PAPER, PASTEBOARD, Etc.

The Colouring of Paper with Coal-Tar Dyes. Papier Zeit. 1891, **16**, 2182—2183.

See under VI., *page* 921.

PATENTS.

The Manufacture of Artificial Manure or Manures from the Dross or Refuse of Esparto and other Grasses, Straw, Rags, Wood, and other Materials used in the Manufacture of Paper. E. Pearman, Hemel Hempstead. Eng. Pat. 14,587, September 16, 1890. 4*d.*

See under XV., *page* 939.

Improvements in the Manufacture of Paper, Boards, and such like Materials. C. Weygang, London. Eng. Pat. 14,753, September 18, 1890. 6*d.*

The inventor claims certain improvements on his former patents, Eng. Pats. 7904 and 12,159 of 1886 (this Journal, 1886, 331), which improvements relate chiefly to the employment of peat and manure as sizing agents in paper. The pulp may be coloured by means of salts of iron.

—E. J. B.

Improvements in the Manufacture of Paper from Vegetable Fibre. A. W. Hayles, Crawley. Eng. Pat. 15,697, October 1, 1890. 4*d*.

According to this invention the reed known as the *Phragmitis communis* is used as the raw material. When it is intended to store the pulp for any length of time, it is mixed with boracic or salicylic acid to prevent fermentation. —E. J. B.

Improvements in Lining Boilers or Digesters used in the Manufacture of Paper Pulp and for similar Purposes. C. Kellner, Vienna, Austria. Eng. Pat. 15,930, October 8, 1890. 4*d*.

The boiler is first coated with the cement described in specification Eng. Pat. 6951 of 1890 (this Journal, 1891, 380), consisting of a paste of ground slate and silicate of soda. Upon this cement a paste is laid made of 1 part ground slate, 2 parts ground glass, and 1 part Portland cement.—E. J. B.

Improvements in Lining Boilers or Digesters used in the Manufacture of Paper Pulp and for other similar Purposes. C. Kellner, Vienna, Austria. Eng. Pat. 15,931, October 8, 1890. 4*d*.

According to this invention the boiler is lined with blocks or slabs made of the same materials as the cement described in the previous specification.—E. J. B.

Improvements relating to the Manufacture of Paper, Pasteboard, and the like, and to Apparatus therefor. B. J. Beckmann, Papenburg, Germany. Eng. Pat. 16,546, October 17, 1890. 8*d*.

The improvements consist in introducing wire gauze or wire-work into the middle of a sheet of paper as it is being formed on a paper machine. The arrangement of the necessary apparatus is shown in the drawings accompanying the specification.—E. J. B.

Improvements in the Manufacture of Strainer or Knotter Plates for Straining Paper Pulp, Wood Pulp, and the like. H. B. Watson and J. S. Watson, Newcastle. Eng. Pat. 16,928, October 23, 1890. 11*d*.

The improved strainer plate consists of a frame cast in bronze into which are fitted a number of plates made of an alloy of 95 parts of copper and 5 parts of tin. These latter contain the narrow slits through which the pulp is strained, and they are so arranged as to fit easily into the frame and be readily removable when necessary.—E. J. B.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES AND EXTRACTS.

Cantharidin. F. Anderlini. Ber. 1891, **24**, 1993—2000.

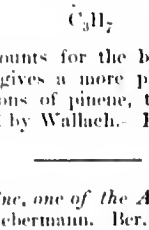
In a previous paper (Ber. 1890, **23**, 485; this Journal, 1891, 645) the author has shown that ammonia reacts with cantharidin to produce the imide $C_{10}H_{12}O_3NH$, a body which is stable both towards the caustic alkalis and caustic baryta. The hydrogen of the imido-group in this compound can be replaced by alcohol radicles by treating the imide with alkyl iodides in presence of the carbonates of the alkalis, whilst the same products can be prepared directly from cantharidin by the action of the corresponding primary amines in methyl or ethyl alcohol solution at 150—160° C. These substituted cantharidin-imides are weak bases which do not unite with acids to form salts, whilst the characteristic physiological properties of cantharidin disappear for the most part in the substituted imides. The following imides have been prepared:—

Cantharidin-methylimide, $C_{10}H_{12}O_3N.CH_3$
Cantharidin-ethylimide, $C_{10}H_{12}O_3N.C_2H_5$
Cantharidin-amylimide, $C_{10}H_{12}O_3N.C_5H_{11}$
Cantharidin-allylimide, $C_{10}H_{12}O_3N.C_3H_5$
Cantharidin-phenylimide, $C_{10}H_{12}O_3N.C_6H_5$
Cantharidin-α-naphthylimide, $C_{10}H_{12}O_3N.C_{10}H_7$

Acetic anhydride reacts with cantharidin-imide at 230° to form the *acetyl compound*, $C_{10}H_{12}O_3N.C_2H_3O$, which is saponified by boiling with water. It has already been shown that hydriodic acid converts cantharidin into a monobasic acid called cantharic acid, $C_{10}H_{12}O_4$. The same acid is produced by treating cantharidin with chloro-sulphonic acid; it forms rhombic crystals, which melt at 275° C. It reacts with ammonia, similarly to cantharidin, to form an *imide*, $C_{10}H_{12}O_4.NH$, melting at 187° C. Cantharic acid when heated with acetyl chloride in a closed tube to 135° C. is converted into an isomer of cantharidin, *isocantharidin*, which forms monoclinic crystals, readily soluble in alcohol, ether, and benzene, and melting at 75°—76° C. The aqueous solution of this acid when heated to boiling for some hours is transformed into a dibasic acid, which has the composition $C_{10}H_{14}O_5 + H_2O$, and to which the name *iso-cantharidinic acid* is given. It loses its molecule of water of crystallisation at 100° C. and at 163° C. gives up a second molecule of water, forming an *anhydride*, which melts at 75—76° C. and which, when boiled with water, regenerates the acid. The acid decomposes the alkaline carbonates; analyses of the *silver* and *barium salts*, both of which contain water of crystallisation, are given. Treated with methyl iodide, a *dimethyl ester* results, $C_{10}H_{12}(CH_3)_2O_5$. —C. A. K.

Constitution of Pinene. G. Wagner. Ber. 1891, **24**, 2187—2190.

The author does not agree with Wallach's explanation of the formation of pinene glycol (pinol hydrate) by the oxidation of pinene (Ber. 1891, **24**, 1524; this Journal, 1891, 850); he also considers that the constitution of pinene is most correctly represented by the formula—



which not only accounts for the behaviour of pinene on oxidation, but also gives a more plausible explanation of various other reactions of pinene, than the constitutional formula put forward by Wallach.—F. S. K.

Benzoyl-ψ-Tropeïne, one of the Alkaloids of Javanese Coca Leaves. C. Liebermann. Ber. 1891, **24**, 2336—2345.

Benzoyl-ψ-tropeïne was recently discovered by F. Giesel in a small-leaved coca plant cultivated in Java. The plant contains 2 per cent of alkaloids, of which about one-twentieth consists of cinnamyl-cocaïne, whilst of cocaïne there is very little. Benzoyl-ψ-tropeïne resembles dextro-cocaïne, but it has no optical activity, and its hydrochloride differs from that of *d*-cocaïne in solubility and crystalline form. With potassium bichromate it yields a crystalline precipitate instead of an oily one like cocaïne and *d*-cocaïne. On hydrolysis it yields—not ecgonine like the other cocaïne bases—but ψ-tropine, which contains one carboxyl group less than ecgonine. In a solution of the hydrobromide,

sodium carbonate produces a milky precipitate of benzoyl-ψ-tropeïne, which does not subsequently become crystalline. It may be extracted by means of ether, and the solution leaves on evaporation an oil which, when quite dry, solidifies into a stellate mass of crystals which melts at 49° C. The base is very soluble in all the common solvents, and its alcoholic solution is strongly alkaline. When quickly heated small quantities of the base distil unchanged.

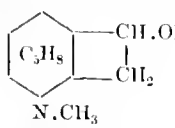
Benzoyl-ψ-tropeïne hydrochloride, $C_5H_{14}NO(C_7H_5O)HCl$, prepared by mixing ethereal solutions of hydrochloric acid and of the free base, forms white needles, melting at 271° C. A solution of this salt gives with platinic chloride a flesh-coloured, amorphous, insoluble powder of the composition $(C_5H_{14}NO(C_7H_5O)HCl)_2PtCl_4$. The gold salt, $C_5H_{14}NO(C_7H_5O)HCl,AuCl_3$, crystallises from boiling water in yellow needles, melting at 208° C. Mercuric chloride yields with the hydrochloride a voluminous crystalline precipitate, whilst with picric acid a precipitate of fine yellow needles, with difficulty soluble in water, is obtained.

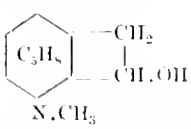
On heating with hydrochloric acid, benzoyl-ψ-tropeïne is decomposed into benzoic acid and ψ-tropine. This base was first prepared by Ladenburg and Roth (Ber. **17**, 151; this Journal, 1884, 328, 329) by the decomposition of hyoscine. The properties ascribed by these authors to ψ-tropine and its compounds are identical, practically in all respects, with those which the author has found for his own corresponding preparations. ψ-Tropine is strongly alkaline in reaction, and has no effect on polarised light. It is readily soluble in alcohol and water. An ethereal solution yields, on evaporation, fine needles of the base, melting at 106°—107° C. The synthesis of benzoyl-ψ-tropeïne from benzoic anhydride and ψ-tropine is most easily effected, the yield being very satisfactory.

Cinnamyl-ψ-tropine prepared from cinnamic anhydride and ψ-tropine melts at 87°—88° C. It is readily soluble in cold alcohol, ether, and benzene; somewhat less soluble in petroleum spirit. The hydrochloride is prepared by passing hydrochloric acid gas into a solution of the base in ether. It is easily soluble in alcohol and water. The picrate and gold and platinum salts of cinnamyl-ψ-tropine resemble the corresponding compounds of benzoyl-ψ-tropeïne.

Benzoyl-ψ-tropeïne hydrochloride is not a true mydriatic substance; injected into the eye of a rabbit, it only produced strong local anæsthesia.

In order to arrive at the constitution of ψ-tropine, the author intends to study the action of oxidising agents upon it. If tropic acid be the product of oxidation, the relationship existing between tropine and ψ-tropine may possibly be that exhibited by the following formulæ:—





If Ladenburg's assumption of the existence of an open side-chain in tropine be correct, the two formulæ would be—

$$C_5H_7.N.CH_2.CH_2.OH$$
$$C_5H_7.NCH(OH).CH_3.$$

—H. T. P.

Conversion of Maleïc into Fumaric Acid. Z. H. Skraup. Monatsh. Chem. 1891, **12**, 107—145.

It has been assumed by Wislicenus that in the transformation of maleïc into fumaric acid by the action of hydrochloric acid, the maleïc acid is converted into chlorosuccinic acid; this compound is then supposed to undergo a stereochemical change, and finally to split up into fumaric acid and hydrochloric acid. Many other transformations of a like nature are explained by Wislicenus in a similar manner, but his hypothesis has been called into question by Anschütz and Fittig on the grounds that in several cases the hypothetical intermediate products are quite stable under the conditions of the experiment.

The author finds that the conversion of maleïc into fumaric acid is brought about by acids, such as sulphuric, nitric, and oxalic acid, which could hardly form addition products, and also, at a certain temperature, by water under pressure. His experiments show that Wislicenus' hypothesis is certainly not tenable in its present form, although it is true that addition products play an important part in the conversion of maleïc into fumaric acid.—F. S. K.

Gentisin. S. v. Kostanecki. Monatsh. Chem. 1891, **12**, 205—210.

See under IV., *page* 915.

On Gentisin. St. v. Kostanecki and E. Schmidt. Monatsh. Chem. 1891, **12**, 318—322.

See under IV., *page* 915.

Action of Hydriodic Acid on Quinine; Isoquinine. E. Lippmann and F. Fleissner. Monatsh. Chem. 1891, **12**, 327—337.

It has been suggested by Skraup that, in the compounds formed by the combination of cinchonine with three molecules of hydrochloric acid and hydrobromic acid respectively, two of the molecules of the acid are combined in the ordinary way, the remaining molecule forming a true addition product with the cinchonine, one of the double bindings being transformed into a single one. According to the investigations of Koenigs and Comstock quinine behaves in a similar manner, and in the case of the compounds—

$$C_{20}H_{24}N_2O_2,\ 3\ HBr,\ \text{and}\ C_{20}H_{24}N_2O_2,\ 3\ HCl$$

it may be assumed that one molecule of the acid combines with the base to form a true addition product.

Now, since the quinine molecule is supposed to consist of the two atomic complexes $CH_3O.C_9H_6N$ and $C_{10}H_{15}NO$, and since, further, quinoline and its derivatives do not combine directly with halogen acids, it would seem that the molecule of the acid is added to the complex $C_{10}H_{15}NO$. This view is rendered more probable by the fact that partially reduced phthalic acids combine directly with bromine, as has been proved by Baeyer. The following experiments show that the molecule of hydriodic acid, which is assumed to be added to the quinine molecule, is readily eliminated by the aid of alcoholic potash.

Hydriodoquinine, hydriodide. $C_{20}H_{24}N_2O_2,\ 3\ HI$ is deposited in yellow prisms when quinine or its hydrochloride is warmed with concentrated hydriodic acid on the water-bath for 1 to 2 hours; it is separated from the cold solution by filtration, washed with hydriodic acid and alcohol successively, and then extracted with boiling alcohol. It begins to decompose at 215°, melts at 230°, and is only sparingly soluble in cold water and alcohol.

Hydriodoquinine $C_{20}H_{24}N_2O_2,\ HI$, is obtained when the preceding compound is triturated with dilute ammonia and the mixture extracted with ether; it crystallises from a mixture of benzene and light petroleum in slender needles, softens at 95°, and decomposes at a higher temperature; when heated with silver nitrate it is completely decomposed with separation of silver iodide. The *platino-chloride*, $C_{20}H_{24}N_2O_2,\ HI,\ H_2PtCl_6 + 2\ H_2O$ forms small brown crystals.

Hydriodoapoquinine hydriodide, $C_{19}H_{22}N_2O_2,\ 3\ HI$, prepared by heating hydriodoquinine hydriodide with concentrated hydriodic acid at 100° under pressure, separates from alcohol in yellow, ill-defined crystals, and melts at 237° with decomposition; when treated with ammonia it is converted into *hydriodoapoquinine*, $C_{19}H_{22}N_2O_2,\ HI$, a crystalline compound, the *platino-chloride* of which has the composition $C_{19}H_{22}N_2O_2,\ HI,\ H_2PtCl_6 + H_2O$.

Isoapoquinine, $C_{19}H_{22}N_2O_2$, can be obtained by heating hydriodoapoquinine with alcoholic potash; it melts at 176°, whereas Hesse's apoquinine decomposes at 160°, but, like

the latter, it is readily soluble in dilute alkalis. The *platino-chloride*, $C_{19}H_{22}N_2O_2$, $H_2PtCl_6 + H_2O$, is a crystalline compound, sparingly soluble in water.

When hydriodoquinine or its hydriodide is boiled for some hours with alcoholic potash, it is completely converted into a base, isomeric with quinine, which the authors name *isoquinine*. This compound has properties quite different from those of Hesse's conchinine and quinicine; it is very readily soluble in alcohol and benzene, but only sparingly in boiling water and hot dry ether; it gives the same reaction with chlorine water and ammonia as quinine and its solutions in dilute sulphuric acid and nitric acid show a blue fluorescence, which disappears on the addition of hydrochloric acid or chlorine compounds. It melts at 186°, and its specific rotatory power in 97 (volume) per cent. alcoholic solution is $[\alpha]_D = -180{\cdot}8$ at 27° ($C = 0{\cdot}9644$), but this value decreases with increasing concentration; isoquinine, and its salts, have an intensely bitter taste. The *hydrate*, $C_{20}H_{24}N_2O_2 + 2\,H_2O$, is obtained in small needles, when a solution of the hydrochloride is decomposed with ammonia, the solution extracted with ether, and the extract slowly evaporated at the ordinary temperature. The *sulphate*, $(C_{20}H_{24}N_2O_2)_2$, $H_2SO_4 + 10\,H_2O$, crystallises in needles, and is very readily soluble in water. The *neutral hydrochloride*, $C_{20}H_{24}N_2O_2$, $HCl + 2\,H_2O$, crystallises in needles, and is readily soluble in water, but the *acid hydrochloride*, $C_{20}H_{24}N_2O_2$, 2 HCl, is more sparingly soluble. The *platino-chloride*, $C_{20}H_{24}N_2O_2$, H_2PtCl_6, is a yellow crystalline compound. When isoquinine is treated with silver nitrate in alcoholic solution (see next column) a compound of the composition $C_{20}H_{24}N_2O_2$, $AgNO_3$, is precipitated.

—F. S. K.

Bergapten. C. Pomeranz. Monatsh. Chem. 1891, **12**, 379—392.

The ethereal oil of the fruit-peel of *Citrus Bergamia aurantica*, which is extensively used in the making of perfumes, deposits on standing a yellowish crystalline substance, the stearopten of oil of bergamot, which has been long known under the name of bergapten or bergamot camphor, and has been the subject of various earlier investigations.

The author has carefully examined a sample of bergapten obtained from Schimmel and Co., and purified by sublimation and by crystallisation from alcohol. The pure substance melts and sublimes at 188°, crystallises in colourless, lustrous needles, and is only very sparingly soluble in boiling water, but readily in hot alcohol, glacial acetic acid, &c. Analyses, and a molecular weight determination in phenol solution, gave results agreeing with those required by a compound of the molecular formula $C_{12}H_8O_4$.

When bergapten is boiled with methyl iodide and methyl alcoholic potash for about five hours, two compounds are formed, one of which is insoluble, the other soluble in water. The former separates from alcohol in microscopic prisms, melts at 52°, and has the composition $C_{13}H_{10}O_5$; the latter is the potassium salt of an acid which the author names *methylbergaptenic acid*. This acid crystallises from dilute alcohol in rhombic plates, melts at 138°, and has the composition $C_{13}H_{12}O_5$; the compound melting at 52° is the methyl salt of this acid.

Ethylbergaptenic acid, $C_{14}H_{14}O_5$, can be prepared in a similar manner; it crystallises in prisms or needles, and melts at 142°.

When bergapten is fused with potash it yields phloroglucinol, and when treated with bromine it is converted into a crystalline, unstable compound which seems to have the composition $C_{12}H_7O_4Br_3$. On treating methylbergaptenic acid with sodium amalgam it yields a crystalline acid which melts at 122° and has the composition $C_{13}H_{12}O_5$.

The constitution of bergapten is not definitely established by these experiments, but it is hoped that further investigation will settle the question.—F. S. K.

Action of Hydriodic Acid on the Cinchona Alkaloids. Z. H. Skraup. Monatsh. Chem. 1891, **12** 431—434.

The prospective publication of Lippmann and Fleissner's paper (see preceding page) on the action of hydriodic acid on quinine has led the author to give a brief account of the results which he and his pupils have already obtained in their investigation of the behaviour of the cinchona alkaloids and their derivatives with hydriodic acid.

Quinine, quinidine, cinchonidine, and cinchonine combine with 3 mols. of hydriodic acid forming yellow or orange-red compounds; under certain conditions a methyl group is eliminated from the quinine and quinidine molecules, and there are formed compounds of the composition—

$$C_{19}H_{22}N_2O_2,\ HI,$$

which are soluble in potash.

The salts of the composition, $C_{20}H_{24}N_2O_2$, 3 HI, and $C_{19}H_{22}N_2O$, 3 HI, obtained from quinine and cinchonidine, are converted into bases of the composition $C_{20}H_{23}N_2O_2I$ and $C_{19}H_{21}N_2OI$ respectively, on treatment with warm alkalis, 2 mols. of hydriodic acid being eliminated in each case; the isomeric salts obtained from quinidine and cinchonine are converted into bases of the composition $C_{20}H_{23}N_2O_2I_2$ and $C_{19}H_{21}N_2OI_2$ respectively, on treating them with excess of alkali, 1 mol. of hydriodic acid being eliminated. The salts of the composition, $C_{19}H_{22}N_2O_2$, 3 HI, obtained from quinine and chinidine (see above) show an analogous behaviour; that obtained from quinine loses 2 mols. of hydriodic acid on treatment with potash, whereas only 1 mol. of the acid is eliminated from the quinidine salt.

Several other facts are briefly stated, the full account of the experiments being reserved for a future paper.—F. S. K.

A New Laboratory Process for Preparing Hydrobromic Acid. G. S. Newth. Chem News, October 30, 1891, 215.

This method is a synthetical one, and consists in passing a stream of hydrogen and bromine vapour over a spiral of platinum wire heated to bright redness by means of an electric current. A glass tube, about 7 inches long and five-eighths inch bore, is fitted at each end with a cork carrying a short straight piece of small tube; through each cork is also fixed a stout wire, and these two wires are joined by means of a short spiral of platinum wire, the spiral being about 1 in. long. One end of this apparatus is connected to a small wash-bottle containing bromine, through which a stream of hydrogen can be bubbled. The other end is attached to a tube dipping into a vessel of water for the absorption of the gas, or, if a large quantity of the solution is required, to a series of Woulf's bottles containing water. Hydrogen is first slowly passed through the tube until the air is displaced, when the platinum spiral is heated to bright redness by the passage of a suitable electric current. Complete combination takes place in contact with the hot wire, and the colour imparted to the in-going gases by the bromine vapour is entirely removed, and the contents of the tube beyond the platinum are perfectly colourless. The vessel containing the bromine may be heated to a temperature of about 60° C. in a water-bath, at which temperature the hydrogen will be mixed with nearly the requisite amount of bromine to combine with the whole of it. So long as even a slight excess of hydrogen is passing, which is readily seen by the escape of bubbles through the water in the absorbing vessels, the issuing hydrobromic acid will remain perfectly colourless, and therefore free from bromine; so that it is not necessary to adopt any of the usual methods for scrubbing the gas through vessels containing phosphorus. When the operation is proceeding very rapidly a lambent flame occasionally appears in the tube just before the platinum wire, but this flame is never propagated back through the narrow tube into the bromine bottle. The precaution may be taken, however, of plugging this narrow tube with a little glass wool, which renders any inconvenience from this cause quite impossible. By this method a large quantity of

bromine may be rapidly converted into hydrobromic acid without any loss of bromine, and the operation when once started can be allowed to proceed without any further attention.

PATENTS.

Improvements in Obtaining or Separating Oxygen from Atmospherie Air. J. H. Parkinson, Manchester. Eng. Pat. 14,925, September 22, 1890. 8*d*.

Permanganates give off oxygen when heated in vacuo, and the residue absorbs oxygen by treatment with air under pressure. The reacting material may consist of permanganate or manganate of potash or soda, preferably baked with kaolin (see following abstract), or a combination of lower manganese oxides and free alkali mixed with clay, or else pumice stone, "saturated with a solution of permanganate or with the lower oxides of manganese,"—the purport of all of which mixtures being to reduce the permanganate to a porous spongy condition. This permanganate is charged in retorts and kept at a temperature of, say, 550° C., whilst a vacuum pump draws off the oxygen and conveys it to a gas-holder. Superheated air, previously purified with caustic soda or lime, is now forced into the retort, and coming in contact with the residue consisting of "the lower oxides of manganese and probably free alkali," gives up its oxygen, whilst the nitrogen escapes into the atmosphere. The retorts are worked in series; a description of the apparatus is given, accompanied by five drawings; the details of the apparatus are fully described in Eng. Pat. 9457, 1891 (not yet published).—H. A.

Improved Process of Treating Permanganate of Potash to Produce a Spongy Porous Mass. J. H. Parkinson, Manchester. Eng. Pat. 14,931, September 22, 1890. 8*d*.

For the successful production of oxygen (see previous extract) it is necessary that the permanganate should be in a finely-divided condition. This is best attained by grinding together permanganate or manganate of potash or soda with, say, 15 per cent. of kaolin, mixing the mass with water into a stiff paste, in which state it is moulded into bricks. The slabs are placed on shelves within a vessel provided with a tightly-fitting lid and provided with a connection to a vacuum pump. The operation is assisted by saturating the atmosphere of the vessel with aqueous vapour, for which purpose three-quarters of an inch of water is placed on the bottom of the vessel, which is thereupon exhausted of air and gently heated, commencing at 15°—20° C., till all the water has evaporated. Under the combined action of the vacuum, and of a steadily increasing heat (up to 100° C.), the mass will bake in 3—4 hours time into a hard and porous mass.

At one part of this drying and baking operation "the communication with the vacuum pump is closed and the heat gradually applied until a pressure somewhat above that of the atmosphere is produced in the retort, by which time the water placed in the retort and the moisture of the mixture is converted into vapour."

At the end of the operation some oxygen is given off. Two sheets of drawings accompany the specification.—H. A.

Improvements in the Filling of Cylinders or other Receivers with Oxygen, Hydrogen, Coal, Oil, and other Gases or Mixtures of Gases under Pressure. J. H. Parkinson, Manchester. Eng. Pat. 18,445, November 15, 1890. 8*d*.

See under I., *page* 908.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

PATENT.

Improvements in or Relating to Photo-Mechanical Colour Printing. F. J. Upton, London, and G. Stephens, Walthamstow. Eng. Pat. 1793, January 31, 1891. 6*d*.

A photographic negative of the object to be represented is taken and developed in the usual manner. From this negative, which is of any required size, several positives are printed upon paper sensitised in different manners according to the number of colours in the object photographed; thus, a positive intended to receive the yellow shades alone of the original object is coated with potassium dichromate (15 parts), silver nitrate (5), "muriates of iron or protochloride" (5), gelatine (30), and water (45); for the red shades, with potassium dichromate (20 parts), silver nitrate (15), gelatine (20), and water (45), after floating the paper in a 10 per cent. solution of chrome alum and drying it; for the blue shades solely, with potassium dichromate (20 parts), "muriates of iron or protochloride" (10), gelatine (10), and water (60), after floating in a chrome alum solution (10 per cent.) and drying; for the black, brown, and grey shades, with gelatine (10 parts), potassium dichromate (10), and water (80) (in printing for these shades, the time of exposure varies inversely with the intensity of shade required, the positive for black being, thus, exposed for the shortest time of the three); and for "any slight tints of colour, having no body" the paper is lightly coated with a solution of gelatine (5 parts), potassium dichromate (5), alcohol (2), and water (88). The printed positives are covered with a mixture of "re-transfer ink" and palm oil, washed with water to remove the surplus ink, partially dried, and transferred to lithographic stones. The resultant impressions from these various stones upon paper, each having its requisite form, position, and colour, produce a perfect picture of the object photographed.—E. B.

XXII.—EXPLOSIVES, MATCHES, Etc.

Chemical Theory of Gunpowder. H. Debus. Annalen, 1891, **265**, 257—315.

The author discusses briefly the earlier views which were entertained in regard to the products of the explosive decomposition of gunpowder, and refers to a former paper of his (Annalen, **212**, 295—298) for a fuller statement of his views on this part of the subject. He notes how Noble and Abel confirmed the conclusions of Karolyi that the quality of the products of decomposition when the powder is fired in a closed vessel is only dependent on the composition of the powder and not on the pressure developed. The quantities of the products, however, as found in different experiments and by different observers, vary greatly, but the author points out several circumstances which would account for these discrepancies, and states that both the quality and quantity of the products of decomposition depend solely on the composition of the powder. As the composition of powders is very varied, so must also be that of the products of their decomposition, and the author proceeds to develop a general equation which can be adapted to each special case, and by means of which the quantities of the different products of decomposition, the amount of heat and gas produced, and also the relative energy can be calculated, and shows that theory and facts agree, and that it is possible to determine by purely theoretical means the composition of a powder which is required to fulfil specific conditions. He assumes that the combustion is complete, and that the powder is composed only of saltpetre, sulphur, and pure carbon, the other constituents of the carbon being neglected. He also takes

the potassium sulphide formed to be K_2S_x. The quantity of carbonic oxide formed must be determined by experiment, and this be represented by n then the general equation for the decomposition is as follows:—

$$x(KNO_3) + yC + zS =$$
$$-\tfrac{1}{2}y\,[4x + 2y - 3z - 4n]\,K_2CO_3$$
$$+\tfrac{1}{2}y\,[2x - 2y - 3z + 4n]\,K_2SO_4$$
$$+\tfrac{1}{2}[-4x + 2y + 3z]\,K_2S_x$$
$$+[2x - 4y + 3z]\,CO_2$$
$$+[y - 4n]\,CO$$
$$+[x]\,N_2$$

The author gives an example of the calculation of the relative potential energy of a powder by means of this formula, and as its further suggestion to take the product of the volume of gas evolved and the number of calories given off as a measure of the potential energy and then indicates the general principles that in every kind of powder the quantity of gas increases and the quantity of heat decreases with the nitre and sulphur. Next follows a comparison of theory with the results obtained by Noble and Abel and Rodman (Journ. Jahresberichte, 1879—1880), when it is seen that although the latter experimenters found in all cases more gas and calories than the former, the order in which the relative potential energy of the powders follows is the same according to both observers, and agrees with theory. The author then goes on to describe a graphic representation of the quantities of saltpetre, sulphur, and carbon, which are converted into potassium carbonate, sulphate, sulphide, carbonic acid, and nitrogen, but the original article, as well as another (Annalen, 213, 4) must be consulted for explanations of the author's views and method of calculation. He shows that "when the amount of saltpetre and sulphur is constant the energy increases with the carbon, and when the saltpetre and carbon are constant it increases as the quantity of sulphur increases." As an evidence of the insufficiency of the purely empirical methods which have been hitherto employed to determine the composition of gunpowder, he points to the great variations in the powders which have been used from time to time in different countries and in different works. In Prussia military powder had the following composition in the undermentioned years:—

Year	Saltpetre	Charcoal	Sulphur
1776	74·4	13·3	12·3
1858	75	15	10
1865	75	12·5	12·5
1871	75	13·5	11·5

The composition of the powder of the principal countries of the world may be referred to the three following types:—

	I	II	III
Saltpetre	74·4	75·0	75·0
Charcoal	13·3	12·5	13·5
Sulphur	12·3	12·5	11·5

The author states that the same number as the highest on a match carries the greatest weight of gunpowder for the burning sulphur heats the saltpetre and charcoal to the temperature of reaction. A mixture of saltpetre and charcoal is less easily ignited than one containing sulphur in addition and he concludes that a certain proportion of sulphur is necessary. In reference to such a powder it is shown that theory and practice agree, and this agrees with experience.—W. M.

Explosions of Powder, Dynamite, &c. Chem. Ind. 1891, 14, 279—283.

Commenting on an explosion which took place at a powder mill, attention is called to the necessity of carefully and at once removing powder-dust whenever it is formed, or thoroughly sprinkling the place with water.

Few explosions are reported in dynamite works, and this favourable state of affairs is attributed to the improved method of working and the more perfect construction of the cartridge machines. A most important point in these machines is to have the rammer working true in the charging cylinder.

An accident having occurred through the explosion of some frozen nitroglycerin lying in a gutter which was being scraped by an iron rake, it is recommended that all such gutters and conduits should be thoroughly washed out with warm water (about 30° C.).

Some accidents occurred in picric acid factories. In this connection it is pointed out that picric acid by itself is not dangerous, and cannot be exploded by blows, but in the form of a picrate is very dangerous. Picric acid melts at 117°, and in this state readily combines with any lime-dust, or iron oxide from rusty nails. Hence it is necessary to take special care in the construction of the drying rooms, the walls must not be whitened with lime, the acid should be dried on glass plates in wooden frames, but the latter must not be fastened with nails.

A few trivial accidents are reported from the inflammation of gun-cotton.

The manufacture of mercury fulminate and detonators gave rise to the greatest number of accidents. The old practice of using a wooden "charging spoon" is condemned and the advantages of employing one of ebonite advocated. As the latter does not shrink or warp, the holes for the copper cap and detonator cases can be bored the correct size, and thus avoid the loitment of the fulminate round the cases, which often give rise to accidents when they are removed from the spoon.

The practice of destroying fulminate residues by burning is condemned, and the method of decomposing by means of hydrochloric acid recommended. The view that fulminate is rendered harmless by treatment with caustic soda or lime and addition of sodium sulphide is unreliable, as explosive double salts are often formed. When zinc or tin is used to precipitate the mercury, the fulminic acid goes over to the other metal. The disadvantage of the hydrochloric acid method is the evolution of hydrocyanic acid which takes place; this, however, can be remedied by efficient ventilation of the room in which the decomposition is effected.

It is further recommended that the nitrous vapours which are given off when the mercury is dissolved in nitric acid, as well as those evolved from the action of the mercury nitrate on the alcohol, should be condensed as far as possible, and the permanent gases led into a high chimney. Precautions should also be taken against mercury poisoning among the workpeople.—W. M.

PATENTS.

Improvements in the Manufacture of Explosives for Industrial and Projectile Purposes. A. J. Campion, Margate, and J. E. Tennison-Woods, London. Eng. Pat. 13,726, October 4, 1890. 6*d*.

This invention consists, first, in the manufacture of ammonium nitrate for explosive purposes by a new process, and, second, its formation into an explosive by admixture with certain solid hydrocarbons, such as ozokerite or paraffin wax, and, in some cases, sulphur and charcoal are also added.

The ammonium nitrate is thus rendered non-hygroscopic. The salt is prepared, according to the first process, by adding ammonium chloride to sodium nitrate in solution, double decomposition takes place, and the salts are separated by crystallisation. In the second method, sodium nitrate is added to calcium chloride, double decomposition ensues, and the salts are separated by crystallisation. To the calcium nitrate thus obtained ammonium sulphate or

carbonate is added, and the ammonium nitrate is separated from the precipitated calcium salt and obtained by evaporation from its solution.—W. M.

Improvements in Explosives. G. Trench, Faversham. Eng. Pat. 18,472, November 15, 1890. 4*d*.

This specification describes an explosive containing, say, dinitrobenzene 1 part, nitrocellulose 1 part, barium and potassium nitrates 6 parts, nitroglycerin 2 parts.

The presence of the nitroglycerin renders the substance plastic, an advantage not possessed by the explosive described in the inventor's previous patent, 18,241 of 1889 (this Journal, 1890, 1010).—W. M.

XXIII.—ANALYTICAL CHEMISTRY.

APPARATUS.

The Measurement of the Concentration of Solutions by Means of Refractive Index. H. O. G. Ellinger. Jour. prakt. Chem. 1891, **44**, 152—157.

When a substance is dissolved in a liquid, the index of refraction of the latter is changed, and the change becomes greater as the concentration increases. Very exact measurements of the degree of concentration of a solution can be carried out by making use of this fact. The "oleorefractometer" introduced by Amagat and Jean is specially adapted for such determinations. It ought to be called a "difference refractometer," since it is capable of wider use than its original name indicates. The apparatus is arranged as follows:—The collimator and telescope are placed in a fixed position, so that their axes are in line. The light after leaving the collimator passes through a layer of liquid contained in a trough bounded by two parallel glass plates, and from this into the telescope; but within the layer of liquid mentioned there is a hollow prism formed by two plane-parallel glass plates, into which another liquid can be introduced. Instead of a slit the collimator has a vertical knife edge, moveable by means of a micrometer screw. In the telescope there is a transparent plate, on which is a finely-divided scale of 100 divisions. The following is the method of finding the amount of a given substance in solution in water:—

Distilled water is first poured into the trough and prism, and a candle-flame is placed in front of the knife edge of the collimator. The field of the telescope now exhibits a bright and a dark part separated by a sharp division line. By means of the micrometer screw this line is made to fall on the null part of the scale in the field of view of the telescope. If the water in the prism is now replaced by a solution of any substance, the position of the division line is shifted, and since the refracting angle of the prism is to the left of the observer looking through the telescope, the line will shift to the right if the solution has a higher refractive index than water. In the case of common salt, if 1 per cent. shifts the division line through $7\frac{1}{2}$ divisions, 2 per cent. through 15, and 5 per cent. through 38, these numbers show the method is delicate, and that the readings are fairly proportional to the concentration. Solutions which are so concentrated that they give readings beyond the range of the apparatus (*e.g.*, common salt solutions beyond 8 per cent.) can be measured after diluting them with known proportions of water. For each substance a number can be determined which the author calls its "*promillefactor*;" this is the number by which the telescope reading must be multiplied in order to give the amount of the substance dissolved in 1,000 of water.

The method is rapid and easy, and can be applied to solutions in quantities as small as 2 cc. The following serves as an example and test of its use:—

A solution of sugar was made up, and contained 7·7 per cent. of sugar. This was tested (1) as prepared; (2) diluted with an equal weight of water; (3) twice the weight of water; (4) three times the weight of water. The corresponding readings were 49, 24, 16, 12. Since the promillefactor of sugar is 1·6, these readings give 78·4, 38·4, 25·6, and 19·2 parts of sugar per 1,000; and indicate the strength of the original solution as 7·84, 7·68, 7·68, 7·68 per cent. respectively.

The addition of spirits of wine to water causes an increase in its refractive index, but this increase is not so rapid nor so regular as when a salt is dissolved. Thus the constant promillefactor would give incorrect results, and it is necessary to construct a curve or table, and work from this by interpolation. In the following table the first column gives percentages of spirits of wine by volume, and the second column the corresponding readings of the instrument:—

Percentage.	Reading.	Percentage.	Reading.
1	2	12	$27\frac{1}{4}$
2	4	14	$32\frac{1}{4}$
4	$8\frac{1}{4}$	16	38
6	13	18	$43\frac{1}{4}$
8	18	20	$48\frac{1}{4}$
10	$23\frac{1}{4}$		

The following are values of promillefactors for various substances (the water of crystallisation being reckoned in with the weight of the substance):—Sodium chloride, 1·33; potassium chloride, 1·7; ammonium chloride, 1·2; potassium carbonate, 1·45; potassium hydrocarbonate, 2·08; sodium carbonate, 1·11; sugar, dextrin, and gum, 1·6.

—D. E. J.

Burette Float for Opaque Liquids. H. Rey. Ber. 1891, **24**, 2098.

The float described has two bulbs; the upper one, upon which is marked the line for reading, is smaller than the lower one, so as to prevent its touching the sides of the burette. The float is weighted so that the upper bulb is completely above the liquid, and therefore readings can be made with it irrespective of the character of the liquid in the burette.—D. A. L.

INORGANIC CHEMISTRY.—QUALITATIVE.

Preparation of Ammonium Sulphide. E. Donath. Chem. Zeit. 1891, **15**, 1021.

Instead of the usual method of preparing ammonium sulphide, by saturating ammonia solution with sulphuretted hydrogen gas, which is troublesome and unpleasant, the author distils a mixture of ammonium chloride and solution of sodium sulphide. The sal-ammoniac, in the form of powder, is mixed with twice its weight of sodium sulphide dissolved in hot water (1 part of sodium sulphide to $2\frac{1}{2}$ parts of water), and the mixture is distilled until half the liquid has passed over. The yellow solution, so prepared, is very concentrated, and has all the properties of the ordinary reagent.—H. K. T.

The Detection of Arsenic in Metallic Iron. O. Sautermeister. Chem. Zeit. 1891, **15**, 1021—1022.

In the German dispensatory it is directed that powdered and reduced iron shall be tested for arsenic by adding hydrochloric acid, and allowing the gas evolved, after ignition, to impinge on a porcelain dish, as in Marsh's test. The author, when testing iron in this way, added some arsenic solution in order to test the accuracy of the process, and was astonished to find that no arseniuretted hydrogen was evolved. As much as 0·1 grm. of arsenious

anhydride could be added to 1 grm. of iron without any evolution of arseniuretted hydrogen taking place. On examining the residue left after the solution of the iron, the arsenic was found as a black mass, and had evidently been reduced to the metallic state by the nascent hydrogen, as ferrous chloride does not reduce arsenious anhydride. After much searching, the author has found that this action of iron on arsenic solutions is mentioned in an article by Wöhler in the Annalen der Pharm. of 1839. If excess of zinc be added to the iron, arseniuretted hydrogen is easily obtained when arsenic is present. The author hoped that this behaviour of arsenic in the presence of iron might allow of its separation from antimony, but on trial the latter element was found to behave in the same way as arsenic (a similar behaviour in the case of phosphorus has been proved by J. B. Mackintosh; this Journal, 1886, 106). In conclusion, when testing iron for arsenic, the residue left on solution of the metal in hydrochloric acid should always be examined.—H. K. T.

On the Detection of Arsenic. J. Thiela. Annalen, 1891, 265, 55—66.

1. *Hypophosphorous Acid as a Reagent for Arsenic.*—It is already known that arsenic is deposited in the metallic state from solution on boiling with hypophosphorous acid. The author finds that when a solution in hydrochloric acid is used the reduction takes place without boiling, and does not require a very concentrated solution of hypophosphorous acid: the method is therefore a convenient one for detecting arsenic in presence of antimony and tin. The solution to be tested may contain the arsenic as arsenious or arsenic acid: it is made strongly acid with hydrochloric acid, and commercial hypophosphorous acid is added in the proportion of 1 grm. to every 10 cc. of solution. It is best to warm the solution by placing it in a test-tube and dipping this into boiling water: the arsenic is soon precipitated as a dark-brown powder. If the solution is more dilute it may require warming for 30 minutes. When the amount of arsenic present is very small no precipitate is thrown down, but the solution turns brown in colour. In sulphuric acid solution, in absence of halogens, there is only a partial reduction, or sometimes none at all. It therefore appears that the process must be regarded as a reduction of a chloride, and not an oxide, of arsenic. In view of the fact that arsenic has a smaller affinity for iodine, it appeared likely that the iodide would be even more readily reduced. Experiment showed that the addition of potassium iodide did considerably increase the delicacy of the reaction.

With the exception of the noble metals (which are also reduced by hypophosphorous acid), copper is the only substance which is likely to lead to error: for even in dilute solution it is reduced just like arsenic. Antimony and bismuth are only reduced in concentrated solutions, and are further distinguishable by the black colour of the precipitates which they give. If the colour indicates the presence of either of these metals, the precipitate is brought into a small filter, and, without washing (for this might allow of oxidation of the arsenic) is dissolved in a few drops of a solution of bromine in hydrochloric acid. This solution will contain nearly all the arsenic and very little of the other metals, so that a repetition of the test should give a precipitate having the characteristic arsenic colour. The method cannot be used for the quantitative separation of arsenic from antimony and tin, because the precipitate oxidises very readily, and therefore cannot be washed.

2. *On the Use of Marsh's Apparatus to detect Arsenic in presence of Antimony.*—Solutions of antimony in presence of iron and hydrochloric acid do not evolve any antimoniuretted hydrogen. Since compounds of arsenic do evolve arseniuretted hydrogen under the same conditions, it appeared probable that this difference in behaviour might provide a means of detecting the one in presence of the other. Unfortunately, all commercial iron (even *ferrum reductum*) contains sulphur. This gives rise to an evolution of sulphuretted hydrogen which completely masks the arsenic test. The author met with unexpected difficulties in obtaining iron free from sulphur, but finally succeeded in preparing it by electrolysis of iron chloride. The metal so prepared oxidises readily, and must be immediately rinsed with water, alcohol, and ether, and dried in a desiccator in vacuo. It dissolves readily in dilute acids, and when so treated in Marsh's apparatus, it gives no trace of a mirror, even when considerable quantities of antimony chloride are introduced. On the addition of arsenious or arsenic acid there is an immediate evolution of arseniuretted hydrogen. (See also previous abstract.)

3. *On the Use of Platinised Zinc in Marsh's Apparatus.*—In testing reagents for arsenic, the author generally followed the common practice of adding a few drops of platinum chloride to accelerate the solution of the tin until he found that this led to errors and diminished the delicacy of the reaction. This probably arises through the formation of a compound of arsenic and platinum. It was frequently found that hydrochloric acid, sold as "free from arsenic," appeared to be really so when tested with platinised zinc; whereas, in the absence of platinum, it produced undoubted arsenic mirrors.

4. *On the Precipitation of Arsenic Acid with Sulphuretted Hydrogen.*—The author corroborates the results arrived at by other chemists respecting this reaction. From warm acid solutions the arsenic is precipitated by a *rapid* stream of gas as pentasulphide, whereas a *slow* current of gas throws down a mixture of pentasulphide and trisulphide. On the other hand, when a rapid stream of sulphuretted hydrogen is passed through a cold solution of arsenic acid in hydrochloric acid, a bright yellow precipitate is obtained which does not consist of pure pentasulphide, but is a mixture of the trisulphide with sulphur.—D. E. J.

INORGANIC CHEMISTRY.—QUANTITATIVE.

Note on the Precipitation of Phosphorus from Solutions of Iron and Steel. R. Hamilton.

See pages 904—906.

On the Analysis of Commercial Aluminium and its Alloys. F. Regelsberger. Zeits. f. Angew. Chem. 1891, 360—363.

The external characteristics and behaviour, on casting, of commercial aluminium of various grades of purity are first given: then follow rapid methods for the determination of the usual impurities. The commonest of these are silicon and iron, then follow copper, lead, calcium, sodium, sulphur, and carbon. Of the impurities iron and silicon, the former is the most prejudicial. If these two impurities alone be present, and if the silicon exceed the iron in quantity, the metal may be taken as suitable for technical purposes requiring tensile strength and malleability if it contain 98 per cent. of aluminium. For a general examination of aluminium the metal is dissolved in potassium hydrate. Iron, copper, and some other metals remain undissolved, and silicon goes into solution. The residue is dissolved in sulphuric acid, the copper is precipitated by sulphuretted hydrogen or electrolytically, and the iron titrated. The alkaline solution, containing the silicon, is neutralised with hydrochloric acid, evaporated to dryness, the residue treated with water and hydrochloric acid, filtered off, ignited and weighed. It is then treated with sulphuric and hydrofluoric acids, and any aluminium dissolved out is determined in the usual way. The difference gives the silicon as silicic anhydride.

When the metal is dissolved in hydrochloric acid there is a slight loss of silicon as silicon hydride, but this solvent can be used when determining iron and aluminium. For this purpose the solution is evaporated to dryness with nitric acid or potassium chlorate, and the residue redissolved in hydrochloric acid and divided into two portions. In one of these the iron is titrated by means of stannous chloride; in the other the aluminium is separated by means of potassium hydrate, and estimated in the usual way. For exact determinations the following methods are expeditious:—

Silicon.—2 to 4 grms. of the metal, according to the quality, is dissolved in a platinum dish in six times its

weight of potassium hydrate and 50 cc. of water. The dish is covered during the first violent reaction. Afterwards the liquid is warmed until solution is complete, neutralised, and evaporated to dryness with continual stirring. The ignited and weighed silicon is to be tested with hydrofluoric acid, as above.

Iron.—3 grms. of the metal are dissolved in 50 cc. of 40 per cent. potassium hydrate in a 500 cc. flask. Then 200 cc. of dilute sulphuric acid of 1·16 sp. gr. are added, with continued shaking, and the liquid warmed until clear. After slight cooling, the iron, which is in the ferrous state, can be titrated with potassic permanganate.

Aluminium.—2 grms. of metal are dissolved in 12 grms. of potassium hydrate and sufficient water, and the solution is diluted to 200 cc. 50 cc. of the clear liquid are taken and boiled with 20 grms. of ammonium nitrate. The precipitate of aluminium hydrate is filtered by means of the filter-pump, and washed, ignited and weighed. It is then powdered and again ignited. Aliquot parts are then taken: one is boiled with water, and any alkali present estimated; the other is fused with potassium bisulphate, dissolved out in water, and any separated silica filtered off and weighed. The alkali and silica are to be deducted from the original weight of the precipitate.

The above estimation of aluminium requires time, and the author has endeavoured to find a volumetric method, but without success. Mercuric chloride is at first rapidly reduced by aluminium, but the action soon slackens, probably owing to a coating of alumina forming round the particles of metal. Methods depending on the measurement of the hydrogen evolved during solution are vitiated by the fact that the impurities, iron and silicon, also liberated hydrogen. Silicon may be rapidly estimated for technical purposes by solution of the metal in hydrochloric acid instead of potassium hydrate, the small loss of silicon as silicon hydride being neglected. For this purpose 3 to 5 grms. of the metal are dissolved in 80 to 100 cc. of hydrochloric acid of sp. gr. 1·08 in a tall, covered beaker, the solution is evaporated to dryness, and the residue washed and ignited. It is then fused with 2 to 5 grms. of mixed sodium and potassium carbonates, since it contains ferric oxide and free silicon as well as silica. The silica is then determined in the usual way in the fused mass. This method has been further simplified, as it has been found, in the course of many determinations, that the mixture of silicon, silica, and ferric oxide left on evaporating the hydrochloric acid solution has practically the same weight as the total silicon, hence the fusion with mixed carbonates may be omitted. Alloys in which aluminium forms the chief constituent, such as copper-nickel and silver-aluminium, can be analysed by the above methods. The latter, however, is preferably dissolved in aqua regia.

Silicon probably occurs in aluminium in two forms, since, when the metal is dissolved in hydrochloric acid, the residual silica always contains free silicon, no matter whether an oxidising agent has been used or not. The ratio of the combined to the free silicon can be determined by first weighing the precipitate ($Si + SiO_2 + Fe_2O_3$) left on solution of the metal in hydrochloric acid. The precipitate is then fused with mixed carbonates, and the total silica and iron determined. From these data the ratio of free to combined silicon can be calculated.—H. K. T.

Contribution to the Quantitative Estimation of Sulphur. F. P. Treadwell. Ber. 1891, **24**, 1937—1941.

Sulphides which are soluble in dilute acids are readily examined by determining the sulphuretted hydrogen volumetrically or, after oxidation, as barium sulphate. But the sulphur of insoluble sulphides must first be brought into a soluble form, and the author has devised the following method of doing this: A weighed portion of the sample in fine powder is added to 3 grms. of freshly reduced iron powder, contained in a small glass or porcelain boat placed in a combustion tube, through which a stream of carbonic acid is made to pass. The tube is heated to dull redness for 10 minutes, after which it is allowed to cool during the continued passing of the gas. The boat with its contents is then placed in a 400 cc. flask through which a stream of hydrogen is sent. Dilute hydrochloric acid contained in a stoppered funnel is then allowed to drop slowly into the flask, and the sulphuretted hydrogen is collected in two absorption tubes charged with ammoniacal hydrogen peroxide, or, in certain cases, *e.g.* when arsenic or antimony is present in the substance, an ammoniacal solution of silver nitrate should be used. The stream of hydrogen serves to sweep out the sulphuretted hydrogen from the flask into the absorption tubes, the contents of which are then boiled for a quarter of an hour to complete the oxidation, and the solution is acidified with hydrochloric acid and evaporated on a water-bath. This latter precaution is necessary in order to separate silicic acid. The residue is taken up with dilute hydrochloric acid, and precipitated with barium chloride. The iron powder used is the ordinary commercial "ferrum reductum," which must be heated to redness in a stream of hydrogen prior to use, and, as it always contains some sulphur, the amount of this must be determined by a blank experiment. Various determinations of sulphur in pyrites and galena by this method agree well with those made by standard methods.—G. H. B.

Decomposition of Chrome Iron Ore by the Electric Current. E. F. Smith. Ber. 1891, **24**, 2182—2185.

Thirty to forty grammes of caustic potash are heated to fusion in a metal crucible $1\frac{7}{8}$ in. high and 2 in. in diameter, and the heating continued until the excess of water has been removed. The crucible is then placed in a strong copper ring, which is connected with the anode of the battery employed. 0·1—0·5 grms. of the finely ground chrome iron ore (the ore need not be ground so fine as is necessary in the case of decomposition by fusion according to the ordinary methods) are transferred to the crucible, which is heated gently throughout the decomposition. The crucible is covered with a watch glass containing a hole in the centre, through which a platinum rod, connected with the cathode of the battery, passes. The current employed must not exceed one ampère, which suffices to effect complete decomposition of the ore in 30—40 minutes. Before breaking the current, it is desirable to reverse it for a short time, owing to the fact that some metallic iron is always separated on the cathode which encloses small particles of the undecomposed ore. This reversal, which renders this portion of the ore oxidisable, is readily effected by having a commutator and a Kohlrausch amperometer in circuit. When the electrolysis is complete, the contents of the crucible are digested with water, which dissolves out the excess of alkali, potassium aluminate, silicate, manganate and chromate. The insoluble portion consists essentially of oxide of iron, and should be completely soluble in warm hydrochloric acid; if there is any residue the ore has not been completely decomposed. The chromium can be determined in the aqueous extract, either gravimetrically or volumetrically, the latter method consisting in treating the solution with a known weight of ferrous ammonium sulphate, and titrating back the excess of the latter with potassium bichromate, a process which allows of the carrying out of the whole of the determination in the course of one hour. Several analytical results are given, which show variations of from 0·03—0·79 in the percentage of Cr_2O_3 found, the mean of the results agreeing well with those obtained by the ordinary fusion methods.—C. A.K.

A Source of Error in Determination of Nitrates in Water. G. H. Bartram. J. Franklin Inst. 1891, **131**, 385—386.

It is shown that in presence of relatively large quantities of chlorine, 20 per cent. of the nitrates, or, in extreme cases, even 40 per cent., may fail to be recorded by the use of the phenol sulphonic acid process unless the precaution be taken to use freshly prepared phenol sulphonic acid, or to remove the chlorine. Thus, water containing 20 parts of chlorine

to 0·5 parts of nitrogen gave the following decreasing quantities of nitrogen as the age of the solution increased:—

N found.	Age of Reagent.
0·5	Freshly prepared.
0·5	1 day old.
0·47	2 days old.
0·42	13 days old.
0·40	17 days old.
0·40	27 days old.

Correct figures were obtained, however, even when the phenol sulphonic acid had been kept for 18 months, providing that the chlorine did not much exceed the nitrogen of the nitrates.—T. L. B.

ORGANIC CHEMISTRY.—QUALITATIVE.

Optical Analysis of Butter and its Substitutes. H. O. G. Ellinger. Jour. Prakt. Chem. 1891, **44**, 157—159.

The authors have investigated the optical behaviour of butter and its substitutes by means of the oleorefractometer described on page 949. The experiments were carried out at a temperature of 15°, and for this purpose an outer trough containing warm water, and protected by felt, was employed. The inner trough was filled with a normal oil recommended by Amagat and Jean, and at first the prism was also filled with the same oil. On substituting the specimen of butter for the oil in the prism, the division line shifts to the left, showing that butter has a smaller index of refraction than the oil. After each experiment the prism must be emptied and cleaned out with alcohol and warm water, before a fresh specimen is introduced. The authors examined 510 samples of pure Danish butter, as well as commercial margarin. Before deciding whether the method could be used for detecting adulterations, it was necessary to find the extent to which the readings given by pure butter varied. These variations naturally depend upon the feeding-stuffs used, the nature of the neighbourhood, and the time of the year. With respect to the latter, the following may be taken as average readings made at the seasons mentioned:—

(a.) February, to June	30·5
(b.) September and October	27
(c.) November	30·5
(d.) December	33

From a further discussion of the separate measurements the author concludes that specimens of pure butter may give readings varying from 23 to 35.

The different kinds of margarin occurring in commerce contain different percentages of butter, and therefore give various readings. The specimen examined which contained least butter (given as ½ per cent.) gave a reading of 8. When pure butter corresponding to a high reading of 35 is mixed with equal parts of such margarin, the mixture gives a reading of 21½, which is lower than the lowest limit (23) given above for pure butter. Hence the method is capable of indicating adulteration with margarin to the extent of 15 per cent. and over.—D. L. J.

On the Methods of Examining Olive Oil for Earth-Nut Oil. Hobbe. Mitth. Konig. techn. Versuchs. Berlin, 1891, **9**, 105—107.

The author criticises the various methods, pointing out that the method of Marie by crystallising arachidic acid from a mixture of the acids dissolved in 90 per cent. alcohol is not reliable. He points out a method of Peters (a modification of the above), which is as follows:—A mixture of 2 cc. of the acids is cooled with 2 cc. of alcohol to 10°—11° C. for half an hour. If earth-nut oil is present, tiny clusters of crystals form on the sides of the tube, but if the olive oil is pure, no crystals separate: if now the alcohol be half evaporated away turbidity occurs at 18°—20° C. in case earth-nut oil is present. This modification of Peters's seems, however, not to give reliable results. In the Paris Laboratory, separation of potassium arachidate at low temperatures from the saponified oil is taken as indication of the presence of earth-nut oil; but this method also the author considers to be altogether uncertain in its action.

The best means of detecting the admixture he considers to be the adoption of Renard's method (Zeits. f. Anal. Chem. 1873, 231). 10 grms. of oil are saponified, the fatty acids are freed by means of hydrochloric acid, dissolved in 90 per cent. alcohol, and the lead salts precipitated with acetate of lead. The precipitate is extracted with ether, whereby the oleate is removed, the residue consisting then chiefly of lead palmitate and arachidate, which are now decomposed by hydrochloric acid. The fatty acids are dissolved in 50 cc. of warm 90 per cent. alcohol, and carefully crystallised. The arachidic acid separating is filtered off and washed with 70 per cent. alcohol. It is then dissolved off the filter by hot alcohol, and so brought into a tared dish from which the alcohol is evaporated; the acid may then be weighed. Note must be taken of the acid dissolved by the alcohol used for washing purposes. Total arachidic acid obtained should melt at 70°—71° C. (it contains some palmitic acid). So long as acid of this melting point separates from the alcoholic solution crystallisation must be continued.—T. L. B.

ORGANIC CHEMISTRY—QUANTITATIVE.

Volatile Organic Matter in Potable Water and a Simple Method of Estimating Dissolved Fixed and Volatile Organic Matter in Water. W. C. Young.

See pages 883—887.

The Eschka Method of determining Sulphur in Coal. J. Rothe. Mitth. König. techn. Versuchs. Berlin, 1891, **9**, 107—109.

In order to determine the completeness of the method of Eschka (see this Journal, 1889, 361), the results obtained with it are compared with results obtained by the combustion method of Sauer (this Journal, 1890, 330). The conclusion arrived at is that no loss of sulphur takes place, the results being quite equal to those obtained by Sauer's process, which is more inconvenient.

A proposal is made to use porcelain crucibles for the roasting, which may be accomplished in a muffle in half an hour. A number of roastings may be performed together in one muffle, and furthermore there is no liability to contamination with sulphur from the gas flame.—T. L. B.

The Separation of Resin from Fatty Acids. J. Arthur Wilson. Chem. News, Oct. 23, 1891, 201—205.

The detection of resin and its separation from fats and oils was at one time a very difficult problem to the analyst, and in many cases was impossible. Amongst many processes we have those of Henderson, Barfoed, and Gladding, the latter of which has found the greatest favour. It suffers from one very serious defect, however, and that is the correction for solubility of the fatty acids and silver salts in ether. This is a very variable factor, and, of course, is dependent on the nature of the fatty matter used in the fabrication of the soap. With small quantities of resin the error thus introduced may be as much as 20—30 per cent., but of course in soaps of high resin content—say 20 per cent.—the error diminishes.

E. Williams (Analyst, **15**, 190) obtained very good results by the process; thus, in a soap which actually contained 30·0 per cent. of resin, he obtained 30·7 per cent., but no mention is made as to whether the amount remaining

in the lyes, after precipitation of the soap, was determined. As to the simple detection of resin, no doubt the best test is to boil the dry fat or fatty acids (10 drops) with 5 cc. acetic anhydride, cool, and add 2 drops of pure sulphuric acid (1·84 sp. gr.), when the reddish-violet colour due to resin is easily observed, 1 per cent. of which can thus be detected.

It seems that all the above processes must make way for the admirable process of Twitchell (Analyst, Oct. 1891), who found that whereas fatty acids are, as is well known, converted into neutral ethers on passing dry hydrochloric acid gas into their alcoholic solution, the acids constituting resin are not attacked. The process obviously may be either gravimetric or volumetric, but chemists will prefer the latter on account both of speed and accuracy. The description of the process is as follows :—2·5 to 3 grms. of the dried fatty and resin acids are dissolved in from 25—30 cc. of perfectly absolute alcohol, and a current of dry hydrochloric acid gas passed in constantly. The flask containing the mixture must be kept cool by immersion in cold water. When the etherification is complete the ethers separate and the gas is no longer absorbed. The flask is removed, corked well, and allowed to stand half an hour. It is diluted with about 100 to 125 cc. hot water, then cooled, transferred to a separating funnel, and agitated with 75 cc. of ether. The aqueous layer is removed, and the ethereal layer washed with cold water till neutral to delicate litmus solution (twice always is sufficient). The ethereal liquid is received in a flask, the separator washed out with about 50 cc. of neutral spirit, and the whole titrated by standard alcoholic alkali, using phenolphthalein as indicator. The alkali should be standardised by an accurate solution of half-normal HCl, and should be either one-fifth or one-half normal, according to the amount of resin in the fatty acids. Taking the mean combining weight of resin as 347, then the percentage is easily calculated ; it is reported both on 100 of dry fatty matter and on 100 of soap.

Twitchell's test experiments are eminently satisfactory, and the author confirms them by his own tests :—

1. Sample of distilled fatty acids containing no resin, when treated as described, showed 0·7 per cent. resin.

2. The above distilled fatty acids, to which were added common resin to the extent of 22·5 per cent. showed, when treated as above described, 23·3 per cent. of resin, which, after deducting the 0·7 per cent. found in No. 1, gives exactly 22·5 per cent., or the amount which was added.

3. Soap made from palm oil and other fats, but no resin, gave 0·8 per cent. resin.

4. Another soap made from fatty matter of unknown origin, but no resin, gave 1·0 per cent. resin. This, it should be observed, was of a dark colour, and evidently contained some altered or oxidised oily matter.

5. Soap which showed by Gladding's test 6 per cent. of resin, gave 4·9 per cent. by Twitchell's process.

The above results are all that may be desired, and the author has now to show how the process may be still further shortened without any sacrifice of accuracy. This can be done by leaving out the washing and dissolving in alcohol direct. A few drops of methyl orange are then added and alkali, till neutral to this indicator ; phenolphthalein is then added, and the titration completed as before. The alkali required in the first case is for the neutralisation of the free hydrochloric acid, and is of course neglected. That required to neutralise to phenolphthalein is of course due to the resin, and is calculated as such.

The Estimation of Combined Alkali in Soap. J. Arthur Wilson. Chem. News, Oct. 23, 1891, 205.

The writer, who was the first to point out the error attendant on the use of the alcohol method of determining free caustic alkali in soap (Chem. News, **49**, 280 ; this Journal, **8**, 479), advised, when both free fat and free caustic alkali are present simultaneously, the adoption of the following method :—

Determine, firstly, the total alkali in the usual manner. Then determine the amount of alkali required to neutralise the isolated fatty and resin acids from a weighed quantity of the soap. Obviously the difference is the alkali present as hydrate, carbonate, or silicate of soda, &c. In the same paper above mentioned the following sentence occurs :—"Supposing palmnut, or cocoanut oil to have been used in the fabrication of the soap, the determination of the Na_2O required to neutralise the fatty acids becomes inaccurate, owing to the solubility of the lower fatty acids ; hence another complication arises. The error, of course, may be of greater or less extent, according to the nature of the fatty matter of the soap." Fortunately, this error can be completely excluded by operating in a very simple manner as follows :—

1. The alkali, in all forms, is determined by titration with standard acid in the usual manner.

2. Another weighed quantity of the soap is decomposed in an Erlenmeyer flask with a slight excess of dilute H_2SO_4, and the flask kept on the water-bath till the fatty acids separate quite clear. The flask is then placed in ice-water to cool, and then filtered. The fatty acids are washed three times successively with 250 cc. of boiling water and allowed to cool each time and filtered. The united filtrates are diluted to 1 litre, and 500 cc. placed in a clear white beaker and tinted with methyl orange ; N 10 alkali is then dropped in till the liquid acquires the usual colour, after which a little phenolphthaleïn is added, and the addition of standard alkali continued till a permanent pink is established. The number of cc. used in the latter titration are due to the soluble acids, and are calculated to caprylic acid. The fatty acids in the flask, and any little on the filter are dried and weighed, and then dissolved in alcohol, and titrated with N 2 alcoholic alkali. The alkali so used, *together with that required for neutralisation of the soluble acids*, and deducted from the total alkali, gives the alkali existing in other forms than as soap.

Of course, if desired, the soap may be decomposed with standard H_2SO_4, and the alkali required to neutralise the methyl orange noted, which, deducted from the total acid used, would give the acid equivalent to the alkali existing in all forms. In this manner we get—

Total alkali.
Combined alkali.
Insoluble fatty acids.
Soluble fatty acids.

The following examples illustrate the method :—

No. 1.—*Soap from Cocoa-nut Oil and other Fats (Highly Watered). Total Alkali by Titration, 2·06 per cent. Na_2O.*

	Grms.	Per Cent.
Weight of soap taken	17·145	
Weight of insoluble fat acids	2·29	= 13·35
Cc. of N 2 alkali to neutralise	16·1	= 8·05 normal.
Cc. of N 10 alkali to neutralise soluble acids	4·2	= 0·42 normal.

Cc. of N 10 alkali to neutralise soluble acids 4·2 = 0·42 normal = 0·36 per cent. soluble acids (= caprylic).

Total alkali used for both soluble and insoluble fatty acids, cc. = 8·47 normal.

$$\frac{8·47 \times 0·031 \times 100}{17·145} = 1·53 \text{ per cent. combined alkali.}$$

	Per Cent.
Total alkali (Na_2O)	2·06
Combined alkali (Na_2O)	1·53
Uncombined	0·53
Soluble fatty acids	0·36 = caprylic.
Insoluble fatty acids	13·35
Total fatty acids	13·71

No. 2. *French Scouring Soap. Total Alkali by Titration, 7·037 per cent.*

	Grms.	Per Cent.
Weight of soap taken	5·889	
Weight of insoluble fatty acids	2·005	= 34·06
Cc. of N 2 alkali to neutralise	18·05	= 9·025 normal.

Cc. of N 10 alkali to neutralise soluble acids, 10·7 = 1·07 normal = 2·6 per cent. caprylic acid.

Total alkali used for both soluble and insoluble acids = 10·1 cc. normal = 20·2 N 2.

$$\frac{20·2 \times 0·0155 \times 100}{5·889} = 5·32 \text{ per cent. combined alkali.}$$

	Per Cent.	
Total alkali (Na_2O)	7·037	
Combined alkali	5·32	
Uncombined	1·717	
Insoluble fatty acids	34·06	
Soluble fatty acids	2·6	= caprylic.
Total fatty acids	36·6	

The Absorption of Bromine by Fatty Bodies. Schlagdenhauffen and Braun. Monit. Scient. 1891, **5**, 591—600.

The authors criticise Levallois' method for the determination of the bromine absorption coefficient of fats and oils, and state that its use will inevitably lead to the most erroneous results. This is so for the following reasons:—In the first place, bromine water, which is used volumetrically in the process, parts so readily with its bromine that it may alter greatly in strength during the time required to perform an analysis. Secondly, Levallois entirely neglects the amount of bromine absorbed by the alcohol used as a solvent for the fatty acid during titration. Experiments are quoted to show that the quantity of bromine taken up by alcohol is very considerable, and that it varies with the experimental conditions. These sources of error may be completely eliminated by the process of Mills and Snodgrass (this Journal, 1883, 436—436).—H. T. P.

The Hübl Iodine Equivalent Method. Holde. Mitth. Königl. techn. Versuchs. Berlin, 1891, **9**, 81—100.

This method for the examination of oils and fats has led to a great deal of discussion, owing to the fact that there is great difficulty in obtaining concordant results. Hübl, in his original communication (this Journal, 1884, 641), recognised some of the uncertain points, and indicates the necessity of a sufficient excess of iodine. He recommends that 0·2—0·3 grm. of a drying oil, or 0·3—0·4 grm. of a non-drying oil should be used. This should be dissolved in 10 cc. of chloroform, and then 20 cc. of iodine solution, made by dissolving 25 grms. of iodine and 30 grms. of mercuric chloride in a litre of alcohol, should be added; in case decolourisation takes place 5—10 cc. more of this solution should be added; after which the whole must stand for 1½—2 hours. At the end of this time, after addition of potassium iodide, and water, titration with sodium thiosulphate is to be performed. Immediately before or after the experiment, he says, 10 cc. of the iodine solution itself must be titrated with thiosulphate for standardising purposes.

Dietrich (Helfenbergers Ann. 1886) and Herz (Rep. f. analyt. Chem. 1886, 605) gave the iodine numbers for a number of oils and their mixtures, shortly after which Schweissinger (Pharm. Centralhalle, 1887, 147), pointed out that these numbers varied with the concentration of the iodine solution, stronger solutions giving higher results than weaker ones.

Next Benedikt (Zeits. f. Chem. Ind. 1887; also this Journal, 1888, 591) pointed out that the fact of the solution remaining brown was not necessarily an indication of there being an excess of iodine present; he recommended for drying oils 50 cc. of iodine solution for 0·30—0·36 grm. of the oil, and 25 cc. of iodine solution to 0·15—0·18 grm. of oil. Merkling (Chem. Zeit. 1887, **11**) recommended that iodine solution and sublimate solution should be kept separate until required for use; and showed that the duration of experiment and the concentration of the solutions do not affect the results in the case of non-drying oils. Brüche (Apoth. Zeit. 1890, **5**, 493), found that the iodine numbers after two hours' action had not yet attained a maximum, but that this maximum was reached at the end of 24 hours. (See also this Journal, 1886, 309.)

In the present thesis Holde examines the questions as to what excess of iodine solution of given concentration is necessary for obtaining concordant results, and what influence variations in the concentration of the iodine solution have, equal excesses of iodine being used in the various experiments. From a large number of experiments, the results of which he gives in a comprehensive series of tables, it would seem that Benedikt's excess (30 per cent.) is insufficient, but that constant results are only obtained with most oils by an iodine excess amounting to 65—70 per cent. For about 0·3 grm. of a non-drying oil, therefore, an initial addition of 50 cc. of iodine solution is necessary, and for 0·2 grm. of a drying oil, 60 cc. With regard to the concentration of the iodine solution, the experiments tend to show that for the examination of linseed oil the solution should be as strong as possible, and at most eight days old, whilst for olive oil and rape-seed oil 50 cc. of the solution works well, providing the solution is not more than 14 days old; the solution may be used in the case of these latter oils, however, up to three months, providing that an excess of 70 per cent. of iodine is always present. As regards time, two hours prove to be quite sufficient for the experiment.

The author formulates his conclusions into the following method for working the process:—

0·3 grm. of non-drying oil, or 0·2 grm. of drying oil, is weighed out and dissolved in a flask of about 300 cc. capacity by the aid of 18—20 cc. of chloroform. To the non-drying oil 50 cc. of iodine solution, not more than 14 days old, are added, to the drying oil 60 cc. of a solution not older than eight days. Two samples of an oil should be treated alongside each other. Action is allowed to take place for two hours. At the beginning of the experiment 50 cc. of iodine solution are titrated with sodium thiosulphate after addition of 40 cc. of a 10 per cent. solution of potassium iodide and of starch in a well-stoppered bottle; 50 cc. of iodine solution are also run into a second well-stoppered bottle, to be titrated at the end of the experiment: the mean of these two titrations is taken as correct. After the oil reaction mixture has stood for two hours, it is shaken up with 40—50 cc. of 10 per cent. potassium iodide, 120 cc. of water are then added, and titration with sodium thiosulphate is performed. If the chloroform solution of the oil should become turbid during the experiment, more chloroform must be added. A table in the original paper shows the results obtained with various oils as compared with the results of previous observers.

The numbers given are, for—

Linseed oil	179—180
Hemp-seed oil	175
Poppy oil	139—143
Sesamé oil	106—109
Cotton-seed oil	110—115
Common rape-seed oil	100—108
Refined rape-seed oil	100—107

The author determined the iodine number for a sample of supposed pure oleic acid; using the method as suggested by Hübl, almost the theoretical number was obtained, but in presence of larger excesses of iodine higher numbers were obtained, which became constant when the excess of iodine rose to 65 per cent. He concludes, since also the specific gravity, 0·905, does not agree with that given by Beilstein (0·898) for pure oleic acid, that the specimen obtained was not pure, and he has in hand the preparation of a quantity of pure oleic acid, with which further tests will be made.

On account of the wide differences between the numbers for drying and non-drying oils the author considers that the method is of the highest utility in aiding in the detection of mixtures, when used in conjunction with determination of the saponification equivalent, and of the specific gravity, and index of refraction, and with a study of the action of sulphuric acid. A table is given of the saponification equivalent, iodine number, fluidity, specific gravity, and index of refraction of a number of oils and their mixtures. (See also this Journal 1889, 308; 1891, 802 and 860.)—T. L. B.

Effect of Cooling on the Viscosity of Oils. Bender. Mitth. Königl. techn. Versuchs. Berlin, 1891, **9**, 100—105.

See under XII., *page* 936.

Study of a Method for the Quantitative Determination of Sucrose, Invert Sugar, or Levulose. Part II. F. G. Weichmann. The School of Mines Quarterly, 1891, **12**, 249—256. For Part I. see School of Mines Quarterly, 1890, **11**, No. 3.

The experiments were made in order to determine the conditions which affect the destruction of levulose by boiling with hydrochloric acid.

The acid used was six times normal strength and 0·25 grm. sugar was taken for every experiment.

I. Invert sugar was boiled down with 60 cc. acid. In four hours the entire reducing power was equivalent to the destruction of the whole of the levulose. If more acid is used, the time necessary to destroy the same amount of sugar is proportionately reduced.

II. Dextrose was boiled with 60 cc. acid. The diminution of the reducing power of the solution was not very marked at first, but quickly increased with the time; in six hours about one-third of the dextrose was destroyed. Increase of acid proportionately diminished the time necessary to produce a given reduction.

III. Levulose was boiled with 60 cc. acid. In three hours half of the levulose was destroyed, in six hours nearly 90 per cent. was destroyed. If more acid was used the time necessary to produce a given reduction was proportionately reduced.

IV., V., and VI. Invert sugar with varying proportion of dextrose or levulose added were boiled with the same acid. These experiments showed that the amount of levulose destroyed in a given time depended on the proportion of the two sugars present.

It is evident from these experiments that a method of analysing a mixture of dextrose and levulose, based on the destruction of the levulose by boiling with hydrochloric acid, is untrustworthy.—A. L. S.

On Roasting, Malting, and Drying Processes, with special reference to Cocoa. A. Stutzer. Zeits. f. angew. Chem. 1891, 368—375.

See under XVIII. *A., pages* 940—941.

ANALYTICAL AND SCIENTIFIC NOTES.

The Cause of the Difficult Solubility of Chemically Pure Zinc in Acids. J. M. Weeren. Ber. 1891, **24**, 1785—1798.

The author maintains that chemically pure zinc, as well as other chemically pure metals, are difficultly soluble in acids because the metals become coated at the moment of immersion with an adherent film of hydrogen, which, under normal conditions, prevents further action. In proof of this view, it was found that chemically pure zinc in contact with dilute sulphuric acid of sp. gr. 1·0575 (1:20) was scarcely attacked, but on removing the atmospheric pressure the adhering hydrogen left the surface of the zinc, and solution of the metal was rapid so long as the vacuum was preserved, but ceased again with restoration of the pressure. It was found also that increase of temperature up to 98° C. causes a very small increase of chemical action, but on reaching actual boiling at 2 degrees higher, the action became energetic, but was checked when boiling ceased. The presence of oxidising agents in the acid, such as chromic acid or hydrogen peroxide, caused very energetic action by preventing the formation of the hydrogen film. Parallel experiments were made with impure zinc, and the results of the whole may be summarised in the following table, the acid used being dilute sulphuric acid (1:20), each experiment lasting 30 minutes, and a stick of zinc of 12 grms. being used.

Description of Experiment.	Chemically pure Zinc.		Impure Zinc.	
	Zinc dissolved.	Relation.	Zinc dissolved.	Relation.
	Grms.		Grms.	
Dilute sulphuric acid alone.	0·0050	1	1·3422	1
Dilute sulphuric acid in vacuo.	0·0631	6·6	1·2063	0·89
Dilute sulphuric acid at 100° C. with ebullition.	0·1221	24·4	5·9504	4·4
Dilute sulphuric acid at 100° C. without ebullition.	0·0078	1·6	6·0177	4·5
Sulphuric acid + chromic acid.	0·8703	175·0	8·7033	6·5
Sulphuric acid + hydrogen peroxide.	1·5301	306·0	4·6599	3·5

Similar results were obtained with cadmium, cobalt, nickel, iron, and aluminium. In the case of impure zinc or other metal the hydrogen, according to the author, is all evolved in the neighbourhood of the impurity, and a protecting film of hydrogen is not formed on the zinc, consequently a difference in the conditions of experiment does not greatly alter the amount of chemical action.

—G. H. B.

On the Compounds of Platinum Carbonoxide. F. Mylius and F. Foerster. Ber. 1891, **24**, 2424—2443.

In experimenting on the preparation of pure platinum the authors have made some observations on the remarkable volatile compound of platinous chloride with carbon monoxide which were described by Schützenberger in 1868 (Ann. Chim. Phys. **15**, 100, and **21**, 350). This observer recognised the existence of three compounds, $PtCl_2$, CO; $PtCl_2$, 2 CO; and 2 $PtCl_2$, 3 CO in the product of the reaction between chlorine carbonic oxide and platinum sponge at a temperature of 250°. All these substances are decomposed in contact with water into metallic platinum, hydrochloric acid, carbonic acid, and, in the case of the two last, also carbonic oxide. They also unite with other substances to form additive compounds, and the authors have investigated some of these, as well as the properties of the original substances. $PtCl_2CO$ was prepared by the method described by Schützenberger, and was freed from the other two accompanying compounds by digestion for some time in concentrated hydrochloric acid, which decomposes them. The substance $PtCl_2CO$ forms the starting-point for the preparation of the substances investigated. It is a powerful reducing agent and precipitates silver from silver nitrate solutions. Alkalis decompose it with separation of platinum black. It has a feebly basic character and forms a soluble compound with hydrochloric acid, which could not, however, be separated from solution; but the double salts with sodium, potassium, ammonium, and zinc chlorides are crystalline and of yellow colour, but so easily decomposed that their preparation is difficult. The double chlorides with organic bases are much more stable, and the double chloride of amylamine and platinum carbonoxide, $COPtCl_2.C_5H_{13}NHCl$ forms yellow leafy crystals very soluble in alcohol and acetic ether, less so in ether, benzene, and chloroform, and dilute hydrochloric acid, but water decomposes it. It melts at 184°. The aniline and pyridine double salts were also prepared, whilst the quinoline double salt was so stable as to be soluble in warm water without decomposition.

The carbon in these compounds may be determined by elementary analysis, but the authors have devised an alternative method by the direct measurement of the carbonic oxide which is evolved on treating these compounds with a solution of potassium cyanide. The reaction proceeds according to the typical equation—

$$COPtCl_2 + 4\ KCN = K_2Pt(CN)_4 + 2\ KCl + CO$$

and the evolved carbonic oxide is measured by absorption in cuprous chloride.

The corresponding bromine compound is obtained by treating the chlorine compound in hydrochloric acid solution with hydrobromic acid, and is obtained in a pure form by recrystallisation from hot benzene in orange-red needles, melting at 181—182°. The iodine compound is obtained in a similar manner, but the product must be evaporated to dryness, and the residue extracted with hot benzene in order to obtain the substance in a pure condition. $COPtI_2$ forms red crystals resembling chromic acid, and melt at 140—150°. It is stable in the air and only slowly decomposed by water, but is decomposed readily like the chloride by alkalis and by potassium cyanide. The corresponding cyanogen compound could not be isolated, owing to its very unstable character, but the double sulphocyanide $COPt(CNS)_2$, $KCNS$ was obtained in the form of small yellow crystals, easily soluble in alcohol. No fluoride could be prepared. By passing sulphuretted hydrogen through a hydrochloric acid solution of platinous chloride, carbon oxide, a brownish-black precipitate is obtained, which contains carbon oxide, and which the authors conclude, after examination, to be $COPtS$. Attempts to form the oxide $COPtO$ were only partially successful, and it could not be isolated in a pure condition. In all these compounds it would appear that the group $PtCO$ plays the part of a dibasic radicle similar in its affinities to platinum.—G. H. B.

Actions of Heat on Solutions of Salts of Chromic Oxide. A. Recoura. Compt. Rend. 1891, **112**, 1139—1142.

See under VII., *page* 925.

New Books.

THE ALKALI MAKERS' HANDBOOK. Tables and Analytical Methods for Manufacturers of Sulphuric Acid, Nitric Acid, Soda, Potash, and Ammonia. By GEORGE LUNGE, Ph.D., and FERDINAND HURTER, Ph.D. Second edition, enlarged and thoroughly revised. London: Whittaker and Co., 2, White Hart Street, Paternoster Square; George Bell and Sons, York Street, Covent Garden. 1891.

As is explained in the Preface, the size to which this work has grown, and the size of the page adopted, have justified the adoption of the term handbook rather than that of pocket-book. It is now an 8vo. volume, bound in cloth, containing 181 pages of subject-matter, preceded by Prefaces to the 1st and 2nd editions, a Note with regard to temperature scales adopted (Centigrade unless otherwise stated), atomic weights, &c., the Table of Contents, and followed by an Addendum, an Erratum, and the Alphabetical Index. A considerable number of new methods of analysis have been introduced in this new edition (this Journal, 1890, 1013). It is also announced that the tables of Kolb and Carius, contained in the 1st edition, have been now replaced by the new tables for specific gravities of sulphuric, hydrochloric, and nitric acid, and of liquor ammoniæ, constructed by one of the authors in conjunction with his assistants. The text is divided into GENERAL TABLES and the SPECIAL PART. In the latter the following subjects are treated of, both as regards tabulated matter and analytical details:—1. Fuel and Furnaces. 2. Sulphuric Acid Manufacture. 3. Salt-cake and Hydrochloric Acid. 4. Bleaching Powder and Chlorate of Potash. 5. Soda Ash Manufacture. 6. Sulphur Recovery (Chance Process). 7. Nitric Acid Manufacture. 8. Potash Manufacture. 9. Ammonia Manufacture. APPENDIX. Devoted to—A. Preparation of Standard Solutions. B. Rules for Sampling. C. Comparison of the Hydrometer degrees. D. Value of Alkali per ton. The text is illustrated by 12 well-executed wood engravings.

The price of the handbook is 10*s.* 6*d.* Strongly bound in half-leather, 12*s.*

CHEMIKER-KALENDER, 1892. Ein Hülfsbuch für Chemiker, Physiker, Mineralogen, Industrielle, Pharmaceuten, Hüttenmänner, *u. s. w.* VON DR. RUDOLF BIEDERMANN, Dreizehnter Jahrgang, Mit einer Beilage. Berlin: Verlag von Julius Springer, 1892. London: H. Grevel and Co., 33, King Street, Covent Garden.

THIS well-known work, is one of pocket-book form and dimensions, is strongly bound in cloth, price 3*s.* It contains almanack for 1892 inside the cover, and also a table of frequently-used Atomic weights and their multiples. After the title page, then follows the Preface, in which is pointed out the various improvements and novelties introduced in the present edition. Thus, the table of the Coal tar colours is much enlarged, whilst that of the reactions of the Fatty bodies had to be taken over and completed by the editor, owing to the sudden death of Dr. Schädler. After the Table of Contents, a Chronological table of the principal events from the History of the Sciences, especially Chemistry. Then follows the Notebook Calendar with its blank spaces for the different days of the year, and after this 30 pages of blank paper ruled, with four pages unruled, for memoranda, &c. Then comes the Tabulated matter, comprising tables of the most useful kinds: Specific gravities of Gases and Liquids. Salts, Alcohols. Tables of Solubility. Properties of Chemical substances. Analysis. Volumetric Analysis. Spectrum Analysis. Gas Analysis. Physiological Chemical Analysis. Technical Chemical Investigations, relating to:—I. Water. II. Assaying. III. Fuels. IV. Sulphuric acid. V. Alkali. VI. Chloride of lime. VII. Nitre and Explosives. VIII. Starch and Sugar. IX. Colours. X. Fats and Oils. XI. Tanning Agents. XII. Ceramics. XIII. Glass. XIV. Mortars and Cements. Mineralogy.

BEILAGE ZUM CHEMIKER-KALENDER, 1892.—Contains an assortment of further useful tables of a more pronounced technological character, commencing with one of the leading foreign money currencies. II. A series of Mathematical tables. III. Another on Weights and Measures. IV. A series on Heat and Cold Measurements, &c.

A HANDBOOK OF INDUSTRIAL ORGANIC CHEMISTRY. Adapted for the Use of Manufacturers, Chemists, and all interested in the Utilisation of Organic Materials in the Industrial Arts. By SAMUEL P. SADTLER, Ph.D. Philadelphia: J. B. Lippincott Company. London: 10, Henrietta Street, Covent Garden.

THE present work is designed "within the compass of a moderate-sized octavo, to take up a number of the more important chemical industries, or groups of related industries, and to show in language capable of being understood, even by those not specially trained in chemistry, the existing conditions of those industries."

The price of the book is 1*l.* 5*s.*, and in its compass it includes the Preface, Table of Contents, List of Illustrations, List of Diagrams, Text covering 499 pages, and the Alphabetical Index. The whole is exceedingly well illustrated with 127 excellent wood engravings and 19 diagrams.

Chap. I. treats of the Petroleum and Mineral Oil Industry. II. The Industry of the Fats and Fatty Oils. III. Industry of the Essential Oils and Resins. IV. The Cane-Sugar Industry. V. The Industries of Starch and its Alteration Products. VI. Fermentation Industries: A. Nature and Varieties of Fermentation; B. Malt Liquors and the Industries connected therewith. VII. Milk Industries. VIII. Vegetable Textile Fibres: A. Paper-making; B. Gun-Cotton, Pyroxiline, Collodion, and Celluloid. IX. Textile

Fibres of Animal Origin. X. Animal Tissues and their Products: A. Leather Industry; B. Glue and Gelatin Manufacture. XI. Industries based upon Destructive Distillation: A. Destructive Distillation of Wood; B. Destructive Distillation of Coal. XII. The Artificial Colouring Matters: I. Raw Materials; II. Process of Manufacture; III. Products; IV. Analytical Tests and Methods; V. Biography and Statistics. XIII. Natural Dye Colours. XIV. Bleaching, Dyeing, and Textile Printing.

Appendix.—I. The Metric System. II. Tables for Determination of Temperatures. III. Specific Gravity Tables. IV. Alcohol Tables.

Quantitative Chemical Analysis. Adapted for Use in the Laboratories of Colleges and Schools. By Frank Clowes, D.Sc., F.I.C., and J. Bernard Coleman, F.I.C. London: J. and A. Churchill, 11, New Burlington Street. 1891.

Octavo volume, bound in cloth, price 7*s.* 6*d.* It contains Preface, Table of Contents, List of Books of Reference recommended, subject-matter illustrated by 83 wood engravings, and Alphabetical Index. The work is divided into five parts and an Appendix. Each part is then subdivided into sections, and the items in these are not only paged, but also paragraphed for the convenience of students and others.

Part I. contains *Sect. I.* The Balance, Weights and Weighing. *Sect. II.* Specific Gravity, Melting Point, Boiling Point. *Sect. III.* Mechanical Division, Drying, Solution, Precipitation, &c. *Sect. IV.* Exercises on Crystallisation, &c. Part II. Simple Gravimetric Estimations. Part III. Volumetric Analysis, divided into four sections. Part IV. General Quantitative Analysis. *Sect. I.* Technical Analyses. *Sect. II.* Water Analysis. *Sect. III.* Food Analysis, Tannins, Soap. Under Food Analysis we have Milk Analysis, Butter Analysis, Partial Analysis of Beer and Wine, Analysis of Sugar, Partial Analysis of Tea. *Sect. IV.* Organic Analysis. Part V. Volumetric Estimations of Gases. Appendix, containing: I. Nitrate in Water; Preparation of Gases. II. Results of Typical Analyses. III. Tables of Useful Constants. IV. Lists of Apparatus and Chemicals Required.

The Organic Analysis of Potable Waters. By J. A. Blair, M.B., D.Sc., Edin. Second Edition. London: J. and A. Churchill, 11, New Burlington Street. 1891.

Small 8vo. volume, bound in cloth, price 3*s.* 6*d.*, containing Table of Contents, Preface to Second Edition, Introduction, and subject-matter covering 97 pages, and Appendices A. to E. The text up to the Appendices is divided into four parts. Part I. The Albuminoid-Ammonia Process, and Oxygen Process at ordinary temperatures. Part II. The Oxygen Process at 100° C. Part III. The Sulphuric Acid Process for Organic Nitrogen. Part IV. The Sulphuric Acid and Permanganate Process for Organic Carbon. The Appendices treat of the following subjects:—A. Solutions for Albuminoid Ammonia and Sulphuric Acid processes. B. Solutions for Oxygen Process at ordinary temperatures. C. Solutions for Oxygen Process at 100° C. D. Estimation of Nitrates by Arsenious Acid. E. Solutions for the Sulphuric Acid and Permanganate Process for Organic Carbon.

Trade Report.

TARIFF CHANGES AND CUSTOMS REGULATIONS.

(From the Board of Trade Journal.)

Russia.

The Duty on Starch.

Note.—Poud. = 36 lbs. avoirdupois. Rouble = 3*s.* 2*d.*

The following is a copy of a memorandum which has been received from the Foreign Office on the subject of the duty on starch in the Russian tariff:—

Representations having been made with a view to obtain a reduction of the amount of duty, 1 r. 75 cop. per poud, on starch packed in paper or in cases, in the new Russian Customs tariff, the Russian Government has consented to allow cases of starch of not less than half a poud in weight to be imported at the lower rate of 1 r. 40 cop. per poud.

Regulations affecting Customs Declarations.

The *Journal des Tarifs et Traités de Commerce* for the 17th September says that, in consideration of the difficulties experienced by merchants in filling up declarations with detailed specification of certain merchandise, the Russian Minister of Finance has ordered that the declaration for the under-mentioned articles are admissible as stated, without other detailed indication:—

"Pyrites of iron, copper ores, and copper scoriæ," according to the notes 1 and 2 of Art. 138, without indication of the proportion of copper per pound.

"Cotton tissues, raw and bleached, dyed, coloured, and printed," according to Arts. 187 and 188, without indication of the number of square arshines per pound of these tissues.

Finland.

Tariff Change.

Mr. J. Michell, Her Majesty's Consul at St. Petersburg, in a report to the Foreign Office, dated the 24th October, says that, according to an intimation from Mr. Vice-Consul C. J. Cooke, of Helsingfors, the Imperial Finnish Senate has decreed that half-made goods of aluminium shall henceforth pay a higher rate of duty, namely, the same as that charged under the Finnish tariff on copper and brass half-finished goods, which is 5 marks 90 pennis per 100 kilogrammes.

Switzerland.

Classification of Articles in Customs Tariff.

Note.—Quintal = 220·4 lb. avoirdupois. Franc = $9\frac{6}{10}d.$

The following decisions affecting the classification of articles in the Swiss Customs tariff were given by the Swiss Customs authorities in the month of September last:—

Sulphate of barytes, washed, in paste.—Category 16. Duty, 30 cents. per quintal. This was formerly included in Category 30.

Changes in the Canadian Customs Tariff.

By resolutions recently adopted by the Canadian House of Commons the following changes have been introduced into the Customs tariff of the Dominion. The old duties, published at pp. 409—18 of the October number, and pp. 535—52 of the November number of the *Board of*

Trade Journal for last year are modified on the undermentioned articles:—

Articles.	Duties now levied.
	Dols. Cts.
All cane sugar and beetroot sugar not above No. 14 Dutch standard in colour, all sugar sweepings, all sugar drainings or pumpings drained in transit, all melado and concentrated melado, all molasses and concentrated molasses not elsewhere specified, all cane juice and concentrated cane juice not elsewhere specified, all beetroot juice and concentrated beetroot juice not elsewhere specified, all tank bottoms not elsewhere specified, and concrete when *not* imported direct without transhipment from the country of growth and production, 5 per cent. *ad val.*; provided, however, that in the case of cane sugar produced in the East Indies and in countries to the east thereof and imported therefrom *viâ* Hong Kong or Yokohama, such rate of 5 per cent. *ad val.* shall not be exacted if transhipped at Hong Kong or Yokohama	5 per *ad val.*
All sugars above No. 14 Dutch standard in colour, and refined sugar of all kinds, grades or standards, and all sugar syrups derived from refined sugars	Lb. 0·00½
Glucose or grape sugar, glucose syrup, and corn syrup, or any syrups containing any admixture thereof	„ 0·01½
Spirituous or alcoholic liquors, distilled from any material or containing or compounded from or with distilled spirits of any kind, and any mixture thereof with water, for every gallon thereof of the strength of proof, and when of a greater strength than that of proof, at the same rate on the increased quantity that there would be if the liquors were reduced to the strength of proof. When the liquors are of a less strength than that of proof, the duty shall be at the rate herein provided, but computed on a reduced quantity of the liquors in proportion to the lesser degree of strength; provided, however, that no reduction in quantity shall be computed or made on any liquors below the strength of 15 per cent. under proof, but all such liquors shall be computed as of the strength of 15 per cent. under proof, as follows:—	
(*a.*) Ethyl alcohol, or the substance commonly known as alcohol hydrated oxide of ethyl or spirits of wine	Gall. 2·12½
(*b.*) Amyl alcohol or fusel oil, or any substance known as potato spirit or potato oil	„ 2·12½
(*c.*) Methyl alcohol, wood alcohol, wood naphtha, pyroxylic spirit, or any substance known as wood spirit or methylated spirit	„ 2·12½
(*d.*) Spirits and strong waters of any kind, mixed with any ingredient or ingredients, and being known or designated as anodynes, elixirs, essences, extracts, lotions, tinctures, or medicines not elsewhere specified	Gall. 2·12½ and 30 per *ad val.*
(*e.*) Alcoholic perfumes and perfumed spirits, bay rum, cologne and lavender waters, hair, tooth, and skin washes, and other toilet preparations containing spirits of any kind, when in bottles or flasks weighing not more than 4 oz. each	50 per *ad val.*
When in bottles, flasks, or other packages, weighing more than 4 oz. each	Gall. 2·12½ and 30 per *ad val.*
(*f.*) Nitrous ether, sweet spirits of nitre, and aromatic spirits of ammonia	Gall. 2·12½ and 30 per *ad val.*

Note.—In all cases where the strength of any of the foregoing articles cannot be correctly ascertained by the direct application of the hydrometer, it shall be ascertained by the distillation of a sample, or in such other manner as the Minister of Customs directs.

GENERAL TRADE NOTES.

Iron and Steel Production, 1890.

In an article which appeared in the *Viestnik Financoff* of October 4th were published particulars regarding the production of iron and steel in the seven principal iron-producing countries of the world, viz., the United States, the United Kingdom, German Empire with Luxemburg, France, Belgium, Austria-Hungary, and Sweden, which together produce 95 per cent. of the annual iron production of the world. The extent to which the production of pig iron has developed in each of these countries will be seen from the following table:—

	1870.	1880.	1890.
	Production (in Tons of 2,204 lb.)		
United States	1,718,000	3,957,000	9,352,000
Great Britain	6,039,000	7,820,000	8,005,000
Germany*	1,170,000	2,763,000	4,696,000
France	921,000	1,727,000	1,963,000
Austria-Hungary	902,000	464,000	922,000
Sweden	292,000	404,000	820,000
Belgium	563,000	608,000	779,000
Total	11,105,000	17,743,000	26,517,000

* Excluding Lorraine and Luxemburg, where 3,400,000 tons and 3,300,000 tons of pig iron were respectively produced in 1890.

It will be seen from these figures that the iron industry of the United States shows a greater expansion than that of any of the other countries. The production of pig iron in the United States in 1890 was 21 per cent. greater than in 1889, which year showed an increase of 17 per cent. on 1888; it has doubled itself within the last six years, and increased threefold since 1878. On the other hand, it has taken Great Britain 27 years to double its production. The year 1890 was the first in which the production of pig iron in the United States exceeded that of Great Britain, not only for the same year, but for 1883, the year in which the pig iron production of the latter reached its maximum.

Germany, including Lorraine and Luxemburg, produced 11,400,000 tons of pig iron in 1890, almost exclusively from native ore. The total production of pig iron in Germany in 1889 was 11,000,000 tons. There were 2,469,000 tons of wrought iron, and 2,162,000 tons of steel produced in Germany in 1890, the corresponding figures for 1889 being respectively 2,769,000 tons and 2,095,000 tons.

In France, owing to the high rates of duty on coal and pig iron, the quantity of the latter produced in 1890 exceeded that of 1889 by 11 per cent., and France now produces all the iron and steel required for her own use, with the exception of a few special sorts still imported from England. The production of pig iron in France in 1890 and 1889 respectively was 1,900,000 tons and 1,700,000 tons, the quantities of wrought iron produced in the same years respectively being 823,000 tons and 793,000 tons, and of steel 566,000 tons and 529,000 tons.

Austria-Hungary produced, in round numbers, 920,000 tons and 850,000 tons of pig iron in 1890 and 1889 respectively. The corresponding figures for wrought iron being respectively 471,000 tons and 439,000 tons, and for steel 734,000 tons and 617,000 tons.

Hungary is recently attracting attention through the progress of her iron and steel industries, largely due to increased traffic on the railways, brought about by the zone system and causing a great increase in the demand for rolling stock, locomotives, tenders, and rails. Thus the average number of railway carriages built annually between 1880 and 1884 was 2,943, between 1885 and 1889, 3,462, while in 1890 the number built was 8,466.

Belgium contrasts with the other countries by a falling off in her production of pig iron and wrought iron, due to the high prices of coal and coke, and a fall in the price of the product itself. This unsatisfactory condition of the Belgian markets was to no small extent due to unfavourable competition with other countries. Belgian manufacturers in their endeavours to improve their position by reducing wages only made matters worse by bringing about strikes. There were 780,000 tons of pig iron produced in 1890 as compared with 830,000 tons in 1889; 507,000 tons of wrought iron as compared with 577,000 tons, and 455,000 tons of steel as compared with 469,000 tons.

As regards Sweden, owing to increased building and engineering activity both for home and abroad in 1890, the iron industry has made further progress. Large ship-building orders from Russia gave special impetus to that trade. Arms were manufactured for Switzerland and Denmark. There was a brisk demand for agricultural implements from Austria-Hungary and South America. The total production of steel in 1890 amounted to 160,026 tons, of which 92,247 tons were Bessemer steel. The total production of steel for 1889 was 135,227. The quantities of iron ore produced in 1889 and 1890 respectively were 787,950 tons and 823,334 tons.

Petroleum in Galicia.

A fresh discovery of petroleum is reported from Krusno in Galicia. Enormous masses of oil and water are forcing their way through the surface of the land, although at present the borings have not reached the oil-bearing strata proper. In the opinion of experts this striking of oil is the most important yet made in the district, the yield being already equal to 100 barrels a day.—*Ironmonger.*

German Zinc Statistics.

A German technical journal publishes some statistics showing the development of the zinc industry during the past ten years. Germany is the chief producer of this metal, her mines at present producing about 140,000 tons per annum, out of a total estimated output of 350,000 tons for the whole world. Curiously enough, although the development of the industry has made such rapid strides, the number of concerns engaged in it has diminished during the past 20 years, there being at present only 29 firms producing zinc, as against 35 in 1870. In 1881 the output in Germany was 105,500 tons, valued at 1,582,700*l.* In 1890 the make had risen to 139,270 tons, and the value to 3,059,900*l.* But whilst the augmentation of output has been advancing at the rate of about 8 per cent. per annum since 1885, the value of the metal is almost double what it was six years ago, in spite of periods of temporary weakness. The average selling price in 1881 for C.G.H. brand of Silesian zinc in Breslau was 30·83 m.; for W.H. and S.S. brands of Rhine zinc at Cologne, 32·66 m.; and for refined Galmium and Blende in Frankfort a/M. 33·53 m. In 1890 these qualities fetched an average price at the several selling centres of 45 m., 47·92 m., and 47·02 m. respectively. The second largest zinc-producing country is Belgium, with about two-thirds, and the United States of America, with about one-half, that of Germany.—*Ibid.*

A Permanganate of Potassium Combination.

The formerly existing syndicate of German permanganate of potassium manufacturers came to an end about two years ago; since that time the makers have been underselling one another with great vigour. At last they seem to have become tired of that policy, for they now announce that, from 15th inst., they have placed the exclusive sale of their potassium permanganate in the hands of the Chemische Fabrik auf Actien (vorm. S. Schering) in Berlin. The two makers who have done so are Dr. M. Goldschmidt, of Cöpenick, and Gebr. Borchers, of Goslar. Messrs. A. M. Zimmermann will sell for the three firms (Scherings are also manufacturers of the article) in this country. We believe that at the present time there is only one other manufacturer in Germany, and his works are temporarily closed owing to removal.—*Chemist and Druggist.*

New Material for Insulation.

A new material, known as litho-carbon, of which enormous deposits have been discovered in Texas, has been found to be an excellent insulator, having a resistance, it is claimed, seven times as great as any other known substance. The material is said to resist heat, salt air, water and gases of any kind, and is, therefore, well suited for paint. Under very high temperatures it softens, but will not burn. In its natural state this mineral is found in intimate mixture with white sand and sea shells, from which it can be separated by benzene as a black viscous material.—*Industries.*

Papers of Interest to Technologists and Manufacturers.

The following articles in the *Board of Trade Journal* for November will repay perusal:—

The Patent Laws of Austria-Hungary ..... p. 521
The Coal Industry of India..... p. 529
Coffee and Cocoa Production of Brazil..... p. 534

The Output of British Minerals.

There has recently been issued from the Home Office, a tabular return, showing the annual output of the principal minerals produced in the United Kingdom, from the year 1860 to the year 1890. The term United Kingdom includes the Isle of Man and Ireland. The quantity in tons, and the value in pounds, are given for each year. The compilations have been made from official returns by Mr. James B. Jordan, the Clerk of Mineral Statistics. Copies of the return may be obtained from Messrs. Eyre and Spottiswoode. For the benefit of our readers, the figures for last year (1890), are culled from the report:—

Mineral.	Quantity.	Value.
	Tons.	£
Alum clay (bauxite)	11,527	5,763
Alum shale	6,420	802
Arsenic (white arsenic, crude and refined) produced from arsenical pyrites not included in the next line.	7,276	60,727
Arsenical pyrites	5,114	4,414
Barytes	25,353	29,684
Clays (china clay, potters' clay, fullers' earth, &c., but exclusive of ordinary clays)	3,308,214	899,166
Coal	181,614,288	74,953,997
Cobalt and nickel ore	84	260
Copper ore and copper precipitate:—		
Copper ore	12,136	27,801
Precipitate	345	4,670
Fluorspar	268	392
Gold ore (auriferous quartz)	575	434
Gypsum	140,293	57,991
Iron ore	13,780,767	3,926,445
Iron pyrites	16,018	7,666
Lead ore	45,651	406,164
Manganese ore	12,444	6,733
Ochre and umber	19,068	17,475
Oil shale	2,212,250	608,369
Phosphate of lime	18,000	29,500
Salt (rock salt and salt obtained from brine)	2,146,840	1,100,014
Slates and slabs	434,352	1,027,235
Sulphate of strontia	10,276	5,138
Tin ore (" *black tin* ")	14,911	782,492
Wolfram	104	1,848
Zinc ore	22,041	109,890

It is to be noted that, in addition to the above, small quantities of other minerals are occasionally produced, *e.g.*, ores of antimony and bismuth, bog-iron ore (used for purifying gas), jet, lignite, petroleum, plumbago, silver ore, steatite, and uranium ore.

"A very large quantity of stone used for building and other purposes is also annually raised, besides chalk, ordinary clay, gravel, &c., the total quantity of which cannot be accurately ascertained, but the value in 1890 was estimated to be upwards of 8,708,000*l*."—*Chemical Trade Journal.*

The Use of Metric Weights and Measures in Export Trade.

The *Engineering and Mining Journal* has already called the attention of certain American manufacturers, engaged in the export trade, to the universal employment of metric weights and measures in South American countries, whose markets the United States is now endeavouring to control, and the pressing importance of furnishing to them machinery of metrical gauges and dimensions. That journal now goes on to say that it is evident that to secure a commanding position in the trade of any of these countries there must be a strict compliance with local customs and demands. That this has not been done has been the burden of the complaints of American consular officers at foreign ports for many a year. The necessity in this particular point—metric weights and measures—is, however, so obvious that it should impress itself upon American manufacturers.

Apropos of this subject several recent reports of British consular officers are of service. British consuls in countries as widely separated as Italy and Japan have thus warned the manufacturers and exporters of their own country that they were losing trade because they persisted in using, in their circulars and price lists, English weights and measures, which were almost unintelligible to the people of these countries, where the metric units are in general use; whereas their French and German competitors, the former as a matter of course and the latter adapting themselves to the circumstances with the facility which has gained them such an immense export trade to all parts of the world, employ the metric system, which is familiar to everybody, and naturally attract custom. Similar warnings are uttered by the British consuls at Alexandria and Cairo, in Egypt, who declare that British manufacturers are simply playing into the hands of their rivals by continuing the use of weights and measures which to many Egyptian merchants are no more intelligible than those of China.

EXTRACTS FROM DIPLOMATIC AND CONSULAR REPORTS.

Spain.

Decline in the British Drug Trade.

The British Consul at Bilbao is very pessimistic about the decline in several important branches of commerce with Spain, in which this country formerly took the lead. Drugs is one. The following significant figures are given:—

Imports from.	1883.	1884.	1885.	1887.	1888.	1889.
	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.
United Kingdom ...	826	852	744	210	170	165
Other countries.....	41	111	237	262	1,303	1,807
Total	867	963	981	472	1,473	1,972
British percentage..	95·26	88·47	75·80	50·98	26·51	8·35

The three years 1883—85 illustrate the condition of things previous to the Anglo-Spanish convention of 1886—a convention which was believed to be particularly favourable to British trade—and the triennium 1887—89 the state of business subsequent to the convention.

Its Causes.

With regard to other staple articles, it may be observed that in the British imports of woollens, mineral oils, paraffin, paints and dyes, and varnishes, there was a fair increase during the years succeeding the convention, while copper and brass, glass, porcelain, and agricultural and industrial machinery show a large decrease. The result cannot be regarded as satisfactory.

Bearing in mind (continues the Consul) that the general commerce of Bilbao has considerably advanced, it might have been anticipated that Great Britain would have absorbed a larger share of the trade in those articles in which, previously to the convention, she was unfairly handicapped with other foreign countries. Under the heads of drugs and chemicals the figures are so discouraging that some explanation seems called for. Since many years France, Germany, and Belgium have made strenuous efforts to secure the command of the trade of Bilbao, and on the convention with Great Britain being concluded, those efforts were redoubled, while the British trader, unmindful of the advice so often given him, has not changed his way of doing business. He does not take the proper steps to further a demand for his goods by offering the same facilities as French, German, and Belgian traders, such as employing active and intelligent agents acquainted with the language of the country, the manners and customs of the people, the tastes and requirements of particular districts, and empowered to make sales, contracts, and financial arrangements in accordance with the usage of respective places, without delay or reference to the houses they represent. With respect to financial accommodation, it would appear that the British trader is indisposed to conform to the custom and views of Spanish buyers, and while he follows the prudent course of requiring cash payments or short bills for his consignments, his competitors offer every facility in the shape of long credit; thus, although it is notorious that, were the conditions of business the same, preference would in many cases be given to British produce and manufactures, our traders are constantly driven out of the market on this ground. In a word, it cannot be again too seriously urged for the consideration of British traders that until they adopt a system similar to that of their keen opponents, they must not expect to be otherwise than at a disadvantage.

New Industries.

Several new industries were initiated in Bilbao last year, among them a chemical factory, established by Messrs. Burt, Boulton, and Haywood, of London, for the treatment of coal tar and extraction of various products, including aniline and other colours.—*Chemist and Druggist.*

Fourteenth Meeting of the Society for Protecting the Interests of the German Chemical Industries.

This meeting took place on September 19th at Nuremberg, under the presidency of Dr. J. F. Holtz. In presenting the annual report, the secretary, Mr. O. Wenzel, stated that the progress of the last five years still continued and factories had been fully employed, although prices, owing to keen competition, had in many instances hardly kept pace with the great increase in cost of production. The number of works had increased from 4,809 to 5,043 during the year, employés from 90,585 to 97,198, or 7·63 per cent., and wages from 3,580,552*l*. to 4,003,735*l*. The foreign trade amounted in 1890 to 1,916,522 tons, valued at 26,828,300*l*., or an increase over the preceding year of 40,275 tons, valued at 495,600*l*.

The following table supplies the necessary details :—

	Imports.		Exports.	
	Raw Materials.	Manufactured Products.	Raw Materials.	Manufactured Products.
	Tons.	Tons.	Tons.	Tons.
Tons.....	1,016,254	210,915	257,126	422,927
Increase.....	10,169	28,046	..	10,261
Decrease.....	..	..	17,204	..
	£	£	£	£
Value.....	7,496,900	5,596,800	1,629,100	12,105,500
Increase.....	..	265,800	8,250	766,200
Decrease.....	544,850	..	..	..

It will be seen that whilst the value per ton in the case of the imports had declined from 11*l.* 3*s.* 4*d.* to 10*l.* 11*s.* 10*d.*, the corresponding figures for the export trade show a rise from 19*l.* 2*s.* to 20*l.* 3*s.* 9*d.* per ton, or about 5 per cent.

This rise is explained by the increased proportion of goods of a higher value, and not by an increase in price, as might be assumed at first sight. The increase in the cost of production, on the other hand, is estimated at about 3½ per cent., chiefly owing to higher wages and larger coal bills. Any prosperity in the chemical industries must, therefore, have resulted not from higher prices having been obtained in the market, but from the increase in the volume of trade. The published accounts for 1890 of 82 limited companies show a capital of 9,903,655*l.*, on which was divided 1,269,465*l.* or an average of 12·81 per cent.

The following figures show the proportionate earnings of these 82 companies :—

Eighteen companies, or 22 per cent. of the whole, paid no dividend.

Two, or 2½ per cent., paid from 0 to 2½ per cent.

Fifteen, or 18 per cent., paid from 2½ to 5 per cent.

Five, or 6 per cent., paid from 5 to 7½ per cent.

Fifteen, or 18 per cent, paid from 7½ to 10 per cent.

Fourteen, or 17 per cent., paid from 10 to 15 per cent.

Thirteen, or 16 per cent., paid over 15 per cent.

The average dividends for the previous years amounted to :—

	Per Cent.
1882	12·82
1883	10·02
1884	7·96
1885	6·37
1886	7·17
1887	8·92
1888	9·78
1889	10·58

so that since 1885 there has been a steady improvement. The earnings of the *Alkali Companies* for 1890 (including the *same* companies during the last five years) are as follows :—

	Per Cent.
1886	4·61
1887	5·34
1888	5·97
1889	6·87
1890	7·18

so that in this important industry there is also a decided improvement. The *Stassfurt salt industries* details did not, however, share in this improvement, while the *potassium industry* remained substantially unaltered. The demand for saltpetre suffered from the introduction of smokeless powder, and the same was the case with potassium chlorate. Potassium bichromate had a hard struggle against English competition. After a long period of depression the *soda industry* has improved, partly due to the formation of the United Alkali Company. Whereas formerly imports of soda exceeded exports by 28,000 tons, the position is now reversed, and the excess of exports almost amounts to the figure quoted. This is considered to be due to the Customs tariff which has strengthened home production without affecting consumption.

Pharmaceutical, Photographic, and other Technical Chemicals yielded an average dividend of 11·10 per cent. In the interests of this branch a possible increase in the Italian tariff is much to be deprecated, as tending to close a portion of the foreign market. Ether and alcoholic preparations have been gravely affected owing to the anomalies in the Customs tariff. Movements have been set on foot to remedy this evil, and the various Governments have been petitioned. Mineral colours have been in great demand at home, although business has not been easy in foreign markets, partly through Customs tariffs and partly through competition. With England and Belgium, however, the trade has been good. The syndication of the ultramarine factories has done much good, and the prospects of this industry are considered good. Agitation for syndicating the *Soap* manufacture has not yet had any result. The *Coal-Tar Colour Industry* is satisfactory, and the large factories divided an average of 20·75 per cent., previous years showing the following figures :—

	Per Cent.
1886	9·94
1887	13·25
1888	15·44
1889	17·50

Attention is drawn to the still growing importance of coal-tar colours, to which are attributable in a large measure the good results obtained.

The trade in *Explosives* has likewise been successful, average dividends being as high as 18·88 per cent., the figures for the previous years being :—

	Per Cent.
1886	16·09
1887	14·08
1888	15·41
1889	13·00

Last year's good results are mainly due to the older dynamite exporters, among whom there exists a syndicate which has done much to assist business. Gunpowder for exportation has done well, partly owing to orders from Africa, partly owing to the growing favour in which German makes are held in foreign markets. 1890 marked a great change with respect to gunpowder for military purposes, but it is pretty clear that the old makes of powder will hold their own for a long time to come, particularly as regards guns of large calibre. The *Gun-cotton, Detonator,* and *Match trades* have not shown any remarkable features, the former in fact not having been very flourishing.

Artificial Manures have earned an average dividend of 10·21 per cent. clearly showing that the importance of these products is being more and more recognised every year. In spite of determined competition from England it is said that German manufacturers continued to hold the field owing to greater care in selection of raw materials and mechanical preparation, the main object being to produce superphosphate as dry and finely ground as possible. Arrangements have been made with the agricultural experimental stations ("Versuchsstationen") with a view to guaranteeing to consumers the supply of certain brands. The extended use of *Thomas slag* appears to have benefited the superphosphate industry rather than proved detrimental to it as had been feared.

The Secretary, after alluding to a proposed alteration in the Society's subscription and certain contemplated improvements and extensions of the Society's Journal, went on to say that the new German patent law would afford increased protection to inventors, particularly in the chemical world; and it was matter for congratulation, he thought, that the Society's exertions in this direction had been so successful. The researches of the Society into the results of the McKinley tariff, as far as the German chemical industries were concerned, had not shown so far any direct injury, but certain branches of the trade had certainly suffered indirectly through slackness in the demand for certain chemicals required in the textile trade.

Dr. Martius then referred to the participation of the chemical industries in the Chicago Exhibition, 1893. The members had already expressed their readiness to take part in the exhibition, but he thought that the Imperial Government should assist with funds in order to ensure as complete a representation as was possible. He estimated that about 300,000*l.* would be required, a portion to be expended in assisting exhibitors in the cost of transport, but the bulk for the artistic decoration of the buildings and exhibits. The Paris Exhibition showed the immense advantage reaped by French exhibitors from their skill in displaying their goods in an imposingly decorative manner, and he thought that preparations in this direction could not be commenced at too early a date. *Herr Caspar*, taking up the discussion, agreed with the last speaker in regard to his main point, but thought the sum named was unnecessarily large. The Prussian and Bavarian State railways had already expressed their willingness to carry exhibition goods at one-half of the ordinary rates, and negotiations were pending with the steamship companies with a view to securing a similar concession. From all reports to hand, he imagined that the competition from other countries would be very keen. *Dr. Witte* spoke in corroboration, and the motion of Dr. Martius to appoint a special committee to open a list for applications from intending exhibitors was unanimously approved.

Herr Siegle reported on the exceptions to the prohibition of Sunday labour, and, after a discussion, it was agreed that a sheet of queries should be forwarded to every member, in order to get the information necessary for submitting proposals to the Federal Council. A motion was then carried, brought forward by *Dr. Hecht*, to petition the Government on the subject of the protection of factory and business secrets. Further motions referred to "concessions of industrial establishments" (moved by *Herr Kaopp*), "the carrying into effect of patents in foreign countries" (*Herr Buttinger*), and "the use of duty-free alcohol for industrial purposes" (*Dr Witte*). (Compare this Journal, 1890, 1080—1082.)—H. S.

BOARD OF TRADE RETURNS

Summary of Imports.

	Month ending 31st October	
	1890.	1891.
	£	£
Metals	2,073,732	1,803,088
Chemicals and dyestuffs	458,458	434,685
Oils	636,067	709,918
Raw materials for non-textile industries	4,105,988	4,038,012
Total value of all imports	37,746,256	36,873,829

Summary of Exports.

	Month ending 31st October	
	1890.	1891.
	£	£
Metals (other than machinery)	4,76,275	3,179,014
Chemicals and medicines	799,073	798,180
Miscellaneous articles	3,191,284	2,810,960
Total value of all exports	23,673,091	21,166,113

Imports of Metals for Month ending 31st October.

Articles.		Quantities.		Values.	
		1890.	1891.	1890.	1891.
				£	£
Copper:—					
Ore	Tons	10,480	8,896	82,700	87,122
Regulus	„	6,984	8,069	225,936	210,632
Unwrought	„	5,315	4,121	314,152	213,645
Iron:—					
Ore	„	272,507	212,206	210,772	150,140
Bolt, bar, &c.	„	8,642	6,642	91,079	61,716
Steel, unwrought	„	647	620	6,975	6,768
Lead, pig and sheet	„	14,916	16,651	208,977	209,785
Pyrites	„	43,861	31,913	81,998	58,833
Quicksilver	Lb.	174,960	94,256	23,250	9,235
Tin	Cwt.	36,417	39 253	181,187	184,212
Zinc	Tons	7,965	5,161	185,505	119,037
Other articles	Value £	..	..	461,201	491,963
Total value of metals		..	..	2,073,732	1,803,088

Imports of Raw Materials for Non-Textile Industries for Month ending 31st October.

Articles		Quantities.		Values.	
		1890.	1891.	1890.	1891.
				£	£
Bark, Peruvian	Cwt.	9,353	9,635	21,522	19,231
Bristles	Lb.	300,742	105,038	41,538	26,543
Caoutchouc	Cwt.	23,676	22,949	302,421	245,494
Gum:—					
Arabic	„	2,621	6,578	8,821	14,760
Lac, &c.	„	7,505	7,879	34,790	32,572
Gutta-percha	„	9,175	3,125	99,267	41,843
Hides, raw:—					
Dry	„	30,273	34,410	102,264	95,270
Wet	„	51,302	55,540	117,269	123,866
Ivory	„	1,189	1,717	77,025	83,812
Manure:—					
Guano	Tons	891	3,644	7,502	25,880
Bones	„	3,069	5,003	16,646	22,843
Paraffin	Cwt.	36,405	39,725	47,222	60,262
Linen rags	Tons	2,058	2,715	22,647	28 030
Esparto	„	14,633	15,260	75,136	76,172
Pulp of wood	„	7,628	15,133	49,643	82,163
Rosin	Cwt.	89,145	63,124	21,596	16,831
Tallow and stearin	„	103,105	69,508	133,485	91,865
Tar	Barrels	21,184	16,961	17,337	14,535
Wood:—					
Hewn	Loads	212,054	230,321	481,432	516,743
Sawn	„	538,704	509,035	1,168,543	1,176,145
Staves	„	12,341	15,660	50,923	70,883
Mahogany	Tons	2,525	3,512	25,172	32,409
Other articles	Value £	..	..	1,180,787	1,139,830
Total value		..	..	4,105,988	4,038,012

Besides the above, drugs to the value of 70,556*l.* were imported, as against 67,217*l.* in October 1890.

Imports of Chemicals and Dyestuffs for Month ending 31st October.

Articles.	Quantities.		Values.	
	1890.	1891.	1890.	1891.
			£	£
Alkali..... Cwt.	3,042	10,487	2,444	5,786
Bark (tanners, &c.) „	36,861	41,349	16,589	20,086
Brimstone..... „	41,936	18,183	9,220	6,696
Chemicals..... Value £	..	..	116,477	115,775
Cochineal ..... Cwt.	620	827	4,239	5,101
Cutch and gambier Tons	2,236	2,370	58,426	63,892
Dyes:—				
Aniline..... Value £	..	..	26,468	18,504
Alizarine ..... „	..	..	22,166	32,260
Other ..... „	..	..	2,598	188
Indigo ..... Cwt.	907	308	14,186	4,654
Madder ..... „	1,256	1,385	1,918	1,937
Nitrate of soda.... „	92,246	107,304	38,302	47,954
Nitrate of potash . „	18,772	17,900	17,764	16,729
Valonia..... Tons	927	562	20,431	10,281
Other articles... Value £	..	..	97,149	85,642
Total value of chemicals	..	..	458,458	434,685

Imports of Oils for Month ending 31st October.

Articles.	Quantities.		Values.	
	1890.	1891.	1890.	1891.
			£	£
Cocoa-nut..... Cwt.	17,668	35,081	27,695	47,003
Olive ..... Tuns	872	1,159	34,663	46,620
Palm ..... Cwt.	98,857	110,123	130,734	129,238
Petroleum ..... Gall.	10,159,958	12,112,813	225,671	251,200
Seed ..... Tons	2,565	1,968	67,675	56,664
Train, &c..... Tuns	1,358	1,616	27,417	44,353
Turpentine ..... Cwt.	28,557	51,118	42,650	69,975
Other articles .. Value £	..	..	80,152	64,756
Total value of oils...	..	..	636,007	709,208

Exports of Drugs and Chemicals for Month ending 31st October.

Articles.	Quantities.		Values.	
	1890.	1891.	1890.	1891.
			£	£
Alkali..... Cwt.	535,872	664,721	191,585	250,486
Bleaching materials „	148,638	156,563	43,818	48,523
Chemical manures. Tons	26,621	25,551	171,772	153,546
Medicines..... Value £	..	..	92,340	99,401
Other articles... „	..	..	292,558	246,524
Total value	..	..	792,073	798,480

Exports of Metals (other than Machinery) for Month ending 31st October.

Articles.	Quantities.		Values.	
	1890.	1891.	1890.	1891.
			£	£
Brass..... Cwt.	10,567	11,146	46,956	49,500
Copper:—				
Unwrought ..... „	79,181	67,947	249,265	179,962
Wrought..... „	28,136	30,911	94,761	102,637
Mixed metal .... „	32,662	27,008	97,156	75,820
Hardware ..... Value £	..	..	248,525	226,823
Implements..... „	..	..	122,780	121,276
Iron and steel..... Tons	354,970	287,685	2,811,512	2,151,734
Lead ..... „	4,520	3,557	67,117	49,106
Plated wares... Value £	..	..	14,642	12,894
Telegraph wires, &c. „	..	..	335,064	38,167
Tin ..... Cwt.	9,804	11,079	49,750	52,832
Zinc ..... „	13,030	10,308	14,203	11,753
Other articles .. Value £	..	..	94,614	77,110
Total value	..	..	4,276,275	3,179,014

Exports of Miscellaneous Articles for Month ending 31st October.

Articles.	Quantities.		Values.	
	1890.	1891.	1890.	1891.
			£	£
Gunpowder..... Lb.	994,100	958,700	24,109	24,050
Military stores.. Value £	..	..	155,006	127,821
Candles..... Lb.	1,174,200	1,381,800	23,896	27,170
Caoutchouc ..... Value £	..	..	117,889	120,936
Cement..... Tons	51,577	46,441	106,288	90,110
Products of coal Value £	..	..	133,156	133,276
Earthenware ... „	..	..	185,976	203,302
Stoneware ..... „	..	..	11,249	11,912
Glass:—				
Plate..... Sq. Ft.	214,237	375,981	15,150	25,083
Flint..... Cwt.	10,862	11,264	24,893	23,363
Bottles..... „	83,729	71,581	39,381	33,521
Other kinds.... „	17,839	19,766	14,867	17,184
Leather:—				
Unwrought .... „	15,191	11,036	136,628	106,535
Wrought ..... Value £	..	..	43,308	49,285
Seed oil..... Tons	6,451	6,008	149,082	126,586
Floorcloth ..... Sq. Yds.	1,240,200	1,658,400	60,650	67,862
Painters' materials Val. £	..	..	140,341	143,681
Paper ..... Cwt.	80,362	83,889	146,538	148,384
Rags..... Tons	3,497	4,842	31,818	32,108
Soap..... Cwt.	34,154	45,974	41,175	49,754
Total value	..	..	3,191,284	2,899,960

Monthly Patent List.

* The dates given are the dates of the Official Journals in which acceptances of the Complete Specifications are advertised. Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the said dates.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

Applications.

17,886. H. H. Lake.—From La Société Anonyme du Compresseur Jourdan, France. Improvements in and relating to apparatus for expressing liquids from vegetable, animal, or mineral substances. October 19.

18,000. T. Spendlove. Improvements in apparatus for raising fluids, semi-fluids, and pulverulent substances. October 20.

18,008. A. Allen. Improvements in evaporating pans. October 21.

18,042. W. Muirhead and J. Macfarlane. *See* Class X.

18,084. J. H. Frazer. Improvements connected with furnaces. October 21.

18,113. C. L. Clarke and J. Leigh. Improved apparatus for evaporating and cooling liquids. October 22.

18,116. W. Birch. Improved apparatus for mixing powdered substances with water or other liquids. October 22.

18,216. S. Smithson. Improvements in or relating to means or apparatus for drying dyewoods, myr abolan grain, fuller's earth, night soil, and other pulpy matter. Complete Specification. October 23.

18,483. T. Phipps. An improved stop valve for liquids, vapours, or gases. Complete Specification. October 27.

18,488. J. Sutton. *See* Class XVII.

18,533. J. Wright. Improvements in the construction of vertical stills for the distillation of ammoniacal and other liquors or liquids. October 28.

18,550. R. C. Sayer. Improvements in gaseous pressure apparatus. October 28.

18,876. W. R. Dunstan and T. S. Dymond. An apparatus for shaking, mixing, and generally for purposes of agitation. November 2.

18,904. E. Hesketh and O. J. Ellis. An improvement connected with the employment of carbonic acid gas in refrigerating apparatus. Complete Specification. November 2.

18,959. A. Feldmann. Improvements in distilling apparatus suitable for the treatment of ammoniacal liquors. November 3.

19,027. H. S. Fearon and W. S. Miller. A new or improved process for desiccation or evaporation. November 4.

19,042. H. H. Partridge and J. Millward. Improvements in apparatus for compressing air or other gas by hydraulic pressure. November 4.

19,335. L. Sterne and T. R. Murray. Improvements in regulating apparatus for refrigerating or freezing machines working with volatile liquids. November 9.

19,464. E. Kerr. Improvements in furnaces. Complete Specification. November 10.

19,475. A. Backus, jun. Improvements in furnaces. Complete Specification. November 10.

19,486. D. B. Morison. Improvements in and connected with apparatus for heating or evaporating liquids. November 10.

19,607. H. A. A. Dombrain. Improvements in apparatus for squeezing liquids from pulverulent and granular substances. November 12.

19,780. C. J. Schofield. *See* Class VII.

Complete Specifications Accepted.*

1890.

19,071. O. Imray.—From A. Bergh. Method and apparatus for subjecting liquids having substances suspended in them to centrifugal action, whereby they are brought into contact only with sterilised or with other air, with which they are to be saturated. November 18.

19,550. J. Kirkaldy. Apparatus for heating and evaporating liquids. November 4.

20,834. F. C. Nunn. Apparatus for purifying water. October 28.

20,951. J. A. Drakenberg. Mode of and apparatus for separating fat, grease, or other impurities from the feed-water of steam boilers and other water. October 28.

20,955. O. Clausen. Manufacture of porous magnesian bricks for the linings of stoves, furnaces, fire-places, and flues, and the construction of stoves and furnaces with such bricks. November 4.

1891.

101. W. H. Wilcox. Filter for oils, lubricants, and other fluids. November 11.

16,248. T. Ledward. Improvements in or relating to open air fluid condensers. November 11.

17,034. H. C. Cox. Apparatus for the automatic control of sulphuric acid supply to carbonic acid generators used in aerated water manufacture and other industries. November 11.

II.—FUEL, GAS, AND LIGHT.

Applications.

18,082. The Gas Economising and Improved Light Syndicate, Limited, and J. Love. Improvements in apparatus for carburetting gas or air. October 21.

18,094. J. Major. An improved method for utilising gas. October 21.

18,158. T. McGhie. Improvements in or connected with retorts for the distillation of mineral oil. October 22.

18,213. J. W. Harrison, T. Hammond, and W. Powell. Improvements in the method of and means employed in charging gas retorts. October 23.

18,377. A. Johnson and The Co-operative Inventive Association, Limited. Improvements in the method of removing naphthalene from the inlet pipes of gas holders. October 26.

18,409. G. T. J. Webb. Improved method of producing oxygen gas for illuminating purposes. October 26.

18,414. R. Campion and T. W. Butler. The manufacture of fire-lighters and artificial fuel from a waste material. October 26.

18,498. H. H. Lake.—From C. H. Wilder, United States. Improvements relating to the manufacture of gas from hydrocarbon oils, and to apparatus therefor. Complete Specification. October 27.

18,608. J. C. Chandler and W. Sims. Improvements in apparatus for purifying gas. October 28.

19,152. C. Winter. Winter's improved compound fuel. November 6.

19,255. G. Wilton. Improvements in and relating to the purification of coal-gas, and the recovery of products from the distillation of coal. November 7.

19,418. J. G. Cooper. Improvements in the treatment of petroleum. Complete Specification. November 10.

19,496. J. Lyle. The treatment of ingredients for the manufacture of fuel briquettes. November 10.

19,641. T. G. Springer. Improvements in the manufacture of gas, and in apparatus to be used therein. Complete Specification. November 12.

19,758. Sir G. Elliot, Bart., and J. MacGowan, jun. Improvements in or relating to the manufacture of coke. November 14.

Complete Specifications Accepted.

1890.

18,618. T. A. Greene and C. M. Walker. Improvements in gas lighting. November 18.

18,871. H. Williams. Method and apparatus for burning gas for heating and steam generating purposes. October 28.

18,872. H. Williams. Improvements in gas generating apparatus. October 28.

19,963. A. Vinard. Producing and supplying gas for lighting and motive power, and apparatus therefor. October 28.

1891.

23. J. O. Spong. Improved arrangement of apparatus for obtaining chromatic illumination from gas or other flame. November 11.

13,179. D. C. Fischel. Improvements in artificial fuel. October 28.

16,907. L. T. Wilcox. Devices for heating and lighting. November 18.

17,557. A. Kitson. Apparatus for manufacturing gas. November 18.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

Application.

19,255. G. Wilton. *See* Class II.

Complete Specifications Accepted.

1890.

19,502. A. M. Clark.—From The Gewerkschaft Messel. Production from mineral oils of sulphonic acids and sulphones, and the manufacture of a new product for treating gelatinous matters with sulphonic acid. October 28.

1891.

17,221. E. Binney. *See* Class XIII.

IV.—COLOURING MATTERS AND DYES.

Applications.

18,606. H. H. Lake.—From Messrs. Wirth and Co., agents for A. Leonhardt and Co., Germany. Improvements in the manufacture of colouring matters. October 28.

18,783. O. Imray.—From The Farbwerke vormals Meister, Lucius, and Brüning, Germany. A new manufacture of colouring matter. October 31.

19,061. B. Willcox.—From The Farbenfabriken vormals F. Bayer and Co., Germany. The manufacture and production of new cotton or substantive dyestuffs. November 4.

19,062. B. Willcox.—From The Farbenfabriken vormals F. Bayer and Co., Germany. Improvements in or connected with the manufacture and production of colouring matters. November 4.

19,096. R. Hunt, E. S. Wilson, and E. Stewart. Improvements in the manufacture of colouring matters. November 5.

19,097. R. Hunt, E. S. Wilson, and E. Stewart. *See* Class XII.

19,202. W. J. J. Hawkins. Improvements in copying ink. November 6.

19,588. J. Y. Johnson.—From The Badische Anilin and Soda Fabrik, Germany. The manufacture and production of new blue mordant dyeing colouring matters. November 12.

19,589. J. Y. Johnson.—From The Badische Anilin and Soda Fabrik, Germany. The manufacture and production of new blue mordant dyeing colouring matters. November 12.

Complete Specifications Accepted.

1890.

20,889. O. Imray.—From The Farbwerke vormals Meister, Lucius, and Brüning. Production of azo-colouring matters. October 28.

21,284. J. R. Greigy. Manufacure of diethyldibenzyldiamidodiphenylmethan-disulpho acid and violet dyestuffs therefrom. October 28.

1891.

857. S. Pitt.—From L. Cassella and Co. Improvements in triphenylmethane colouring matters. November 18.

1737. O. Imray.—From the Actien Gesellschaft fur Aniline Fabrikation. Manufacture of colouring matters. November 11.

1883. B. Willcox.—From The Farbenfabriken vormals F. Bayer and Co. Manufacture of new dyestuffs derived from anthracene and anthraquinone. November 18.

V.—TEXTILES, COTTON, WOOL, SILK, Etc.

Applications.

18,129. J. Miller, sen., and J. Miller, jun. Improvements in the method of and apparatus for rendering textile fabrics waterproof by one treatment or process. October 22.

18,389. G. Mort. Improvements in the manufacture of figured textile fabrics. October 26.

18,470. C. G. Hagemann. Manufacture or production of cellular substance and textile fibre. October 27.

18,851. W. Golding. An improved compound of india-rubber and fibre formed by treating fibrous fabrics, yarns, cords, &c., with rubber, so that the fibrous material is permeated by the rubber, and the individual fibres are embedded therein, constituting a new manufacture to be called "Rubbric," and processes, apparatus, and machinery for producing the same. October 31.

18,878. S. Fisher and H. Murgatroyd. Improvements in machinery or apparatus for cleaning and lustreing dyed or undyed yarns of silk, cotton or other fibrous substances. November 2.

19,135. L. E. Vial. Improved means applicable for use in the treatment of China-grass, and other plants adapted for employment in the textile industry. Complete Specification. November 5.

19,710. F. G. Annison. Improvements in the treatment of linen and other textile fabrics, applicable to the manufacture of show bills, show cards, posters, tablets, wall decorations, and other purposes. November 13.

COMPLETE SPECIFICATIONS ACCEPTED.

1890.

20,257. A. H. Briggs. Method and apparatus for scouring, drying, and stretching mohair, alpaca, and such like warps and yarns. October 28.

20,267. A. Ambler, S. Ambler, and F. Ambler. Improvements in the cleansing, treating, washing wool and like animal fibres, and in apparatus employed therein. November 18.

20,806. J. Longmore and R. Williamson. Improvements in the combing of rhea and similar inelastic fibres. November 1.

1891.

92. C. W. Kimmins and T. Craig. *See* Class XII.

10,644. R. Ingham. Improved compound or mixture for use in sizing yarn and fabrics. November 4.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

APPLICATIONS.

17,887. F. Odernheimer. Process for printing and dyeing textiles, fibres, hair, feathers, and the like by means of metal salts. Complete Specification. October 19.

17,939. J. Smith. Improvements in or connected with dyeing, tinting, sizing and bleaching, or similarly operating upon textile fabrics or fibres, and other materials. October 20.

18,467. E. C. Kayser. Improvements in dyeing and printing textile fibres, fabrics, and like materials. October 27.

18,588. G. Young and W. Crippin. Improvements in the construction of hollow perforated skewers employed for dyeing and otherwise treating cops of yarn or thread, and in their arrangement in connection with the parts on which they are to be used. October 28.

18,809. E. C. Kayser. Improvements in dyeing or colouring textile fibres and fabrics. October 31.

18,818. R. F. Flynn. Improvements in the manufacture of linoleum floor-cloth. October 31.

18,879. G. M'Connell. An improved waterproofing solution, chiefly applicable in the staining of paper. November 2.

19,113. W. Ward. Improvements in colouring cork used in the manufacture of floor coverings, and in apparatus used in colouring the same. November 5.

19,342. J. Kennedy. Improved composition or compound to be used in bleaching cotton, linen, or woollen fabrics. November 9.

COMPLETE SPECIFICATIONS ACCEPTED.

1890.

17,694. E. W. Foxlee. Printing with primuline. November 11.

21,062. C. E. Maistre and J. M. Compagnie. Dyeing of textile fabrics or materials with indigo, and the manufacture of saponaceous matter employed therein; also applicable for other operations in which saponaceous material is required. November 4.

VII.—ACIDS, ALKALIS, AND SALTS.

APPLICATIONS.

17,911. H. C. Sacré and H. Grimshaw. The utilisation of the waste oxide of iron produced in the manufacture and purification of chloride of zinc. October 20.

17,933. W. P. Thompson.—From J. A. Bradburn and J. D. Pennock, United States. Improvements in the manufacture of alumina. Complete Specification. October 20.

18,066. H. Kohler. Improved method for the manufacture of picric acid. October 21.

18,159. A. Vogt. Improvements in the treatment of nitrate of alkalis for the manufacture of nitric acid and its by-products. October 22.

18,231. D. Rylands. Improvements in means or processes for producing carbonic acid gas. October 23.

18,324. L. Brunner and A. Zanner. An improved process for manufacturing nitrate of ammonia or chloride of ammonia, simultaneously obtaining either precipitated phosphate of lime or an enriched phosphate of lime. Complete Specification. October 24.

18,181. J. E. Bott. Improvements in the manufacture of salt. October 27.

18,182. J. E. Bott. Improvements in the manufacture of caustic alkalis. October 27.

18,548. J. Simpson. Improvements in the manufacture of carbonated alkali and caustic soda. October 28.

18,693. W. Smith. *See* Class XIII.

18,700. C. W. Vincent. Improvements in the preparation of mineral salts for bathing and drinking purposes. October 29.

18,861. A. McDougall. Improvements in the manufacture of nitrate of ammonia. November 2.

18,959. A. Feldmann. *See* Class I.

19,016. T. H. Williams and W. H. Symons. Improvements in the manufacture of carbonic acid gas. November 4.

19,051. O. Wolff and R. Clug. Improvements in or connected with the manufacture of soluble silicates. November 4.

19,207. H. W. Wallis. Improvements in the manufacture of caustic alkalis. November 6.

19,215. J. L. Kessler. Improvements in and apparatus for the concentration of sulphuric acid. November 6.

19,342. J. Kennedy. Improved composition or compound to be used in bleaching cotton, linen, or woollen fabrics. November 9.

19,375. C. Hoepfner. Improvements in and relating to the manufacture of chlorine. November 9.

19,382. C. Bigot and J. Schreiter. Improvements in the manufacture of sodium borates. Complete Specification. November 9.

19,453. A. J. Boult.—From C. E. Ongley and O. D. Ballert, United States. Improvements in the preparation of salt. Complete Specification. November 10.

19,637. E. Edwards.—From H. Bauer and J. Syiketta, Germany. A new or improved process for the production of boron sulphate compounds, and the application of such products to the unliming of hides or skins, and to prevention of putrefaction. November 12.

19,780. C. J. Schofield. Improvements in apparatus for concentrating sulphuric and other acids. November 14.

COMPLETE SPECIFICATIONS ACCEPTED.

1890.

19,776. J. Simpson. Improvements in the manufacture of chlorine. November 4.

21,225. F. M. Lyte and O. J. Steinhart. Production of chlorine and of strong hydrochloric acid. November 11.

1891.

5352. F. M. Lyte. Production of alkaline carbonates and chlorine and their derivatives. October 28.

15,288. R. J. Brice. A process of utilising galvaniser's waste. November 18.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

Applications.

18,189. E. Edwards.—From K. Goetz, Germany. Improvements in the liquid material or "slip" used in the manufacture of porcelain, stoneware, and the like. Complete Specification. October 22.

18,230. D. Rylands. Improvements applicable to furnaces or retorts used in the production of glass and for similar purposes. October 23.

18,281. C. D. d'Enghien, A. D. d'Enghien, and S. D. d'Enghien. Improvements in kilns or ovens for firing terra-cotta and other like materials. Complete Specification. October 24.

18,559. T. Arnold. Improvements in the utilisation of slag for the manufacture of blocks, slabs, drain pipes, or other moulded articles. October 28.

18,939. J. W. Bonta. Method of and apparatus for rolling plate or sheet glass. Complete Specification. November 3.

19,441. W. W. Pilkington. Improvements in apparatus for forming molten glass into sheets. November 10.

19,527. T. Willett. Improvements in automatic machinery for the manufacture of pottery. November 11.

19,777. T. C. J. Thomas. Improvements in the construction of tank furnaces for the manufacture of glass. November 14.

Complete Specifications Accepted.

1890.

17,407. T. G. Webb. Improvements in the manufacture of glass retorts as used in chemical works for the concentration of acids, and other analogous purposes. November 4.

20,857. G. Swift. Improvements in tiles, faience ware, and other fictile ware required to be cemented to plane or other surfaces. October 28.

20,955. O. Clausen. A manufacture of porous magnesian bricks for the linings of stoves, furnaces, fire-places, and flues, and the construction of stoves and furnaces with such bricks. November 4.

21,212. J. B. Alzugaray. Manufacture of refractory materials or articles. November 18.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

Applications.

18,284. W. A. Briggs. An improved marine cement. October 24.

19,106. D. Ward. Making coloured stucco, coloured concrete blocks, and tiles. November 5.

19,467. J. C. Bloomfield. Improvements in the manufacture of plaster. November 10.

19,534. W. Briggs. An improved concrete paving or flooring. November 11.

Complete Specifications Accepted.

1890.

18,603. T. Arnold. Improvements relating to the manufacture of cement, and the means employed therefor. October 28.

18,922. W. Smartt. Process of drying or burning bricks, pipes, tiles, and other goods in clamps, kilns, and other works, and in apparatus for effecting the same. October 28.

1891.

17,466. T. A. Lee. Improvements in fireproof floors and roofs. November 18.

X.—METALLURGY, MINING, Etc.

Applications.

17,851. G. W. Hart. A process and apparatus for deoxidising or reducing metallic oxides. October 19.

17,933. W. P. Thompson.—From J. A. Bradburn and J. D. Pennock, United States. *See* Class VII.

17,955. C. W. Pinkney. An improved metallic alloy, more especially intended for use for gas or petroleum engine igniters or like articles subjected to great heat. October 20.

18,042. W. Muirhead and J. Macfarlane. Improvements connected with steel-melting and other gas-fired furnaces. October 21.

18,069. J. B. Alzugaray. Improvements in iron or steel alloys. October 21.

18,442. W. A. Sugden.—From W. R. Sugden, United States. Improvements in the manufacture of iron, and in fuel or a compound suitable therefor. October 27.

18,501. J. Nicholas. Improved means of extracting precious metals from their ores. October 27.

18,559. T. Arnold. *See* Class VIII.

18,752. J. A. Norton and J. Noad. Improvements in or relating to means used in effecting the extraction of precious metals from their ores and other compounds. October 30.

18,850. J. M. McMahan. Improvements relating to the extraction of precious metals from their ores, and to apparatus therefor. October 31.

18,907. J. M. McMahan. Improvements relating to the extraction of precious metals from their ores, and to apparatus therefor. November 2.

18,990. J. Colley. Improvements in adding metallic and non-metallic substances to steel and iron. November 4.

19,118. H. Le Neve Foster. Improvements in the manufacture of iron. November 5.

19,191. F. W. Martino. Improvements in the manufacture of alloys of nickel and copper, and of alloys of nickel and iron, and of alloys of nickel, copper, and iron. November 6.

19,254. C. J. L. Leffler. Improved alloys for the manufacture of cutting tools. November 7.

19,330. J. Johnson.—From J. Gayley, United States. Improvements in blast furnace linings. November 9.

19,389. S. H. Johnson and C. C. Hutchinson. Improvements in leaching ores and in apparatus therefor. November 10.

19,457. J. L. Hopper. Improvements in furnaces for roasting, smelting, and separating refractory and other ores. Complete Specification. November 10.

19,501. R. Woodley, J. Spear, and W. Harris. A process for solidifying steel, iron, or other material susceptible to magnetic influence by the application of electrical energy. November 11.

19,563. A. L. Gravier, A. Schanschieff, and K. Sando. Improvements in hardening and tempering steel and other metals. November 11.

19,573. G. Selve. A process of separating cobalt from nickel. November 11.

19,599. A. Fairley and J. F. Fairley. Improvements in the manufacture of hollow ingots or other hollow castings from steel or ingot iron. November 12.

19,771. A. K. Huntington and J. T. Prestige, jun. An improvement in copper alloys. November 14.

Complete Specifications Accepted.

1890.

17,380. J. von Langer and L. Cooper. Improvements in or connected with reverberatory furnaces for puddling or smelting iron, and for other purposes. October 28.

18,080. C. Hopfner. Improved method of treating cupreous liquors for the purpose of utilising the same. November 11.

18,869. A. Gutensohn. Improved method of and process for annealing metal plates and sheets, and apparatus for use in the same, and for other purposes. October 28.

18,869A. A. Gutensohn. Apparatus for preparing metal plates and sheets for annealing and for coating with tin or other metal. October 28.

18,934. W. Paterson and R. Stark. Extraction of metals from ore. October 28.

20,588. R. Martin and R. Evans. Means or apparatus employed in pressing or consolidating quantities of scrap metal. October 28.

20,768. G. J. Atkins and E. Applegarth. Means and apparatus for separating alkaline and earthy metals, and other products from the salts of such metals, or from other substances containing them. October 28.

20,895. J. E. Bott. Manufacture of armour plates and other similar articles. October 28.

21,025. L. Mond. New or improved manufacture of articles of nickel, and of nickel plated goods. October 28.

21,234. E. V. Bath. Utilisation of refuse or scoria of copper-smelting furnaces as a grinding or polishing agent or as a substitute for emery. November 4.

1891.

165. A. Sailler. Manufacture or production of metal plates hardened at one side. November 11.

295. C. Cochrane. Improvement in blast furnaces. November 18.

1785. L. Meyer. Production of aluminium. October 28.

11,337. C. James. An improved method or process for the collection of refined copper. November 4.

11,791. C. Edwards.—From L. Pszeolka. Process for the manufacture of compound armour plates and armour-plated turrets. October 28.

15,288. R. J. Brice. *See* Class VII.

16,192. E. Edwards.—From H. Shoenwalder. Improvements in Siemens-Martin furnaces. October 28.

16,486. L. L. Bordon. Manufacture of seamless compound ingots and wire. November 11.

XI.—ELECTROCHEMISTRY and ELECTRO METALLURGY

Applications.

17,994. R. Scheithauer. Improvements in and relating to electric batteries. Complete Specification. October 20.

18,097. C. N. Souther. Improvements in galvanic batteries. Complete Specification. Filed October 22. Date applied for March 23, 1891, being date of application in United States.

18,143. H. A. Mavor, W. A. Coulson, and S. Mavor. Improvements in the method of mounting storage battery plates. October 22.

18,256. A. S. Ford.—From H. Pottier, France. An improved process for the electro-deposition of metal upon the surface of glass, porcelain, china, earthenware, and other materials. October 23.

18,431. M. Waddell, J. B. Entz, and W. A. Phillips. Improvements in secondary batteries. Complete Specification. October 27.

18,477. O. Schlesinger. A depolarising liquid for galvanic batteries. October 27.

18,522. W. P. Thompson.—From C. L. Coffin, United States. Improved method of and apparatus for welding or working metals electrically. October 27.

18,597. E. Andreoli. Improvements in electrolysis. Complete Specification. October 28.

18,626. J. C. Richardson. Improvements in the construction of electrodes for use in the electrolysis of solutions. October 29.

18,627. J. C. Richardson. Improvements relating to electrodes to be used in the electrolysis of solutions. October 29.

18,931. J. Pullman and H. Lane. Improvements in apparatus and process for obtaining aluminium or other metals by means of electricity. November 3.

18,974. T. Parker. Improvements in electrical furnaces for the manufacture of phosphorus or other matters capable of being volatilised by heat. November 3.

19,458. W. P. Thompson.—From N. H. Edgerton, United States. Improvements in electric accumulators or storage batteries. Complete Specification. November 10.

19,617. M. Müthel. Improved exciting fluid for galvanic zinc carbon batteries. Complete Specification. November 12.

19,691. J. C. Lawson. An improved device for ozonising air or gas by means of electricity. November 13.

19,704. J. C. Richardson. Improvements relating to the application of depolarisers in electrolysis. November 13.

19,775. A. Brener. Improvements in diaphragms for electrolytic decomposing apparatus. November 14.

Complete Specifications Accepted.

1890.

20,102. A. S. Baxendale. Improvement in dynamo-electric machines. November 11.

1891.

10,977. A. de Meritens. Improvements in galvanic batteries. October 28.

12,322. A. J. Boult.—From J. H. Bassler. Improvements in or relating to electrical welding. November 11.

15,575. A. de Meritens. Galvanic batteries. October 28.

16,187. H. H. Leigh.—From J. B. Gardiner. Obtaining a fluid for primary batteries and utilising the waste products of such batteries. November 11.

16,522. W. P. Thompson.—From C. L. Coffin. Improvements in electrically soldering or brazing metal. November 4.

17,003. A. F. Madden. Machines for making grids for secondary batteries. November 11.

17,430. D. M. Lamb. Electric batteries and materials therefor. November 18.

XII.—FATS, OILS, AND SOAP MANUFACTURE.

Applications.

18,224. W. Mills. Improvements in bleaching, deodorising, and purifying fats and oils, and apparatus therefor. October 23.

18,579. P. R. de F. d'Humy. Improvements in the manufacture or treatment of soap for toilet, washing, medical, and other like purposes, and in apparatus for holding or containing soap, and supplying same for personal or other uses. October 28.

18,632. F. G. Haigh and W. C. Haigh. An improved fluid soap. October 29.

18,675. J. J. Mann. Improvements in or applicable to toilet and other soaps. October 29.

18,731. A. G. Smith. Improvements in soap. October 30.

19,097. R. Hunt, E. S. Wilson, and E. Stewart. Improvements in treating crude cotton-seed oil to obtain oil, soap, and colouring matter. November 5.

19,297. J. Taylor. Improvements in the manufacture of soaps. November 7.

19,507. J. Taylor. Improvements in the manufacture of soap. November 11.

19,779. A. W. Hayles. A new or improved sharpening oil. November 14.

Complete Specifications Accepted.

1890.

19,382. J. Taylor. Treatment of soap-makers' waste lyes for the recovery of glycerin and other substances. November 4.

1891.

92. C. W. Kimmins and T. Craig. Separation or treatment of fatty or greasy matters from the wash-waters of wool-washing or scouring establishments. November 11.

101. W. H. Willcox. *See* Class 1.

XIII.—PAINTS, PIGMENTS, VARNISHES, AND RESINS.

Applications.

17,966. T. Christy and C. Weygang. Improvements in the manufacture of materials for use as substitutes for gutta-percha, rubber oil-cloths, and other water-resisting articles, impermeable tissues, and for other purposes, and the application of the products to various uses. October 20.

18,072. W. P. Thompson.—From A. Freiherr (Baron) von Pereira, Germany. Improvements in or relating to the manufacture or preparation of resinous paints. Complete Specification. October 21.

18,310. E. Casper and W. Sowerby. A new or improved manufacture of paint, polishing material, and cements. October 24.

18,566. M. Williams. Improvements in the manufacture of laundry blue. October 28.

18,693. W. Smith. Improvements in the manufacture of white lead by the acetate of ammonia process, and more particularly in the preparation of the acetate of ammonia to be used therein, or for other purposes. October 29.

18,709. T. H. Cobley. Improvements in the treatment of lead ores and the production therefrom of white lead, salts of and colours of lead, as also simultaneously zinc white. October 30.

18,895. C. H. Mathews.—From E. S. Mathews, United States. An improved compound for coating ships' bottoms, piles, and structures subject to the influence of sea-water. November 2.

19,545. E. V. Gardner. Improvements connected with the manufacture of white lead. November 11.

Complete Specifications Accepted.

1890.

16,093. R. W. E. MacIvor and W. Smith. Improvements in the production of "white lead" or basic carbonate of lead, and apparatus therefor. November 18.

16,916. T. Drake. A new turpentine and means of producing same. October 28.

19,323. W. Smith and W. Elmore. Manufacture of basic carbonate of lead or white lead. November 4.

19,784. W. Smith and W. Elmore. Manufacture of basic carbonate of lead or white lead. November 11.

1891.

684. W. Astrop and A. H. Parker. Improvements relating to the manufacture of carbonate of lead, or white lead, and to apparatus therefor. November 18.

1145. J. Campbell. Composition for coating tin and other like vessels. November 18.

13,429. J. Knowles. Improvements relating to laundry blue. November 11.

14,160. A. McCowatt. Improved anti-fouling composition for ships' bottoms. October 28.

16,098. J. C. Fell.—From C. A. Stevens. Manufacture of white lead. November 4.

17,221. E. Binney. Manufacture of lamp black, carbon black. November 18.

XIV.—TANNING, LEATHER, GLUE, AND SIZE.

Applications.

18,003. F. J. Bugg. The manufacture of an improved composition leather fabric. October 20.

19,397. I. Goldschmidt. Improvements in the process of dyeing, tanning, and mordanting leather, teasled fabrics, or other porous materials, and in apparatus employed therefor. November 10.

19,637. E. Edwards.—From H. Bauer and J. Syiketta, Germany. *See* Class VII.

19,658. W. Francis and A. F. S. Grant. An improved vessel for tanning purposes. November 13.

Complete Specification Accepted.

1891.

15,661. J. de Hesselle. Method and apparatus for shrinking leather by means of fat. November 4.

XV.—AGRICULTURE AND MANURES.

Complete Specification Accepted.

1891.

2168. W. Bowler. Improvements in the collection and utilisation of excreta, and in the preparation of manure therewith. November 11.

XVI.—SUGARS, STARCHES, GUMS, Etc.

Applications.

19,257. E. W. Catford. An improvement relating to the process of coating and colouring sugar crystals. November 7.

19,762. R. Morton and T. Morton. Improvements in and connected with pans for boiling or heating sugar or compounds thereof or similar substances. November 14.

19,774. J. Y. Johnson. — From C. Pieper, Germany. Improvements in the manufacture of grape sugar and grape sugar syrup. November 14.

XVII.—BREWING, WINES, SPIRITS, Etc.

Applications.

18,258. F. L. V. Beanes. An improved process for treating grain to obtain a product suitable for use in brewing, distilling, vinegar making, and other purposes. October 23.

18,292. F. Schreiber. Improvements in apparatus for liquoring sugar. October 24.

18,488. J. Sutton. An improved process for filtering beer and other liquids, and apparatus therefor. October 27.

18,511. V. Unlock. Improvements in brewing. Complete Specification. October 27.

18,538. R. H. Leaker. Improvements in pneumatic malting and in machinery or apparatus therefor. October 28.

18,833. L. Barlow. Improvements in drying and calcining brewers' refuse and grains, and other substances and materials. October 31.

18,997. R. H. Leaker. Improvements in kilning malt and in structures and apparatus therefor. November 4.

19,718. F. L. V. Beanes. Improvements in apparatus for treating grain, rice, and the like for the obtainment of a product suitable for brewing, distilling, vinegar-making, or other purposes. November 13.

19,785. J. G. Slater. From the Companhia Fabril de Artefactos de Metal, Brazil. Improvements in distillery apparatus. November 14.

19,787. D. Eylands. An improved substitute for yeast. November 14.

Complete Specifications Accepted.

1890.

20,803. T. Fletcher. See Class XVIII., *A*.

1891.

852. F. Konig. Manufacture of champagne and other beverages charged with carbonic acid. November 11.

12,668. H. Elion. Improvement in the purification of yeast. October 28.

14,276. A. Bruns. Process and apparatus for the production of sparkling wines and other sparkling beverages. November 4.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, and DISINFECTANTS.

Applications.

A.—Chemistry of Foods.

17,899. J. Kay. An improved method of preserving fruit. Complete Specification. October 19.

18,615. J. Quaglio. A process for roasting pure coffee whilst condensing the steam produced during the roasting operation in coffee substitutes or in sugar for the purpose of extracting the aroma and products therefrom. Complete Specification. October 29.

19,007. W. Flowers. Improvements relating to the admixture and treatment of certain ingredients for the production of a new article of food. November 4.

19,369. C. Chambers. An improved solidified jelly. November 9.

19,394. G. Reiss and J. Bauer. An improved preparation suitable for human food. November 10.

B.—Sanitary Chemistry.

17,844. A. Wollheim. An improved plan for the construction of works for the treatment of sewage and other foul or waste liquids. October 19.

17,924. A. P. Hope. Hope's process for oxygenating, deodorising, and disinfecting sewerage, sewage, or other fermentable or noxious matter. October 20.

17,925. A. P. Hope. Hope's process for oxygenating and disinfecting sewerage or other fermentable matter, and separating, clarifying, and precipitating same. October 20.

17,926. A. P. Hope. Hope's process for oxygenating and disinfecting sewerage, sewage, or other fermentable or noxious matter. October 20.

18,286. G. C. Purvis. New or improved method in sewage precipitation. October 24.

18,287. G. C. Purvis. New or improved method in sewage precipitation. October 24.

18,466. A. Lutschaunig. Improvements in and connected with the manufacture of filtering, precipitating, deodorising, and purifying material. October 27.

19,120. J. P. Alliott. Improvements in apparatus for dealing with the refuse of towns. November 5.

19,157. E. Grimshaw and H. Grimshaw. The purification of waste effluent waters from manufacturing processes. November 6.

19,395. H. Lockwood. Improvements in the purification of sewage and other foul waters by the employment of certain waste materials. November 10.

19,433. H. J. Rogers. An improved method of treating sewage. November 10.

19,739. T. Wardle. Wardle's patent process for the treatment of sewage and other refuse matters. November 14.

C.—Disinfectants.

18,118. F. O. Stow. New chemical compounds for fumigating and disinfecting purposes, to be known as "Thiophenylia and eucalyphenylia." October 22.

18,434. S. B. Morss and T. F. Bourne. Improvements in sulphur candles. Complete Specification. October 27.

18,466. A. Lutschaunig. *See* Class XVIII., *B*.

18,840. L. L. G. Baij. Improved apparatus for generating and disseminating vapours for perfuming and disinfecting the atmosphere, and for destroying noxious germs. October 31.

18,913. A. Lembach, F. Schleicher, and C. J. Wolff. Improvements in and relating to soluble quinoline antiseptics. Complete Specification. November 3.

19,379. B. Caillefer, née Rafford, and J. Labadie. An improved liquid insecticide. November 9.

COMPLETE SPECIFICATIONS ACCEPTED.

A.—Chemistry of Foods.

1890.

19,168. E. Luck, R. Pott, and N. Pott. Treatment of cereals for preventing or arresting decomposition, and for preserving or improving the condition thereof. November 18.

20,803. T. Fletcher. The preparation of diastase for use in the manufacture of bread and biscuits, and for other purposes. October 28.

21,006. E. Sonstadt. Extraction of malt and hops, and preparing a confection of the same. October 28.

1891.

16,909. A. D. McKay. Improved medicinal food. November 11.

B.—Sanitary Chemistry.

1890.

19,967. R. Cunliffe and E. Barlow. Improvements in method of and apparatus for treating towns', slaughter-house, and other refuse, or substances or materials. November 11.

XIX.—PAPER, PASTEBOARD, ETC.

APPLICATIONS.

18,465. F. L. Jacob. Improvements in the process of manufacturing millboards and paper. October 27.

18,736. L. H. Grundy. An improved flock paper. October 30.

18,889. G. O. Tschaplowitsch. Improvements in washable writing material. November 2.

19,135. L. E. Vial. *See* Class V.

19,560. H. de Chardonnet. An improvement in the manufacture of pyroxylines. November 11.

19,783. G. L. Hille. Improvements in the manufacture of celluloid balls. November 14.

COMPLETE SPECIFICATIONS ACCEPTED.

1890.

18,169. W. P. Thompson.—From P. R. Thom. Improvements in apparatus for straining or screening paper pulp. November 18.

1891.

748. R. C. Menzies and E. J. Bevan. Manufacture of paper for cheques and like documents. November 18.

16,921. A. Bürkel and C. Osterwald. New manufacture of composition for blotting or absorbing liquids. November 18.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES, AND EXTRACTS.

APPLICATIONS.

18,329. H. R. von Dahmen. Process and apparatus for producing purest cholroform. October 24.

18,408. M. Conrad and F. Geromont. Manufacture or production of salicylic compounds of methylaniline, ethylaniline, *p*-anisidine, and *p*-phenetidine. October 26.

COMPLETE SPECIFICATIONS ACCEPTED.

1890.

17,221. C. Kolbe. Improvements in the manufacture or production of salols. November 4.

20,252. H. H. Lake.—From Wirth and Co., agents for A. Leonhardt and Co. Manufacture of chemical compounds. October 28.

21,006. E. Sonstadt. *See* Class XVIII., A.

21,294. W. W. Horn.—From F. de Nare, Comte N. Ney, M. Sannier, and G. Dambmann. An improved process for the production of camphor. November 4.

XXI.—PHOTOGRAPHIC PROCESSES AND MATERIALS.

APPLICATIONS.

17,967. G. B. Bradshaw. Improvements in photography. October 20.

18,592. E. Hackh. Improved device for photographing in bound light. Complete Specification. October 28.

19,565. J. Burgess. An improved method of producing coloured photographic pictures. November 11.

COMPLETE SPECIFICATIONS ACCEPTED.

1890.

21,059. G. F. Redfern.—From J. M. Jordan. Improvements in or connected with the production of photographic negatives. October 28.

1891.

1736. O. Imray.—From The Actien Gesellschaft fur Anilin Fabrikation. New or improved developers for photographic pictures. November 11.

16,094. V. Mathieu. Process for producing photographic pictures, having colours resembling those of the objects from which they are obtained. October 28.

XXII.—EXPLOSIVES, MATCHES, ETC.

APPLICATIONS.

18,439. C. Huelser.—From G. Gillischewsky, Germany Process for producing a liquid substance for making fir star firework. October 27.

18,788. L. Bonneville. Process for separating phenol and its homologues from other substances, and for converting phenol and its homologues into nitro-compounds for use in the manufacture of explosives. October 30.

18,861. A. McDougall. *See* Class VII.

19,041. G. T. Clarke. Waterproofing matches, cartridge or firework cases, and the like. November 4.

19,068. C. H. Curtis and G. G. André. Improvements in the manufacture of gunpowder. November 4.

19,267. W. P. Thompson.—From E. Landauer, France. Improvements in or relating to the manufacture of explosive substances. November 7.

19,346. P. W. Masson. Time fuze for explosive shells. November 9.

19,478. W. Wunderlich. Improvements in apparatus for nitrating substances. November 10.

19,796. J. McL. McMurtrie. An improved fuze for explosive projectiles. November 14.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

298. E. J. Ryves. Manufacture of explosives, and apparatus therefor. November 11.

11,326. W. E. Gedge.—From The California Explosive Co. Improved method of purification of nitro-glycerin. November 11.

11,326A. W. E. Gedge.—From The California Explosive Co. A novel explosive compound. November 4.

PATENT UNCLASSIFIABLE.

COMPLETE SPECIFICATION ACCEPTED.

1891.

16,910. E. Dean. Manufacture of eucalyptus products for various useful purposes. November 11.

Printed and Published by EYRE and SPOTTISWOODE, East Harding Street, London, E.C., for the Society of Chemical Industry.

THE JOURNAL

OF THE

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Post Office Orders should be made payable at the General Post Office, London, to the Honorary Treasurer, E. Rider Cook, and should be forwarded to him at Bow, unless it be desired to notify a change of address.

Members who require extra sets or back numbers of the Journal are requested to make application to the General Secretary only, to whom also changes of address should be communicated.

Authors of communications read before the Society, or any of its Local Sections, are requested to take notice that under Rule 11 of the bye-laws, the Society has the right of priority of publication for three months of all such papers. Infringement of this bye-law renders papers liable to be rejected by the Publication Committee, or ordered to be abstracted for the Journal, in which case no reprints can be furnished to the author.

Notice is hereby given, for the information of members and advertisers, that the advertisement columns of this Journal have been contracted for by Messrs. EYRE and SPOTTISWOODE, the Society's printers and publishers, to whom all communications respecting them should be addressed.

The Secretary is instructed to negotiate for the purchase of copies of the Society's Journal for January and May 1883, January, February, and April 1886, and February 1889. Members possessing odd copies of these numbers are particularly requested to communicate at once, stating price required, with Mr. Cresswell. The stock of all other numbers is at present sufficient for the Council's requirements.

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McGill, Dr. J. T., Vanderbilt University, Nashville, Tennessee, U.S.A., adjunct professor of chemistry.

Macreath, D., Kwalla Lumpor, Selangor, Straits Settlements, manufacturing chemist.

Margetts, W. C., Wombham, Rochester, Kent, cement manufacturer.

Molesworth, F. H., Eton Street, Malvern, Adelaide, South Australia, analytical chemist.

Owens, Caradoc, 88, Great Clowes Street, Lower Broughton, Manchester, dyer's manager.

Paul, Jas. B., 123, Palace Road, Tulse Hill, S.W., analytical chemist.

Redwood, T. Horne, 2, Fisher Street, Red Lion Square, W.C., analytical chemist.

Sells, E. Perronet, jun., Broad Street, Ratcliff, E., coal merchant.

Williams, Seward W., 187 Central Avenue, East Orange, Mass., U.S.A., manager of Seabury Pharmacal Laboratories.

CHANGES OF ADDRESS.

Ashwell, H., l/o Sherwood; Langley Dale, Grove Avenue, Southey Street, Nottingham.

Barbour, T. F., l/o Glasgow; The Technical School, Coatbridge, N.B.

Barnes, E. A., l/o Charlton; c/o The National Explosives Company, Ld., Hayle, Cornwall.

Butterfield, J. C., Journals to 13, Victoria Street, Westminster, S.W.

Doidge, H., l/o 25; 6, Beech Avenue, Sherwood Rise, Nottingham.

France, H. C. D., l/o Quinton; 8, Vicarage Road, Edgbaston, Birmingham.

Goyder, G. A., l/o Adelaide; Ootalinka, Hawker's Road, Medindie, near Adelaide, South Australia.

Griffin, M. L., l/o Holyoke; Mechanicville, Saratoga Co., N.Y., U.S.A.

Hastings, H., l/o Malvern Terrace; Lavender Villa, Birmingham Road, Kidderminster.

Heywood, G., l/o Middleton; Beech Tree Bank, Prestwich, near Manchester.

Hogben, Walter, l/o France; 15, Pilrig Street, Edinburgh.

Hurter, Dr. F., Widnes; and (Journals) Holly Lodge, Cressington Park, Liverpool.

Jones, A. Fred., l/o Iquique; c/o Walters Bros., Pisagua, Chili.

Lawrence, Jas., l/o Gibbstown; Repauno Chemical Co., Paulsboro', N.J., U.S.A.

Leese, Jos., l/o Preston; Ettrick Bank, Birkdale, Southport.

Lenox, L. R., Journals to Chemical Laboratory, Navy Yard, Washington, D.C., U.S.A.

Marshall, Dr. T. R., l/o Birmingham; University College, Cardiff.

Mond, L., Journals to 64, Via Sistina, Rome.

Neil, Jas. M. (Journals), c/o Señor M. A. Herrera, Puyta, Peru; and (subs.) c/o Collyer, Thirkell, and Bell, 141, Fenchurch Street, E.C.

Orr, Alex., Journals to c/o Mrs. Scott, Wallalong. Hinton, New South Wales.

Rawson, C., l/o Union Street; The Bradford Technical College; and (Journals) 2, Melbourne Place, Bradford, Yorks.

Riley, Jno., l/o Rawtenstall; Thornliebank, near Glasgow.

Savary, W. J. Holgate, l/o Surbiton; 39, Lombard Street, E.C.

Smith, Irwin J., l/o Chicago; 103, Tremont Street, Fairmount, Cincinnati, Ohio, U.S.A.

Williams, D., l/o Kurtz Bros.; c/o United Alkali Co., Gerard's Bridge Works, St. Helens.

Williams, W. J., l/o Camden; 1412, Van Buren Street, Wilmington, Del., U.S.A.

CHANGE OF ADDRESS REQUIRED.

Weldon, E., l/o 64, Noel Street, New Basford, Nottingham.

Deaths.

T. W. B. Mumford at Glendale, Sylvan Road, Wanstead, Essex. December 26th.

Runtz, John, Linton Lodge, Lordship Lane, Stoke Newington, N.

Alex. Sutherland at Ballyclare, co. Antrim. December 21st.

London Section.

Chemical Society's Rooms, Burlington House.

Chairman: T. Tyrer.
Vice-Chairman: W. Crowder.
Committee:

C. F. Cross.	W. Kellner.
J. Dewar.	B. Redwood.
A. G. Green.	W. S. Squire.
S. Hall.	G. N. Stoker.
C. W. Heaton.	F. Napier Sutton.
J. Heron.	Wm. Thorp.
D. Howard.	T. E. Thorpe.

Hon. Local Secretary:

Communications to be sent to T. Tyrer, Stirling Chemical Works, Abbey Lane, Stratford, E.

SESSION 1891-92.

1892:—
Jan. 4th—Mr. Boverton Redwood. "The Galician Petroleum and Ozokerit Industries."
Feb. 1st:—
Messrs. J. A. Wanklyn and W. Johnstone. "The Acids of the Fatty Series and certain of their Derivatives."
Mr. Watson Smith. "The Stability of certain Organic Nitrogen Compounds occurring in Coal-Tar Pitch."

Meeting held Monday, December 7th, 1891.

MR. THOS. TYRER, IN THE CHAIR.

A CONTRIBUTION TO OUR KNOWLEDGE OF THE SOLUBLE AND RESINOID CONSTITUENTS OF BITUMINOUS COAL.

BY WATSON SMITH, F.C.S., F.I.C.

Lecturer in Chemical Technology in University College, London.

In his most interesting Researches on Peat, published in the Memoirs of the Literary and Philosophical Society of Manchester, I think in 1871, the late Dr. R. Angus Smith gives an account of experiments made with the object of tracing the origin of the bituminous deposits or oil, found either in close juxtaposition to peat mosses or under them.

Dr. Angus Smith says, "It is known that on washing peat with ether, bisulphide of carbon, alcohol, or benzene, we obtain substances very rich in carbon and hydrogen. The origin of these compounds seems not to be the decomposition of the dead plant, but traceable with certainty to the living one (principally the *Sphagnum*). The resinoid substance is one apparently, like the resins in wood, resisting decomposition under water, and to a certain extent it thus accumulates, the woody fibre being washed away, and the resins being left to be greater in proportion than at first. This gives the reason why the *old peat* is so much richer than the *new* in these resinoids. If now the action be continued we have at last only the hydrocarbon matter left, the woody fibre being all removed and a hydrocarbon (resin or wax) left. Then after a further time the separation ceases, and resinoids begin to be washed away."

The observations of the late Mr. Binney, of Manchester, made it certain that oil flows from the peat. It may be and is extremely likely that the ozokerite, or earth-wax, is derived thus.

Oil has been found under a large heath in Germany, the *Luneberger Heide.*

The solid resin, prepared by evaporating the solution in naphtha or ether, obtained by washing the peat, is hard and black with a fracture like wax. On the distillation of peat for oil this wax is obtained as a distillate, but by the means of solvent a crude product is obtained exactly as it exists in the peat. Several experiments showed a yield of 6 per cent.

The crude substance analysed gave: carbon, 73·39—73·55 per cent.; hydrogen, 10·78—10·49 per cent. The melting point was 57° C., but when purified this rose to 60° C.

When kept at the boiling point some time, more volatile matter came off. The composition now was carbon = 80·84—80·95 per cent.; hydrogen = 12·00—12·00 per cent.

Rapidly distilled a white solid product came over.

Slowly distilled, an oil with a pleasant odour.

142 grms. of the crude substance gave on distillation the following figures:—

At 100° C.....	No product.
At 200° C.....	1·5 aqueous liquid.
At 280° C.....	0·5 oil.
At 325° C.....	Boils, pungent smell of acetic acid.
At 352° C.....	30 cc. of oil and 2 cc. of water.

The specific gravity of the oil coming over below 350° was 0·857; above 350° was 0·819.

The oils of the distillate were mixed and analysed. Carbon = 83·86 per cent.; hydrogen = 12·70 per cent.

There were indications that these were allied to paraffin oils, but they contained no solid paraffin.

Professor Schorlemmer was certain that they contained a paraffin.

Dr. Angus Smith further extracted resinoids from peat and from the living mosses from the same place, and he found these resinoids similar, testifying to the probable correctness of his belief that these resinoids of peat are simply the residues from the moss plant left in the peat. *Dr. Smith thus concluded that the resinous matter of peat had grown in the plant when fresh, and was not a product of decomposition.*

Now with regard to coal, Professor Morris discovered spores and sporangia, and Professor W. Boyd Dawkins says, "No doubt the bituminous matter of coal is almost all derived from the spores and sporangia of fossil vegetation allied to the Club-moss. Our bituminous coal derives its bitumen from this altered resinous matter, first stored up in the fruits (spores, &c.) and afterwards more or less altered by the subterranean heat into bitumen."

In the Zeits. f. Berg. Hütten u. Salinenw. 1891, **36**, 26 (this Journal, 1891, 753), an investigation by P. Siepmann is described of the soluble resinous constituents of coal. The particular coal examined was a Westphalian gas coal. Its composition was C = 80·31, H = 5·50, O and N = 12·94, S = 1·25. The coal was treated with different solvents, ether, alcohol, and chloroform, and three products differing both in properties and composition were isolated. The product extracted by means of ether amounted to 0·3 per cent., and formed a hard yellowish-brown resin with an aromatic smell. The alcoholic extract amounted to 0·25 per cent., and consisted of a dark brown resin with an aromatic smell and melting at 48°—50°C. It began to decompose at 100° C. The chloroform extract amounted to 0·75 per cent. It was a dark brown pitchy mass with a smell of coal tar.

It melts from 60° C. to 85° C., and decomposes at 145° C.

Rammelsberg, in his "*Mineralchemie*," states that "A few per cents. of a dark resin may be extracted from cannel coals by means of ether, alcohol, and especially bisulphide of carbon, which resin is the cause of the caking of these coals." Siepmann's experiments show that the caking power of such coals is not *due to*, though it is influenced by, the presence of these soluble constituents (this Journal, 1891, 753—754).

M. de Marsilly asserts that all "caking coals" from pits in which firedamp occurs cease to swell up and cake when they have previously been heated to 300° C. Thus, after such a heating, when they are calcined in a state of powder, they will be found in a state of powder. Dr. Percy has confirmed this in the case of the strongly caking coals of Newcastle.

M. de Marsilly infers that the loss of caking property by exposure to air for a long time, and to the action of heat under 330° C. for a short time, are due to the same cause, viz., to volatilisation of the matter on which the property depends. This needs, of course, clear experimental proof. (Percy, Fuel, 308—309.)

I will now give the results of some determinations of the amounts of these peculiar soluble resinoid matters in various coals, chiefly cannels, which I have made recently. In course of this investigation I was invited also to examine a Japanese coal of bituminous character, and the extraordinary quantity of this peculiar resinoid or bituminous matter contained in that coal, has enabled me to extract information through experimental investigation, that with the minute yields of the other varieties of bituminous coals, was beyond my power.

At the outset, I had expected to be able to extract from the richest cannel coals the most bitumen by solvents, but I found this was a mistaken impression.

The solvent I employed was carefully rectified benzene, all of which distilled over between 80° and 82° C.

I did not care to employ a variety of solvents and to subject the coal to fractional treatment, as Herr Siepmann did, for I have as little faith in an attempt to isolate from such a product as this soluble bitumen chemical individuals by such means, as I have in similar attempts made with coal-tar. Hence I adopted benzene as my solvent, because I know by experience that it possesses for such resinoid matters the largest and widest solvent powers. By extracting with benzene in large Soxhlet's extractors, and taking something like 20 grms. of the coal broken up to lumps about the size of large shot, treating for periods of about a fortnight, until in fact the droppings from the extractor were quite colourless, and distilling and evaporating off all benzene until no longer the odour of benzene was perceptible, and weighing the residual resinoids, the numbers subjoined were obtained.

Resinoids or Bitumen Extracted from Cannel Coals.

	Per Cent.	Odours.
Scottish Boghead Cannel	0·6	Smells somewhat like "Asfatki" of Russian petroleum, but fainter.
Australian Cannel (called by Professor Boyd Dawkins "Australian Boghead").	0·67	Almost odourless, on heating, faintly like petroleum.
American Cannel ("*Breckenridge*" Virginia).	1·06	Aromatic, rather pleasant, out of the petroleum character.
Lancashire Cannels :—		
Huckanll Cannel	1·06	Both of petroleum character.
Tyldesley Cannel	0·85	

It is interesting to observe that the above-named Australian cannel was spoken of to me by Professor W. Boyd Dawkins as similar to the celebrated Scottish Boghead cannel, which was the subject of the celebrated old lawsuit based on the question "*Is it, or is it not, a coal*".' But here is the point of special interest, that whereas in the Scottish Boghead not a single fossil could be found to assist the plaintiffs in that case, in this Australian "Boghead cannel," Professor Dawkins did describe at any rate one species of definitely fossilised vegetable remains. Here also we see that the percentage of soluble bitumen is practically identical in both these cannels.

P. Siepmann found in his Westphalian gas coal 0·3 per cent. (ether) + 0·25 per cent. (alcohol) + 0·75 per cent. (chloroform). *Total*, 1·30 per cent. of bitumen.

We now come to the "*pièce de résistance*" of this inquiry, viz., the Japanese coal, already once or twice referred to.

Let me then say at the outset that an extraction with benzene in a manner precisely similar to that by which the other cannel coals were treated, yielded as an average 9·5 PER CENT. of *resinoid matter* or *bitumen*.

But though so much more abundant in quantity, the general characteristics, smell, &c., were much the same as those of the other bitumens extracted. If anything, the odour of the bitumen from the Japanese coal is more pronouncedly a crude petroleum odour. Just to show how fallacious was that old argument as to the similarity of the appearance of the Boghead cannel to solid bitumen or to a light coloured pitch, and its dissimilarity to coal, here we find that the Boghead cannel actually contains only 0·6 per cent. soluble in benzene, whilst this Japanese coal, which does look like coal, and does not resemble pitch or bitumen to the eye, does contain more than ten times as much bitumen soluble in benzene!

Our interest being raised in this coal, I will now give you a short history of it, and its development for industrial uses.

It is, then, the product of a coal mine, known as the Miike mine, and the deposit is situated in 33° north latitude and 130 of east longitude, in the province of Chikugo, in Kiushiu Island, in the south-western portion of the Japanese Empire. It is close to the sea, and facing Shimabara Bay, as shown in the map on the wall—a very admirable example of combined ordnance survey and mineralogical investigation, which I commend to your inspection. It was presented to me by one of my Japanese students of chemical technology, Mr. Kitamura, of the Geological Survey of Japan.

This deposit was known 400 years ago, but the uses of coal being little known to the Japanese until comparatively recent periods, scarcely any importance was attached to its occurrence until 1873, when it was purchased by the Government at the request of its private proprietors. The reason it has been known for so long as a deposit, is probably that the strata in some parts have suffered such extraordinary upheaval, that the coal actually crops out in parts at the surface, or nearly so, the formerly over-lying strata having apparently suffered gradual denudation. In or before 1876, the Government appointed the Mitsui Bussan Kaisha, a branch of the house of Mitsui, sole agents for the sale of this coal, its object being to open and extend the consumption of Japan coal in foreign countries. The quantity then put out was only 300 tons per diem, half of which was composed of smalls, the rest being all large coal. The latter was used for coaling steamers, whilst the former was generally sold to salt works in the inland sea. In the year 1885, a new shaft was opened at a depth of 240 ft., and the production increased to 1,200 tons per day. In 1888 the Government sold the mine by public auction. Mitsui bought it for 4,550,000 dollars, or about 750,000*l*. The Government invested more than 1,000,000 dols. in machinery, pumps, &c., all of newest pattern, opened roads for transport by ponies, improved sea ports, canals, &c.

According to the Japanese survey, the area of the deposit is estimated to extend over 3,758 acres, containing some 85,144,000 tons of coal.

Since the mine was transferred to Mitsui, every new improvement has been introduced, including locomotive- instead of horse-traction, and the production increased step by step up to from 1,900 to 2,000 tons per diem.

From these facts we learn something of the highly intelligent interest taken by the Japanese Government, which, of course, means the Emperor or Mikado, in those matters which lie at the foundation of the commercial prosperity of his Empire, and likewise how readily the example thus set was at once followed in the far-sighted enterprise of Mitsui. Two excellent harbours were soon founded near the Miike deposits, *viz.*, Kuchinotsu and Misumi. Kuchinotsu lies at the mouth of Shimabara Bay, and is about 24 miles distant from the mines. Misumi is only 18 miles from the mines. Tug-boats continually ply to these ports carrying the produce of the mines, and here sufficient stocks of coal are always kept to meet the demands of steamers.

A railway line runs through Miike, and is being extended to Misumi, the new harbour, whither all coal will eventually be sent. A new shaft, 400 ft. deep, is also being sunk for further extension of production. When appointed, in 1876, sole agents, Mitsui Bussan Kaisha opened a branch house in Shanghai. The China Merchant Steam Navigation Co. was the first to use Miike coal, and was then soon followed by Butterfield and Swire, Jardine, Matheson, and Co., and most other important Chinese firms. Thus the coal was proved of excellent quality, and the Mitsui firm then opened branches in Hong Kong and Singapore, and sub-agencies in nearly all the ports in the East. As to specific quality, stress is laid upon its value as a bituminous and steam-

raising coal, and it has the character of being one of the best, if not the very best, in Japan. It will sound strange to us, but as a matter of fact, most of the colliery labourers or miners are supplied by the Miike Prison, about 1,500 prisoners working under regular and systematic supervision, and under regulations established by Government. Not only are the most modern improvements in conveyance of coal adopted, but the mineral is subjected to all the refinements of systematic sieving, and, I believe, washing, just as in the most advanced British collieries.

The following statistics will add the last increment of interest in the development of this wonderful coal deposit in an insular country on the other side of the world, and possessing so many geographical and other analogies with our own, *except the earthquakes!*

Here follows the annual production and exportation of Miike coal since the year 1887 :—

Year.	Total Production.	Export.
	Tons	Tons.
1887	302,105	165,561
1888	383,870	252,004
1889	444,966	276,883
1890	467,089	292,637
	(From January to end of May.)	
1891	240,944	100,042
Estimated production for 1891.....		600,000 tons

I have read over nearly a score of reports on the character of this coal by users of it. But before saying a word on these I observe that it is stated on excellent authority that the seam of coal of the Miike mines fully averages 8 ft. thick, that it is of uniform quality throughout and remarkably free from shale, and that the operations of the mines are under the supervision of a British engineer. As to its reported character by users, I observe that for seven years it has been used and is much appreciated in sugar refineries. The Shanghai Electric Company, Limited, reports the consumption of the coal less than 3 lb. per indicated horse-power with high pressure non-condensing engines. On steamers, the consumption per indicated horse-power is stated to be 1·98 lb. to 2·15 lb. in one case, and in another the rate of combustion in compound marine engines is given as 2·3 lb. coal per indicated horse-power per hour, and it is added that this rate with a more modern type of engines would be much lowered. A Scottish shipping firm says: "The consumption was only between 2 or 3 tons per day in excess of our average consumption of Welsh coal." *Comparatively*, it is stated equally as good as Australian Newcastle coal, also, "the best steam coal used up to that time, except Cardiff or high-class Australian." In another report, "the ashes," are said to be "only about one and a half per cent. more as compared with Welsh coal," and "in point of consumption the difference in Miike is about 15 per cent. more than Welsh." Generally it is classed as nearly equal to the best Welsh steam coals.

But the most interesting report for us is, perhaps, that of Mr. Thos. Weir, of Shangai, where he minutely describes its manner of burning.

The fact of the coal containing about 10 per cent. of bitumen, will now be borne out in the following practical experiences :—

"The Miike lump coal is highly bituminous, having a rather dull, rusty appearance. On first being put on the fire it *gives off great volumes of black smoke* (which could be burned with careful management and suitable arrangement of furnace), and softens almost like pitch, but soon hardens, cokes, and burns brightly, giving off great heat. When once the men know how to use it, it proves one of the best steam coals in the Shanghai market," &c.

I have now only to supplement this information by the results of experiments, in which I have been throughout greatly aided by two of our students of chemical technology in University College, Messrs. J. C. Chorley and E. C. C. Baly, as well as by my assistant, Mr. Hamilton.

The coal is not quite black, and on pulverising it yields a powder of a dark-brown shade. The character is that of a highly bituminous caking coal. The determination of specific gravity gave a mean of 1·269. The fully-burnt ash of the coal is only of a reddish white tint, and the coal is thus intermediate between a white and a red-ash variety.

The amount of ash was given in two determinations as 9·34 and 9·55 per cent. Mean = 9·45 per cent. The calorific value of the coal determined in Thompson's calorimeter, and as the mean of four experiments was 7616 T. U.

An analysis of the ash of the coal gave the following numbers :—

	Per Cent.	
Silica	14·94	With due corrections this 9·45 ash equals about 11½ inorganic matter as in the coal. And the error on the carbon in the coal analysis equals just 1 per cent. due to CO_2 expelled from the $CaCO_3$.
Iron (Fe_2O_3) ..	10·87 = 8·23 Fe	
Alumina	16·04	
Lime.....	42·38	
Sulphur	11·24 = 28·88 SO_3	

The ash was alkaline; certainly quicklime was present. But also sulphides (probably CaS), for on treatment with hydrochloric acid H_2S was evolved. Here, then, was a case of naturally "limed coal," for undoubtedly a considerable part of this lime existed in the coal as carbonate. It may also be pointed to as a coal ash of very exceptional character, and as indicating that the coal plants and vegetation forming the coal must have been deposited not in and amongst the usual clays of those early periods, forming our present carboniferous "fireclays," but in a mixture consisting of a chalky clay (see Percy's Fuel, 278—279). It would be very interesting to analyse specimens of the fireclay contiguous to the deposits of this Miike coal. My belief is that it will not be true fireclay at all, but a chalky mixture containing some silicate of alumina.

Percy has shown that the ashes of coal closely resemble in chemical composition the fireclays contiguous to the seams, for no doubt those ashes represent the original clays with which the fossil vegetation had become mixed. These coal ashes thus consist chiefly of silicate of alumina. But this high percentage of lime may also indicate—and probably does—a formerly existing condition of soil in which the fossil plants grew, and if so, seeing that the character of vegetation is so much dependent on that of the soil in which it grows, the presumably special chalky condition of this soil may account for the luxuriant development of trees and shrubs, specially of the coniferous or other kinds, bearing spores and sporangia particularly rich in resins, which resins, being, like those of the more recent peat, more stable than the organised portions of the fossilising remains, have accumulated somewhat, and have *remained evenly disseminated* through the finally resulting coal, though undergoing *in situ* as it were, certain changes during the developments of subterranean heat in the process of fossilisation ("mouldering"). Thus, I take it, the very composition of the ash, and its special character, points to a special character of the original vegetation, and makes it a matter, so to say, of less surprise that a coal of special characteristics has resulted.

It is of course not improbable that this Miike coal is really a lignite of advanced type, and this would seem the more probable from the cretaceous, and so tertiary character, indicated by the ash. Percy (Fuel, 317) mentions lignites from Auckland, New Zealand, and Tasmania containing resin diffused through it unevenly, in lumps in some cases which could be picked out. A portion dissolved in benzene. After drying between 110° and 120° it contained C = 81·6 and H = 11·06 (see p. 975). But no one can detect resin in this way in the Miike coal. It has not even a resinoid or pitchy appearance. It might provisionally be termed a lignitoid coal, but further one would scarcely be justified in going. The amount of gypsum found in the Miike coal was only 0·2 per cent. The amount of coke left on ignition in a closed space = 60·6 per cent.

Two analyses of the coal gave the following figures:—

	I.	II.	
	Per Cent.	Per Cent.	
Carbon	75·22	77·88	The true proportion of carbon is sufficiently nearly obtained by deducting 1 per cent. from the numbers given in the adjoining analyses.
Hydrogen.....	5·84	5·91	
Nitrogen.....	1·11	..	
Sulphur	3·15	3·13	
Moisture.....	6·62	0·65	

As I can easily show you, a splinter of the Miike coal readily ignites at the flame of a lamp and burns like a bit of cannel. This led me to have a trial made of it as a gas producing coal, and remembering that there is at the Salford Gas Works (Manchester) a fine working model of gas plant, I applied to my friend Mr. Francis Jones, who is the consulting chemist of the Salford Corporation Gas Works, and he kindly undertook to have the trial made for me.

Results of Test in Model Gas Plant.

Make of Gas Per Ton of Miike Coal.	Illuminating Power.	Coke Per Ton of Coal.	Tar Per Ton of Coal.	Liquor Per Ton Coal.
Cubic Feet.	Candles.	Lb.	Lb.	Lb.
11,033	23·42	1,207 = 11·78 cwt.	250 = 11·16 per cent. sp. gr. = 1·117	250 sp. gr. 1·007 contains 0·53 per cent. NH_3

The tar was a perfectly normal one and contained 11·5 per cent. of light oils of sp. gr. 0·977.

But since it might be fairly urged that, to institute any valid comparison, some well known cannels ought to have been tried in the same model under similar conditions, this objection was met by just such a trial.

The two following Lancashire cannels and gas-coals were tried:—

Make of Gas per Ton of Coal.	Cubic Feet.	Illuminating Power.	Coke.
		Candles.	Lb.
1. Ordinary gas-coal -	12,033	18·76	1,512
2. Wigan cannel - -	13,039	20·78	1,441

Thus, taking into account the yields of gas and also the candle power, it is, I think, clear that the Miike coal is fully equal to the Lancashire coals above-mentioned in gas-producing power. Moreover, the percentage yield of tar is exceptionally high, and the tar is decidedly good.

I think there is little doubt the 10 per cent. of bitumen must considerably contribute to the gas-producing powers of this coal, as it does to its flaming character. It will also be remarked that the coal contains bitumen in amount nearly equal to that yielded in tar when coals are carbonised in gas-retorts, viz., 10 per cent. The black smoke it tends to give off when freshly thrown on a boiler-fire is also thus explicable. But I have said it is a strongly caking coal, and it soon occurred to me to try how far the caking powers were modified or removed by prolonged extraction with benzene and removal of the bitumen. I found that thus the caking powers were *diminished* decidedly, *but not destroyed*. My experiment therefore tends to an agreement with that of Siepmann, and to show that at all events the caking power of the Miike coal is not more than partly caused by even so large a percentage of resinoids as 9·5 per cent.

Metallurgical Coke from Miike Coal.—An experiment was now made in the Simon-Carvès coke ovens of the Bear Park Company, Durham, by the kindness of the manager and Mr. Schroller, Mr. Simon's engineer and agent, in order to ascertain if the Miike coal is capable of yielding good metallurgical coke for blast-furnace use. The result was a good yield (60 per cent.) of an exceedingly dense, hard coke, splendidly adapted for resisting the crushing of the burden in the blast furnace. It contains, as just determined by Mr. J. C. Chorley, combustible matter = 83·88, ash = 15·80, and moisture 0·32 per cent. The sulphur amounted to 0·57 per cent. as $CaSO_4$ and 2·54 per cent. as CaS principally, a little only consisting of FeS. There is thus, other things being equal, a fine prospect for the development of the iron industry of Japan, especially as the coke used in Japan is at present got from Durham at necessarily great expense. In using the improved close coke ovens also, sulpbate of ammonia will be placed at the disposal of agriculture, and the creosote oils from tar also obtained would be of enormous value in protecting wooden piles in harbour work, railway sleepers, &c., the former being at present ruined in an incredibly short time by the sea-worms.

The final question of interest is of course that of the composition of this bitumen so richly present in the Miiko coal. By long extraction a quantity of the bitumen was obtained, and the benzene driven off from it. A semi-fluid, tar-like mass was obtained, smelling like crude petroleum. 47 grms. of the bitumen were taken, and distilled in a small retort. This means in percentages:—

Percentage Results.		Results of Distillation.	
Temp. C.	Per Cent.	Temperature.	Cc.
175° to 200°	3·2	175° to 200° C.	1·5 distilled over
250°	4·0	Below 250° C.	1·8 distilled over
300°	9·6	Below 300° C.	4·5 distilled over
Over 300°	21·3	Above 300° C.	10·0 yellow oil of greasy and thick character.
Higher Temperatures.	10·7	At higher temperature.	5·0 of thick red oil.
		Still higher temperatures to softening point of glass.	Red greasy matter and coked residue left. Sulphuretted hydrogen evolved.

23 grms. of coked residue left in the retort = 48·9 per cent.

The first fraction boiling between 175° and 200° C. was a clear naphtha, smelling just like petroleum naphtha, as you can perceive in the specimen here. The portion boiling between 250° and 300° was extracted with caustic soda for phenols, and the solution was treated with sulphuric acid, when certainly a phenol of higher molecular weight was liberated, smelling like pseudocumenol, as you may compare here. It soon turned dark-coloured on exposure to the light. The residual naphtha was now treated with a small quantity of sulphuric acid, and after separation with excess of soda, but no odour in the least indicative of the presence of the pyridine or quinoline series of bases, was manifested. The oil thus refined by the action of soda and acid was redistilled, it came over most of it, below 280° C., and possessed most unmistakedly the odour of petroleum lamp oil. A small portion of it, however, gave, with evolution of red fumes, a heavy oily nitro-product with nitric acid, smelling like nitrotoluene or nitroxylene. This indicates the presence of some aromatic hydrocarbons. Treated with a drop of bromine, the bromine was at once absorbed, and the liquid became colourless, but a very small further addition then caused, especially in diffused daylight, the evolution of hydrobromic acid.

The most remarkable fraction is perhaps that distilling just above 300° C., for on cooling, paraffin scale crystallises out abundantly. The 21·3 per cent. distilling over 300° C.

is thus an oil very rich in solid paraffin, and the oil drained off is quite analogous to the lubricating oils obtained from American petroleum, as the specimens I have here will show you. One of the most singular features of this bitumen is, then, that appearing in the fact that it contains 3·2 per cent. of a naphtha, boiling so low as 175° to 200° C., and that such a naphtha is therefore disseminated through the Miike coal as a natural product. Of course, a coal containing so much of such a bitumen may well smoke copiously when thrown on a red-hot fire.

Now, at first my idea was that this bitumen was the result of subterranean heat on a rich coal, followed by a kind of slow destructive and consecutive distillation, and absorption in the substance of the coal of the distilled matter. This view I consider untenable in view of the great homogeneity of this coal, and of this evenness of character we have given testimony already (page 977, col. 1). I believe, in short, this bitumen consists of the altered or bituminised resins, &c., of the spores, fruits, &c., of a former rich and afterwards fossilised vegetation, a further stage of what Dr. Angus Smith found in the case of the peat waxes and oil, as Dr. Percy analogously found in advanced lignites, and as is believed by Prof. W. Boyd Dawkins to be the case with ordinary bituminous coal. I shall be possibly asked, "Has this case of so rich a content of a petroleum-like substance ready formed in a coal any bearing on the question of the formation of petroleum?" I reply: "Here are both coal and bitumen, with the constituents of the latter; you can yourselves see and compare." Practically, it is a crude petroleum; and if I propound the theory that this is one undoubted way in which our petroleum is derived, I have at least direct experimental results to show for the statement. But I shall be slow to assert that this is the *only* and true source of petroleum. Other theories, such as Mendeleèf's theory of igneous origin, or Zaloziecki's theory of formation from animal remains (this Journal, 1891, 753), though unaccompanied by any direct experimental evidence, *may* nevertheless possibly rank among contributary processes of petroleum formation. Nevertheless, in Zaloziecki's, Engler's, and similar theories, taken as the only true methods of explanation, I find this difficulty: Animal remains are nitrogenous, and, looking at the great stability of nitrogen decomposition products, tending to the formation of tars, &c., were this theory sound, I should expect to find more of the stable nitrogenous bases and other bodies in petroleum than can be found therein. Contrast, *e.g.*, coal-tar and wood-tar (a high and a low-temperature tar), and bone-tar, the latter most highly nitrogenous, abounding in the stable pyrroline, pyridine, and quinoline with still more complex bases. Then imagine a petroleum derived from vegetable and one elsewhere from animal remains; should we not expect analogous differences in respect of nitrogen content? But, do we find them? It is true we have the known differences of American and Russian petroleums, but these are chiefly hydrocarbon differences, and lack of solid paraffins in the latter with abundance in the former. I do not know of any differences of absence or scarcity of nitrogen in one petroleum and abundance in another. I would rather conclude, therefore, that no one organic source of petroleum can be dogmatically fixed upon, but that probably both vegetable and animal remains contribute, the former *greatly out-weighing the latter and diluting their effect*. Quite probably Mendeleèf's theory also points to a contributary source.

But let me, in conclusion, take it that the Miike deposit is uniform throughout, as so far found to be, and that the estimated amount of coal there, is given approximately correctly as 85,444,000 tons (page 976, col. 2), and taking the bitumen as 10 per cent. (soluble in benzene; of course there may be some little remainder insoluble in benzene) we have disseminated through this coal no mean quantity of a substance we should certainly call petroleum were it found similarly disseminated through sandstone, viz., no less than 8,544,400 tons, containing at 21 per cent. of thick paraffin oil, with 5 per cent. of solid paraffin wax (the proportions I estimate) 427,200 tons of solid paraffin wax.

I now propose to extract a large quantity of this interesting coal, with the object of getting about a pound or more of bitumen, which I will submit to a closer investigation. I shall also try by submitting the coal to heat in a retort not exceeding 350° C., to see if I cannot distil off the bitumen in fractions, and still leave a fairly good coal. The character of such residual coal will also be a subject of inquiry. If I succeed in driving out my petroleum thus and collecting it by condensation, still leaving a coal behind, why should not the Pennsylvanian petroleum, at all events to a great extent, have been thus similarly derived from the vast contiguous beds of coal there, now anthracite, but once probably bituminous like the Miike coal, for as such deposits differ as to circumstances, so, we must remember, may the circumstances, degrees, and modes of application of subterranean heat differ. We may have the slow mouldering heats of decomposition and we may have the subterranean heat of igneous origin, and each varying in degree and character, accompanied or unaccompanied by the action of steam.

The question may be thus regarded:—In Pennsylvania we have anthracite and petroleum lying side by side, in Japan we have the coal with the petroleum in it. Is it, I ask, an unlikely theory that the Pennsylvanian petroleum was once embosomed in the Pennsylvanian coal now anthracite? If not, does not the present condition of the Miike coal of Japan contribute to support the probability of this theory? Even if a mountain range now intervene between the respective Pennsylvanian deposits referred to, such range might have been upheaved more recently than the formation of those deposits. I do not see that even such a circumstance need destroy the validity of the theory propounded.

Discussion.

Mr. Alfred E. Fletcher said that it was most interesting to watch the advances in our modes of treating coal with a view to utilising as far as possible the numerous substances contained in it. Coal was originally looked upon simply as something to be burnt, later as something to be distilled so as to produce gas and coke, and then lastly the tar with its allied products and the ammonia were collected. The development of this industry had been very great. There were many works now where the coal was treated simply for its coke, pitch, and liquid products. It might interest many who had not closely followed the gradual changes to know that in many manufactures that which was formerly a by-product, is now really the main product. This was the case in works for the distillation of coal, in certain alkali works, and in some iron smelting works. In one of these latter as much as 70,000*l.* of capital was involved in the mere condensation of the tar, its collection and distillation, and in dealing with the ammoniacal salts. On visiting an iron works recently he had remarked on the extreme complexity and extent of the tar department, and was told that a great deal more capital was involved in that branch and more profit made from the so-called by-products, than from the iron for the production of which the work was originally started. A similar progress was going on in connection with other industries, and as our knowledge increased the term by- or waste-product would become less common.

Mr. F. H. Perry Coste said that the author, in referring to the resinous constituents found in Lancashire coal, had spoken of them as being derived from moss. He (Mr. Coste) supposed from that that Mr. Smith was referring to the bog moss (*Sphagnum*), which was well known to contribute largely to the formation of peat—the first stage; but in a later sentence he had spoken of the so-called club moss, which was really a *Lycopodium*. He would like to ask which the author considered to contain the resin. Next, he had suggested that the bitumen in the Japanese coal was derived from coniferous plants. If so, he would like to know whether any of the remains of such plants had been examined, and if so, whether there was extant any report by botanical experts on their character. He would also like to ask the author whether he could tell them in what stratum this Japanese coal occurred. Although most of the English coal was found in the "carboniferous" strata, it was of course well known that coal occurred in various strata; and assuming that the various European strata has been traced

right across to Japan, he would greatly like to know with which of these the coal bearing stratum in Japan would correspond. When the author stated that he had found 42 per cent. of lime in the ash, it occurred to him that that fact suggested a cretaceous origin for this coal, and he gathered that the same idea had struck Mr. Smith. It was generally supposed that our coal was formed from peat occurring in a marshy country, but it had been pointed out that, although this theory might account for the greater part of it, there had probably been other methods of formation as well. There was good reason to believe that some of our coal deposits were due to a mass of forest vegetation being swept down a mountain side and sunk in landlocked seas, as well as to delta deposits; and the large amount of lodeic carbonate found by the author in this Japanese coal pointed to the probability of a similar marine origin. He was somewhat surprised to find that the author talked of there being no experimental evidence to support the theory of the animal origin of petroleum, since he (Mr Coste) distinctly recollected having seen an account of recent laboratory experiments in which petroleum was formed from animal matter at a very high temperature and great pressure. (This Journal, 1890, 1119.)

Mr. Bertram Blount said that he could confirm the last speaker's remarks. He also had seen the account of certain experiments which were carried out on fish oil, there being no doubt that certain paraffins were produced therefrom by distillation under suitable conditions.

Mr. D. A. Sutherland asked if the percentage of sulphur had been determined in the coke obtained in the experiments at Durham, as this would have a most important bearing in its application for certain metallurgical purposes. He thought that it would be useful if the author could tell them the melting point of the paraffin obtained.

Mr. Thomas Christy supported the author in the view that the resinous bodies in Japanese coal were probably due to moss. He had brought with him samples of paper actually treated with peat and moss, and it would be seen on inspection that those samples were quite glazed by the action of the resin contained in the moss and peat. He would also point out that these resinous bodies rendered the paper practically waterproof, and therefore especially applicable for use in the salt industry.

Mr. Ernest F. Hooper wished for further information in regard to the properties of the higher boiling point fractions obtained from the bitumen. It was well understood that by the distillation of coal-tar oils, certain heavy oils were obtained, and by the distillation of crude petroleum naphthas one got bodies of the vaseline order. He would be glad to know whether bodies of the tar oil type or petroleum residue character were found among the higher distillates of the oil mentioned by the author. Having found a phenolic body in the distillate of this bitumen, was it not natural to suppose that the oils obtained would be more likely to consist of the tarry bodies than of the vaseline bodies?

Mr. Watson Smith, in reply, said that he quite coincided with Mr. Fletcher's remarks, and would remind him of an analogous case, when, owing to the exertions of the late Dr. R. Angus Smith in conjunction with himself (Mr. Fletcher), another waste product became a most valuable article of commerce. He referred to the case of hydrochloric acid. He doubted not Mr. Fletcher, with himself, could easily recall in memory a period when all boats plying on the canal at Widnes required to be "copper-fastened," iron nails quickly disappearing under the action of the dilute hydrochloric acid of that canal. In reply to Mr. Perry Coste's inquiries as to the probable origin of coal, he rather thought that spore bearing growths analogous to the Club-moss formed the variety referred to by Professor Boyd Dawkins. Beyond referring to the actual work and evidences of such writers as Angus Smith, Binney, and Boyd Dawkins, he himself did not attempt to specify any definite variety of plant or tree. Seeing that such a large quantity of bitumen was present analogous in character to that derived from lignite, peat, and peat-mosses, &c., and bearing in mind the special character of the soil traced through the character of the ash of this coal, it appeared to him to be extremely probable that the trees and plants from which the coal was derived might have been those of similarly special character, and indeed such as were very rich in wood and fruits abounding in resins. There was no doubt those natural resins were stable, and that the vegetable matter was unstable. Of course the bitumen was the altered residuum of these resinous matters for the most part, as he took it. He had just been informed by Mr. Christy, however, that a variety of turpentine had recently been obtained from petroleum or petroleum residues. If so, this was additional and rather strong evidence of certain petroleums being formed from resins of vegetable origin. He would himself like to know more of the geological strata in which the Miike coal was deposited. He might remark, however, that certainly one shaft had been sunk 430 ft. Dr. Percy had found it difficult to draw the line between lignites and true coals, as they shaded into one another almost imperceptibly, and both geologically as well as in chemical and physical character. There could be no doubt, however, that the presence of so large a proportion of chalk pointed to a cretaceous stratum. With regard to the question of the origin of the coal, he had tried to avoid dogmatising as to a special theory either for that or for the formation of petroleum. He thought the delta theory of the formation of coal was a good one, but at the same time he was equally prepared to admit that a great deal might also be formed by direct successions of growth and deposition. He also thought that the formation of petroleum was equally ascribable to various causes. As to the animal theory, he did not think that that or the fish oil experiments referred to by Mr. Perry Coste and Mr. Blount proved much, because oils or tarry substances obtained by igneous destructive decomposition went through so many phases, and differed so much and so widely according to the heights of temperature to which they were subjected during such destructive decomposition or distillation, and he would ask what were the temperature-conditions under which petroleum was formed in the earth? It seemed to him that Engler's theory, as an exclusive one, was more convenient than convincing, for nitrogenous matter under conditions and at temperatures at which it could yield such hydrocarbon and other constituents as were found in petroleum would not so almost completely dissipate its nitrogen as ammonia, but would certainly yield stable organic bases as well. He adhered strongly to the view that no one source of petroleum could be fixed upon, but that organic matters of various kinds, both animal and vegetable, contributed, and the latter largely over-balanced the former. He had not as yet determined the amount of sulphur in the specimen of metallurgical coke that was made, but he would get it done in time for its publication in the Journal. As to the bodies analogous to mineral lubricating oils, and of higher boiling points in the bitumen, if Mr. Hooper would afterwards inspect the samples before the meeting, he would see that there were specimens of high-boiling oils as well as lighter naphtha quite similar to those of petroleum. There was an excellent lubricating oil he had prepared from the bitumen, whose odour and character resembled those of petroleum products, and whose specific gravity was low. He also showed a specimen of pure paraffin wax from the same source, all naturally contained in the bitumen, and so in the coal itself.

THE SALT INDUSTRY OF INDIA.

BY MURRAY THOMSON, M.D., F.R.S.E., F.C.S.

Late Chemical Examiner to the Government of the North-West Provinces of India.

THE sources from which salt is obtained in India are four. I. By importation from England chiefly from Cheshire. II. By evaporation of sea-water. III. By evaporation of water from salt lakes, brine pits, and springs. IV. Rock salt from quarries and mines in the Western Punjab. From whatever of these sources it is obtained, it is made to pay duty and it yields a very considerable part of the total revenue of the Government of India, as no less a sum than nearly seven millions of pounds are derived from the salt duty every year.

In considering the salt industry, it is unnecessary to mention any further the salt imported from England.

II. The extraction of salt from sea-water is still carried on both on the east and the west coasts of India. The methods pursued are very primitive, but they are not altogether devoid of either knowledge or skill. The manufacture as pursued at two places may be selected as examples of all the others on the coast. These are at Balasore and Puri. These places are both on the east coast a little southward of where the river Hooghli falls into the Bay of Bengal. At Balasore artificial heat is employed to get rid of the water, while at Puri the heat of the sun only is used. In both cases the native salt-makers begin with as concentrated sea water as they are able to procure. At Balasore mounds of earth are constructed, and the top of each mound is hollowed out into the form of a basin. This basin is filled with earth, impregnated with salt obtained from the land round about which has been under the sea during high tides. When the basin is filled with earth sea-water is poured over it and allowed slowly to percolate, and to find its way through an opening provided with a rough bamboo pipe into a reservoir. The contents of this reservoir are then transferred to unglazed clay pots holding about two quarts each. These are fitted into a bed made of adhesive clay, and underneath this bed a fire is kindled, the fuel used being dry grass obtained from the neighbourhood. The boiling process is carried out for about six hours, when after cooling the salt crystals are ladled out, and then allowed to drain and dry. The cost of the manufacture by this process is very nearly 2*s.* a hundredweight. To this has to be added about 4*s.* for the Government duty, so that the salt can be sold for 6*s.* per cwt.

At Puri the manufacture can only be pursued during the dry warm weather from January to June. Large shallow pits are made about two-thirds of an acre in extent. These are filled by *baling* in sea-water during the hours of high tide. Other smaller pits are also provided, and these are divided by low mud walls. The heat of the sun slowly concentrates the sea-water in the larger pits, and then stronger water is run into the smaller excavations to the extent of one inch deep. In from four to nine days this amount of water has nearly dried up, when men enter the pans and tread the bottom. This process is repeated several times—that is, a small depth of water is let in, allowed to dry up, and then trodden. At the end of about 25 days a layer of salt fit to remove is found in the shallow pans. It should be understood that the whole of the water is not allowed to dry up; a mother-water is left in which the bitter magnesian salts are held in solution and thus separated from the sodium chloride.

III.—1. *From Salt Lakes and Brine Pits.*— The salt tract of India includes a large part of Rajputana, extending from the River Jumna between Delhi and Agra, westward and south-westward to the Gulf of Cutch. There are many salt-producing centres in this area, but the chief are those of the salt lakes at Sambhar and Didwana. The largest of these is Sambhar, a lake, when at its fullest, 20 miles long and 5 broad, but very shallow, mostly not more than 3 ft. It is a lake only in the rainy season; after the rains it is a hollow which receives the drainage of 2,200 square miles of land, in which sand ridges are numerous. One of these, 100 ft. high, protects the lake from being filled up by sand blown by the prevailing winds. There are three theories put forward to account for the salt which exists in the soil all over this tract of India. 1st. That beds of salt exist deep underneath, and that these may be a link between the rocks of the Vindhian chain in Central India with the beds of rock salt in the Punjab. The rocks seen in the neighbourhood are schists and quartzites much disturbed, and like those of the Aravalli Mountains not far off on the west. A thorough geological exploration of the district has not yet been made. 2nd. That the country was at no distant period an arm of the sea, which, when it retired, left the salt-impregnated soil. 3rd. That the salt is brought in solution from the surrounding country, and the water evaporates, and there being no outlet to the lake the salt gradually accumulates, the case of the Caspian Sea and the Dead Sea in Palestine being similar. This last theory has of late obtained great favour.

Sambhar lake is partly in the territory of the Maharajah of Jeypur and partly in that of Maharajah of Jodhpur, but the saltworks on it were ceded to the British Government in consideration of annual money payments made to the respective native Governments.

Salt making or gathering begins in the month of March, and is carried on till the rainy season sets in, at end of June or in July. As the warm weather advances, through April and May, the lake dries up until hardly any water is left. The crusts of salt begin to be formed when the water of the lake acquires a specific gravity of 1·08.

The salt lies as a thick crust over the mud, from which it is separated by small intervals so that the salt gatherers can lift off the salt in cakes. The salt thus gathered has only to be dried to render it fit for sale. It needs no further purification, and it is much esteemed by the people. There is a good deal of waste in the gathering, but this waste salt is purified by solution, subsidence, and then evaporated and crystallised in small excavated pans.

The amount of salt produced at Sambhar is from 100,000 to 120,000 tons in a year.

III.—2. *The Brine Pits of Gurgaon.*—This district is the most easterly part of the salt tract already described. Salt has been obtained from these pits for several centuries by a process similar to that pursued at Sambhar. Of late the making of salt in Gurgaon has declined almost to total extinction. The chief reason for this is the occurrence of magnesian chloride and sulphate, chiefly the latter, which gives the salt a very perceptibly bitter taste. And now that the railways have so opened up the country, salt from other localities such as Sambhar, free from this objection, can be obtained in all the market towns; so that the Gurgaon salt is nearly unsaleable. Some years ago the Commissioner of Salt Revenue referred the question of this salt to me as a chemical expert to see if I could devise a process by which the Gurgaon salt could be purified from the magnesic salts. I made some experiments and hit on a process which was quite successful, but in practice it could not be worked out on the large scale. The plan was to treat the brine with slaked lime, which, in the course of an hour or so, by the help of agitation, converted the magnesic chloride and sulphate into the corresponding calcic salts and magnesia itself. These latter, along with the excess of lime used, were allowed to subside and the purified brine run off. It was then found by test to be quite free from magnesic compounds and yielded a salt devoid of bitter taste. I found that 2 per cent. of slaked lime was enough to effect this change. (Although this 2 per cent. of slaked lime left a large amount of it unaltered and unused, yet I found by experiment that less would not do. Trials with 1·0 and 1·5 per cent. were made, but in these the magnesia compounds were got rid of entirely. Two per cent., therefore, was the smallest effectual quantity of lime that could be used. In these results it seems to me we have an instance of the influence of mass in determining the formation of compounds, an influence which was long ago investigated by Bertholet and by Gladstone). The process fails on the large scale because the difference of cost of the salt that had to be purified and that of pure salt was so small that the cost of the lime exceeded it. A further

difficulty was the accumulation of the lime employed, as, unfortunately, no useful purpose for it could be found.

IV.—In the North-western part of the Punjab there is a range of mountains, the E. flank of which is on the River Jhelum, and the W. end abuts on the River Indus. This range of mountains is known to the natives as *Khawa*, and to the Europeans as the Salt Range. A small part of the range extends to the W. side of the Indus. The rocks comprising the range belong to the Silurian system, so that the salt found imbedded with them is the oldest, in a geological sense, of any known salt deposit in the world.

Further to the N.W., and at no great distance, near Kohat, other extensive salt deposits are found, but these, it it is curious to say, belong to the Eocene groups of rocks. Salt has been obtained from both of these sources from time immemorial. It was in the time of the Emperor Akhbar, 1550 that a tax was first levied on the salt obtained here. All through the time of the *Sikh* possession of the Punjab salt was extracted from these mountains. It is estimated that there is as much salt here as will, at the present rate of consumption, last for 10,000 years. The area yielding the salt is said to be 670 sq. miles, and the thickness of the beds 100 to 225 feet. The *Sikhs* got at the salt by making deep caves, rather than mines, and they worked these in such a rude way that tremendous waste of salt took place, and as no supports were left to keep up the roofs and walls, these often fell in and caused serious loss of life. Since the time the Punjab passed under British rule a much better and safer system has been pursued. And quite recently at the Kheura or Mayo mines a wire tramway has been introduced. This, along with other improvements, has rendered the mines quite safe, and the working much more profitable.

The salt from the Salt Range is very pure and occurs in large and small crystals. The colour is various: red, black, and grey. The red is that most valued. The salt is sent direct into the market from the mines; and to facilitate its export a branch railway has been made to connect the mines with the general system of railways.

The average amount of salt taken from these sources is about 40,000 tons a year.

The question of raising revenue by means of a tax on such a necessary substance as salt requires a short mention. The tax is justified:—1st. Because it is an old tax. It was extant long before the days of British rule, and was then, and is now, submitted to without complaint. 2nd. It is the only tax, of an Imperial kind, laid on the people of the lower classes, and only amounts to 5*d.* per head per annum.

As has already been stated, the tax yields between 6 and 7 millions of pounds each year. The exact figure, 1886—87, was 6,658,000*l.*

A word may here be said on the great Salt Hedge or Barrier—one of the most clumsy and obstructive arrangements that was ever devised to help in the collection of a tax.

This hedge was rendered necessary because the salt tax was not, as it is now, the same all over India, but varied in different provinces, and to prevent smuggling this extensive barrier was constructed. At one time it extended from Attock, on the Indus, to the Mahanadi river in the province of Orissa, a distance of 2,500 miles. This distance, if drawn on the map of Europe, would extend from Moscow to Gibraltar. It consisted of an impenetrable hedge of thorny trees and bushes, supplemented by masonry walls and ditches, across which no vehicle, nor even a beast of burden could pass without detection. It was guarded by a small army of officers and men, 12,000 in number, who divided the hedge into about 1,700 beats, and these had to be patrolled night and day. Of course, this hedge gave rise to an intolerable interference with the traffic of the country and also to much annoyance and oppression to individuals. Although many miles of this hedge still exist, its use is now abandoned, as the salt duty was in 1879 equalised all over India, and so the necessity for keeping it up ceased to be. The duty is Rs. 2 per maund (82 lb.). It was temporarily raised Rs. 2½ in 1888. The normal duty (Rs. 2 for 82½ lb.) is very nearly equal to 4*s.* per cwt.

It has often been proposed to remit the tax on the salt used for cattle, it being thought that, although it might be fair to tax the part of it used by man, yet it was considered hard that the keepers of cattle should have to pay a tax on the salt used by their beasts. The Government of India would willingly grant this remission were it not the fact that the people, especially of the lower classes, would soon take to eating cattle salt. Some years ago this question was referred to all the chemical examiners in India with the view of devising a way by which this salt could be so mixed that, although still usable for cattle, it would be unfit for human use. The problem, although it looks simple, has hitherto been unsolved.

The difficulties are: 1st. The salt must not be made to taste or smell too repulsively, for if that is not attended to the cattle will not eat it. It is allowed that cattle are nearly as particular as men, and indeed more particular than some men, as to taste and smell in their food. 2nd. The adulterant, if I may so call it, must be a non-volatile and incombustible body, for if it can be got rid of by fire, then cattle salt would soon be subjected to a good roasting, then redissolved and crystallised, and so fitted for human use. Again, inorganic colouring matters, such as potass permanganate, potass bichromate can, because of their poisonous nature, be used only in small quantity, and from such small quantities it is easy by crystallising and washing to separate the salt white and clean enough to be used by any human being. From this it will be seen how difficult a question it is, and why it is that all the chemists in India have failed in finding a means of overcoming the difficulty.

ON THE CONSTITUTION OF ORGANIC PHOTOGRAPHIC DEVELOPERS.

BY DR. M. ANDRESEN (BERLIN).

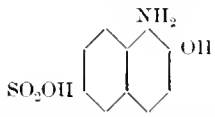
In the *Moniteur de la Photographie* (16, August 15, 1891), Messrs. Auguste and Louis Lumière have published an article of interest on those reducing compounds of the aromatic series which may be used as photographic developers. Now the results published in this article differ in various respects from results obtained by myself, and therefore it seemed to me interesting further to investigate the matter. The authors state that they have made it their business to discover relations between the chemical constitution and the developing power of organic compounds, and this gives me an opportunity to compare their researches with my own.

Par. 1.—The authors mentioned state that the compounds of the aromatic series which may be used as photographic developers contain at least two hydroxyl-groups, or two amido-groups, or one hydroxyl- and one amido-group in the benzene nucleus.

That such a rule exists is true; but the priority of its discovery may be quite another matter, and I may point to the fact that my own paper on para-amido-phenol as a developer (Photographische Mittheilungen, Heft 8, July 15, 1891) contains the following statement:—The faculty of developing the latent photographic image on silver bromide films commences with disubstitution products. It has further been ascertained by experiment that the great number of substitution products of the amido- and of the hydroxyl-groups must be specially taken into account. Moreover, I have stated that if this be correct, three types of developers may be obtained by substituting the amido-group (NH_2), or the hydroxyl-group (OH) for two hydrogen atoms of the benzene formula, viz.,

1. *Diamidobenzene* (*Phenylenediamine*)—
$$C_6H_4\begin{cases}NH_2\\NH_2\end{cases}$$
2. *Amido-oxybenzene* (*Amidophenol*)—
$$C_6H_4\begin{cases}NH_2\\OH\end{cases}$$
3. *Dioxybenzene*—
$$C_6H_4\begin{cases}OH\\OH\end{cases}$$

Par. II.—It has been alleged, secondly, that the above is correct in the general only if the groups are held in the para-position. As regards this assumption, it is a known fact that the meta-compounds cannot be used as developers. Already Eder and Toth (compare Eder, Die Photographie mit Bromsilber-gelatin, &c., 104) have shown that resorcinol cannot be used as a developer. On the other hand, I myself have stated (Phot. Mitth. Heft 8, 1891) that neither *m*-amido-phenol nor *m*-phenylenediamine can be used as developers. But, at the same time, and contrary to what is alleged, I found that besides the para-compounds, the three ortho-compounds of the above given constitution are likewise developers. (Brenzcatechin (Catechol) had already been recognised by Eder and Toth as a developer.) In addition to this, I have to state that I have used *pure* o-amidophenol and *pure* *o*-phenylenediamine in my experiments. To the best of my knowledge there does not exist a single organic compound of the ortho-position belonging to Par. I. which will not develop. On the other hand, it seems probable that the developing power of all para-compounds of this constitution has not been tested, and therefore Par. II. does not seem sufficiently substantiated, especially if we consider that the ortho-position has given us excellent developers in the benzene, and more particularly in the naphthalene series, *e.g.*, eikonogen, of the constitution—



The condition necessary for a substance to act as a photographic developer must evidently not be looked for directly in the relative position of the developing pairs of groups—

$$\begin{pmatrix} H \\ H_2 \end{pmatrix} \quad \begin{pmatrix} NH \\ OH \end{pmatrix} \text{ and } \begin{pmatrix} OH \\ OH \end{pmatrix}$$

to each other, but depends, as I have previously shown repeatedly, upon whether the compound forms a quinone-like condensation within these groups, under the oxidising influence of the halogen silver salts, exposed to light.

Then it is alleged that these rules are only available for molecules consisting of several benzene nuclei, or of combinations of benzene with other nuclei, if the amido- or hydroxyl-groups are bound to the same aromatic nucleus. Now, I have remarked about benzidine (diamidodiphenyl) that it has in this respect the same properties as a mono-derivative, and therefore I have already proved that this substance is no developer. As regards the napththalene nucleus the rule of Messrs. Lumière does not hold good, since compounds like—

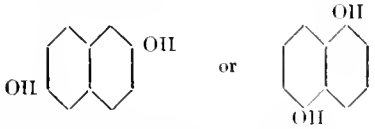


exhibit vigorous developing power.

These authors state that the developing power is absolutely lost as soon as substitution of the amido- or hydroxyl-groups takes place, unless at least two of such groups remain intact in the molecule. My own results do not agree with this statement. I have already published the fact that para-amido-phenetol—

$$C_6H_4\begin{cases} NH_2 \\ OC_2H_5 \end{cases}$$

is no developer (Phot. Mitth. July 15, 1891). Moreover, previous to the appearance of the article referred to at the outset, I had experimented upon dimethyl-para-phenylene-diamine—

$$C_6H_4\begin{cases} N\,CH_3 \\ CH_3 \\ NH_2 \end{cases}$$

These experiments have been repeated and carried further, and the following results obtained:—

1. *Dimethyl-para-phenylenediamine—*

$$C_6H_4\begin{cases} N\,CH_3 \\ CH_3 \\ NH_2 \end{cases} \textit{ is a developer.}$$

2. *Dimethyl-para-amidophenol—*

$$C_6H_4\begin{cases} N\,CH_3 \\ CH_3 \\ OH \end{cases} \textit{ is a developer.}$$

3. *Para-amido-phenetol—*

$$C_6H_4\begin{cases} NH_2 \\ \\ OC_2H_5 \end{cases} \textit{ is no developer.}$$

4. *Hydroquinone-mono-ethyl ether—*

$$C_6H_4\begin{cases} OH \\ \\ OC_2H_5 \end{cases} \textit{ is no developer.}$$

I have used only perfectly pure dimethyl-para-phenylene-diamine and dimethyl-para-amidophenol, and errors which might have resulted from impurities were therefore excluded; and the fact that both these compounds are developers is entirely in accordance with their relation to oxidising agents (compare Wurster, Ber. **12**, 526, 1803). The two other substances, viz., para-amido-phenetol and hydro-quinone-mono-ethyl-ether, show a much greater resistance to oxidising agents, not even silver nitrate oxidising them readily, and they do not reduce silver bromide either exposed or not exposed to light.

I will not omit to give the details belonging hereto. The dimethyl-para-phenylenediamine used by me had been prepared from nitrosodimethylaniline by reduction, and showed the correct melting and boiling point, viz. 51° C. and 257° C. respectively. A solution consisting of 1 grm.—

$$C_6H_4\begin{cases} N\,CH_3 \\ CH_3 \\ NH_2 \end{cases}$$

100 grms. of water, and 1 grm. of caustic soda, developed on a sensitometer plate in three minutes 19° W. with somewhat flat gradation.

The dimethyl-para-amidophenol employed, had been prepared by diazotising dimethyl-para-phenylenediamine, and by boiling the diazo-compound until no more nitrogen was developed, and by re-crystallising from benzene it was obtained in large transparent crystals, which melt at 74° C. A solution consisting of 1 grm.—

$$C_6H_4\begin{cases} N\,CH_3 \\ CH_3 \\ OH \end{cases}$$

100 grms. of water, and 1·5 grms. of caustic soda developed on a sensitometer plate in three minutes 19° W. with good gradation. Both substances are less active developers than *e.g.* non-alkylised para-amidophenol, but that they possess developing properties is beyond dispute, and in face of this fact the statement in effect to the contrary which has been made is incorrect. *But it becomes probable that the developing power of a compound containing only one developing pair of groups, will be entirely lost, if the hydrogen of a hydroxyl group present in the molecule is substituted.*

It is further stated by the authors that it appears that substitution of the hydrogen atoms of the benzene nucleus does not destroy the developing power. This statement is already to be found in an extended form (*a.*) in an article on eikonogen (Farbenindustrie, 1889, 184).

The nucleus substitutions of a compound which develops the latent photographic image have, as a rule, no

great influence on the developing power, but they often affect the physical properties of the substance in such a high degree that its practical application depends upon them. Amidonaphthol, *e.g.*, of the constitution—

is almost insoluble in water, whilst the sodium salt of the sulphonic acid of this compound, viz., eikonogen, is sufficiently soluble for practical purposes.

The authors, Messrs. Lumière, have found that the carboxylic acids of developing substances treated with carbonates of alkalis cannot yield their full developing power. This observation I can confirm. The sulphonic acids of developers of the benzene series, *e.g.*, para-amidophenol-sulphonic acid—

$$C_6H_3\begin{cases}NH_2\\OH\\SO_3OH\end{cases}$$

show similar properties. Caustic alkalis must be applied, in order to increase the reaction, whilst, *e.g.*, the corresponding developer of the naphthalene series, eikonogen—

$$C_{10}H_4\begin{cases}NH_2\\OH\\SO_3OH\end{cases}$$

is known to obtain its full developing power by carbonates of alkalis.

But they further state that the above rules can be applied only to the aromatic series. As far as I know, no photographic developers have hitherto been discovered among the corresponding compounds of the fatty series.

Again, they state that *phenylhydrazine*—the developing powers of which were first pointed out by Prof. Jacobsen—should be regarded as forming an exception. This is correct; but I may point out that a certain similarity exists between its constitution and that of the diamines of benzene, viz.: *Paraphenylenediamine*, $C_6H_4(NH_2)_2$; *Hydrazine* (diamine), $NH_2.NH_2$; *Phenylhydrazine*, $NH_2.NH.C_6H_5$.

Para phenylene-diamine and phenylhydrazine are known as developers. With the hydrazine (diamine) of Curtius I experimented as to its developing properties, with the result that this substance is really a developer if used with caustic alkalis, but only in a slight degree; and it is therefore of hardly any importance, especially as the film, similar to that of hydroxylamine, shows an inclination to wrinkle.

Hydrazine compounds have the two azo-valencies connected amongst themselves, whilst in para-phenylene-diamine each of them is separately bound to the benzene nucleus. An exactly similar relation exists between para-amido-phenol and hydroxylamine, viz.:—

Para-amido phenol—$C_6H_4\begin{cases}NH_2\\OH\end{cases}$

Hydroxylamine—$\begin{cases}NH\\|\\OH\end{cases}$

Hydrazine—$\begin{cases}NH_2\\|\\NH_2\end{cases}$

and *hydroxylamine*—$\begin{cases}NH_2\\|\\OH\end{cases}$

may be regarded in a certain sense as developing pairs of groups in a free state. The third developing pair of groups, dihydroxyl, described in the handbooks of chemistry as peroxide of hydrogen, is known to be under certain conditions a strong reducing agent. On the other hand it belongs to the powerfully oxidising substances, as it easily gives off a portion of its oxygen. On account of these two properties this substance is of great interest to photographers, and I am at present engaged in testing the properties of hydrogen peroxide for developing or weakening the photographic image.

Liverpool Section.

UNIVERSITY COLLEGE, BROWNLOW STREET.

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Vice-Chairman: A. Norman Tate.
Committee:

E. Carey.
V. C. Driffield.
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A. H. Knight.
D. McKechnie.
E. K. Muspratt.
Henry Tate.
A. Watt.

Hon. Treasurer: W. P. Thompson.
Hon. Local Secretary:
Dr. Chas. A. Kohn, University College, Liverpool.

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

SESSION 1891—92.

1892:—
Jan. 13th.—Mr. A. E. Fletcher. "Modern Legislation in Restraint of the Emission of Noxious Vapours."
Feb. 3rd.—Mr. J. H. Dagger. "The Manufacture and Industrial Value of Aluminium and its Alloys."
Mar. 2nd.—Dr. G. Shaek-Sommer. "Bill for the Sale of Agricultural Fertilisers and Feeding Stuffs."
Apr. 6th. Chairman's Address. "Manuring for the Production of Fruit."

Meeting held on Wednesday, December 2nd, 1891.

MR. A. NORMAN TATE IN THE CHAIR.

FUEL PURIFICATION.

BY PERCY BATESON.

THE subject which I wish this evening to bring before the members of this Section is one which is of moment, not only to chemical manufacturers, but to all large consumers of fuel. Although every one who uses coal is well aware that the quality thereof is a matter of some importance, few, I think, fully realise the difference in actual value between a pure and an impure article. Most manufacturers believe that the purification of such a large volume of material would inevitably increase its cost to them, and it is only in a few isolated instances, such as the mixing slack for use in making black ash or crude soda, that they deem it worth while stipulating for a low percentage of impurities. Now I hope to be able to put before you the actual loss incurred by the use of such fuel, and also to show that it is within the power of the coal-owner to produce a comparatively pure article at possibly a less cost than he has to charge for the coal at present supplied, or at an increased cost insignificant compared with the benefit to the consumer.

I would respectfully urge on the attention of the coal proprietors that it is of the utmost importance to the manufacturing industries of this country that they should endeavour to turn out the best article at as low a price as

possible, as the commercial supremacy of this country depends to a great extent upon cheap fuel.

Dr. Redfern, in a paper before the British Association, considers that "under the term coal, those substances must be comprised which consist of compressed and chemically altered vegetable matter, associated with *more or less* of earthy substances, and capable of being used as fuel," with which definition I would venture to agree with the substitution of the words "a small quantity" instead of "more or less." That the quantity of earthy matter should vary it is impossible to deny, but that such variation should extend to the amount found in the fuel commonly met with, is beyond all reasonable expectation. In *Chemical Technology*, by Professors Miall, Green, Thorpe, &c., the mean composition of wood is given as: carbon, 49·6 per cent.; hydrogen, 6·1 per cent; oxygen, 43·1 per cent.; ash, 1·2 per cent.; and of club moss as: carbon, 46·8 per cent.; hydrogen, 6·2 per cent.; oxygen, 42·1 per cent.: ash, 4·9 per cent. From these figures it is evident that when we find a coal containing up to 15 and 20 per cent. ash, some portion of the adjacent layers of earthy substances must have become mixed with the pure coal in the mining operation. Muspratt states the ash of lignite averages 5 per cent., and that of bituminous coal 1 per cent. to 2 per cent. How few samples we see nowadays up to this standard. The statement in Watts' Dictionary, that "the ash in coal varies from 1 to 30 or even 35 per cent.," is much nearer the mark, at any rate as regards that used in factories. I have noticed, and my observation has been corroborated by others, that since the great colliery strike, now nearly two years ago, the percentage of ash in the fuel supplied to manufacturers in this district has increased very considerably, and this is also accompanied by a rise in the price. It is no unusual occurrence to receive a consignment containing from 20 to 30 per cent. of ash, and I think I am not putting the average too high when I place it at 14 per cent.

This is a state of affairs against which it is time some action should be taken, and the recent formation of several powerful unions, or amalgamations, of fuel-consumers, renders possible the carrying out of a combined movement which should have every chance of success.

It is, however, useless to inform a seller of any article that his produce is becoming too impure for use, and must be improved or you will cease to purchase from him, unless you know that such improvement is possible, or that you can get a better article elsewhere at a relatively cheap rate: and the knowledge of your inability to do this has been until recently a sufficient obstacle to any action. But there is now, I believe, a process of coal-washing patented in this country, and available to all colliery owners, under the name of "The Lührig Coal Washer," which enables them to so purify their coal, that the amount of ash may be certainly and uniformly reduced to 4 per cent. and even 2 per cent., and in so doing brings in a large profit to the colliery.

Apparatus for washing coal, as it is termed, is no new idea, and I find in Ronalds and Richardson, Chem. Technology, two illustrated descriptions of such machines used about 1855. Others have been constantly brought forward, but it has remained for Mr. Lührig to perfect the process. His method has been largely adopted by the continental collieries, especially in Germany, and there has lately appeared an article in "Engineering," February 13, 1891, p. 184, illustrated by drawings, describing a large plant successfully at work at the collieries of Messrs. Merry and Cunninghame, Limited, at Motherwell in Scotland, which treats the coal as it arrives over the bank, and delivers it automatically sorted and washed in railway trucks ready for market. I extract the following paragraphs from this article: — "With the increasing scarcity of good coal-beds in this country it has become necessary for coal owners and mine managers to pay more attention to improvements and labour-saving appliances in the treatment of the coal when above ground, in order to enable them to profitably work dirty seams of coal, avoiding at the same time all waste. . . . . Coal-washing becomes therefore more and more essential, and is looked upon as the only means by which the dirt can be effectively removed. . . . . It has been made the subject of investigation by the North of England Institute of Mining Engineers. . . . . Coal hitherto left underground, or sold as an inferior class, is made by this method into good marketable coal, and millions of tons may be thus added at an almost nominal cost to the available stocks. Two hundred plants have been erected by Mr. Lührig in different parts of the world. . . . . In Yorkshire the Denaby Main Colliery, Ltd., have erected a plant, principally for washing of coal to be coked, to enable them to produce a high-class coke from their very dirty hard and soft smudge. The result obtained is about 4 per cent. of ash in the coke" (equal to about 2½ per cent. in the washed coal) "which is of excellent structure, the loss of pure coal in the refuse is only ¾ per cent., or practically speaking none whatever." I had the privilege a year ago of seeing this latter plant in operation, and I was assured by the manager the results were above all expectation.

I have been favoured by the Company working this patent with various particulars and descriptions of the plant, of which the following may prove interesting.

This process is the result of a long and varied experience with the most dirty classes of coal on the Continent of Europe, and is on the gradual reduction system, that is, it is not all crushed up in the dirty state, but is gradually broken up, the shale being automatically separated from the coal by degrees. It is not claimed that one type of machine will be suitable for every class of coal, but it is a process which can be so arranged as to meet the requirements and local conditions of each colliery. The system is, in short, a combination of new screening, crushing, and sizing machinery, improved washing machines, and new and greatly improved machinery for filtering the water used in the plant, so that it can be used over and over again. It is easy to wash nut coal, or even ordinary dross, but to wash fine coal (from ⅜ in. down to dust) without losing more than 1 per cent. of pure coal and retaining only the fixed ash in the washed coal has hitherto been exceedingly difficult. This difficulty has been overcome (on a basis of 500 tons of fine coal being treated daily) at a cost of less than 1*d.* per ton.

The process essentially consists of:—

Dry separation of the run of the mine, that is, the mechanical separation of the slack or dross from the lump coal which, when requiring picking, passes on to picking and loading bands of an improved construction, producing as little "smalls" as possible.

Breaking the larger pieces of coal (interstratified with shale or mixed with pyrites) picked out on these bands to nut sizes, and separating the nuts, peas, &c., thus produced from the dirt in the following washing operations.

Sizing the coal from 4 in. downward in revolving screens for the production of nut, pea, and fine coal.

Washing the different sizes of nut coal coming from the revolving screens separately.

Recovering the mixed or finely interstratified coal (separated by washing from the pure coal and clean refuse in one operation) by crushing and rewashing.

Washing the fine coal from ⅜ in. downwards (after being graded in grading boxes) on separate washers especially constructed for the treatment of fine coal, their work being perfected by the help of felspar; this was first employed by Mr. Lührig in coal-washing machinery and has given the most satisfactory results.

The recovery of the sludge, or the finest coal dust carried away with the washing water, by means of automatic and continuous sludge-recovering machinery.

Clarifying the water used in washing to such an extent as to enable its use over and over again.

The automatic transporting and storing arrangements of the various products, nut, pea, pearl, and fine coal, and also of refuse.

Recovery of by-products, as, for instance, pyrites or brasses, which, in many of Lührig's plants, pays the cost of labour of the whole plant.

Arrangements are also made for automatically storing a considerable quantity of coal, the hoppers being so arranged that a large quantity of coal can be loaded in a short time.

The dry separating portion of the plant is constructed so as to make as little "smalls" as possible, the screening and loading arrangements being economical, efficient, and automatic.

The washing arrangements are such that as much clean nut coal can be extracted as possible, and that three products can be made by each machine, viz., clean nuts, seconds or nuts (finely interstratified with shale) which are raised, crushed, and rewashed, and refuse free from coal. In all of Lührig's plants there is a marked desire to avoid crushing all the coal, that is, the dirty and clean coal, together.

Very often coal from seams with a band, or badly interstratified with shale, is left in the pit; this coal can often be raised at a nominal cost, and treated by this process to yield a good marketable article. In the case of a Scotch colliery, the gain in this way amounts to from 2*d.* to 4*d.* per ton, and the work of each collier can be increased by half a ton per day.

The chief points worthy of notice in this process of coal-washing are:—

The process is automatic and continuous.
The cost of working is almost nominal.
The quantity of water necessary is small.
The percentage of lump coal is considerably increased by careful handling.
The value of nuts and peas is raised.
The fine coal can all be saved and used for coke manufacture or for making briquettes.
Settling ponds are entirely done away with, the "smudge," or fine coal, being recovered by special machinery.
The cost for repairs is practically nominal, the wearing parts being few.
Coke made from washed coal is of increased value.

Several collieries in Saxony and Westphalia which paid no dividend before have, owing to the adoption of this process, been transformed into valuable dividend-paying concerns.

Among the other losses incurred through the use of impure fuel, that of transport may be reckoned.

At one colliery 18 tons of mixed coal are daily thrown upon the shale tip or waste (being 5,400 tons per annum). By this process marketable coal to the amount of 4,428 tons can be produced from this waste coal, worth from 3*s.* to 4*s.* 6*d.* per ton, at a nominal cost.

By careful handling and loading arrangements devised at this colliery by Mr. Lührig, the yield of lump coal has been increased by 6 per cent.

This washer can be made to produce four different sizes of coal, though this is not always the case, in the following proportions:—

	Per Cent.
Treble and double nuts, 2 in. to 1¼ in. and 1¼ in. to ¾ in.	41·84
Single nuts, ¾ in. to [illegible] in.	30·61
Peas [illegible] in. to [illegible] in.	10·21
Sludge [illegible] in. to 0 in.	17·34

In a trial at the Maryport Colliery the coal was divided into two divisions, pearl coal and sludge.

	Ash.	Sulphur.
	Per Cent.	Per Cent.
Small coal before washing	13·78	1·35
Pearl coal after washing	2·78	..
Sludge	11·60	..
Pearl coal and sludge mixed	4·14	0·85

The proportions produced were pearl coal, 86·18 per cent., sludge, 13·52 per cent. 52 tons 13 cwt. treated gave 6 tons 5 cwt. refuse, containing 2·8 per cent. of coal. Another lot of coal at the same colliery—

	Water.	Ash.
	Per Cent.	Per Cent.
Before washing	5·24	22·41
After washing	4·94	4·48

The cost of washing at Motherwell is stated at ½*d.* per ton for labour, and slack, which formerly was sold for 6*d.* per ton containing 23 per cent. of ash, is now washed and sold for 3*s.* 6*d.* per ton, and contains only 2½ per cent. of ash.

The water used is given as 15 cubic feet per minute for a plant treating 800 tons per day of ten hours. The sludge is used at the Denaby Colliery for firing the boilers, not only in this plant, but throughout the colliery.

It may be urged, and with some reason, that this washed coal would probably contain an excess of moisture; but I am assured that this is not so, except in the case of the fine sludge, which latter you will notice only amounts to from 13 to 17 per cent. of the output. The arrangements in the washing plant are such as to drain the coal properly before loading by means of finely-perforated elevator buckets and storage hoppers.

It is of interest to find that in this process the nitrogen in the coal remains intact. The cost of treating the coal, though varying slightly according to the position, &c., may be fairly represented by the following figures for a 1,000 tons a day plant. Cost of plant and erection, 9,000*l.*:—

	£
Depreciation at 10 per cent.	900
Interest at 5 per cent.	450
Repairs, labour, and material	20
Wages process, oil, steam power, &c., 11*d.* per ton	1,875
General charges, say	380
	3,625

on 300,000 tons this equals 2·9 pence per ton. The company working the patent in this country is the Lührig Coal and Ore Dressing Appliances, Limited, 32, Victoria Street, London, who will give such explicit guarantees that a plant erected by them cannot fail to prove successful.

There is one exceedingly obnoxious impurity in coal which is eliminated to a large extent by careful washing; I mean the sulphur. At Kattowitz, in Germany, a coal containing 47 per cent. of ash, chiefly pyrites, is washed down to 5 per cent., and the residue used for making vitriol, which pays the whole cost of treatment. Doctors Playfair and de la Bèche, in the Government investigation, give the quantities of sulphur in various coals as under:—

Welsh, 1·42 per cent.; Derbyshire, 1·01 per cent.; Lancashire, 1·42 per cent.; Newcastle, 0·94 per cent.; Scotch, 1·15 per cent.; and others from 0·8 per cent. to 2·6 per cent. I venture to think that, at the present time, these percentages are somewhat exceeded, and that a fair average would be 2·0 per cent. An estimate of the consumption of coal in manufacturing operations in this country for the year 1877, I think gives the quantity as 80,000,000 tons. In the report of the Inspector of Mines for Manchester and district for 1889, the total output of coal for that year is estimated at, in round numbers, 177,000,000 tons. I think, therefore, we may take the amount used now in manufacturing operations as fully 120,000,000 tons. This at 2 per cent. would give 2,400,000 tons sulphur. In other words, there are annually ponred into the atmosphere of this country 4,800,000 tons of sulphurous acid from the burning of coal alone, not to mention what is turned out in smelting and other processes, to which the much maligned sulphuric acid manufacture only contributes an insignificant 7,000 or 8,000 tons.

Mr. Ludwig Mond estimated, in his presidential address to this Society in 1889, that if one-tenth of the coal used in this country were treated for the production of ammonia from the nitrogen contained therein, we could be entirely independent of the supplies of nitrate of soda and other nitrogenous substances imported from abroad. From the above figures it is evident that precisely the same remark is true substituting sulphur for ammonia, and pyrites for nitrate of soda, &c. However, the prices of these materials are vastly dissimilar, and it is improbable that we could profitably make use of this sulphur; but, on the other hand, if we can simply keep even half of it out of the coal, and so from the atmosphere, are we not achieving a result of vast importance, to the health and comfort of our teeming population?

Dr. Angus Smith, in 1869, estimated the free sulphuric acid in the rain-water falling within the boundaries of the following four chief towns:—

London	0·33	grains	per gallon	H_2SO_4
Manchester	0·89	„	„	„
Liverpool	0·99	„	„	„
Glasgow	1·297	„	„	„

The sulphur is undoubtedly a very obnoxious constituent to the consumer of coal; existing as it mainly does in the form of iron pyrites, on ignition the iron is left as ferric oxide, which forms with the other matters a very fusible slag, stopping up the air channels, and causing heavy wear and tear on the fire-bars. In such industries as gas making, iron manufacture, and others, sulphur-free fuel would be of immense advantage. It is also often asserted that the spontaneous combustion of coal is caused by the presence of sulphur.

Now as to the actual gain in £ *s.* *d.* when using a washed slack containing, say 2 per cent. ash, against one with 14 per cent., which latter I have previously stated as a fair average. I have taken the following figures in both cases, not necessarily as authoritative, but sufficiently correct for comparison:—

	s.	*d.*	
Cost of slack delivered in waggons	7	0	per ton.
Discharging	0	1½	„
Firing	0	9½	„

Removing ashes, &c., at 1*s.* 3*d.* per ton of refuse. This comprises the uncombustible portion, together with 12½ per cent. as actual coal carried away unburnt, which I have found a reasonable percentage. For convenience I have calculated on 100 tons slack.

Coal Containing 14 Per Cent. Ash.

	£	*s.*	*d.*
Cost 100 tons at 7*s.* per ton	35	0	0
Discharging at 1½*d.* „	0	12	6
Firing at 9½*d.* „	3	19	2
Removing ashes, &c., at 1*s.* 3*d.* per ton on 15¾ tons	0	19	8
Total cost of burning 84¼ tons effective fuel	40	11	4

or 9*s.* 7½*d.* per ton.

Coal Containing 2 Per Cent. Ash.

	£	*s.*	*d.*
Cost 100 tons at 7*s.* per ton	35	0	0
Discharging at 1½*d.* „	0	12	6
Firing at 9½*d.* „	3	19	2
Removing ashes, &c., at 1*s.* 3*d.* per ton on 2¼ tons	0	2	10
Total cost of burning 97¾ tons effective fuel	39	14	6

or nearly 8*s.* 1½*d.* per ton.

Now, 9*s.* 7½*d.* − 8*s.* 1½*d.* = 1*s.* 6*d.* per ton of fuel gain in favour of the consumer.

Eighteenpence per ton is a very serious consideration in these days of keen competition, but there should be added to this something more representing advantages gained in ways which it is almost impossible to estimate, viz., increased efficiency of plant while working; less flue cleaning, and consequent increase in output, owing to fewer stoppages; less wear and tear of fire-bars and plant generally; less locomotive power required, the number of full waggons to be manipulated being reduced by 14 in every 100, and of refuse waggons the same; saving in wages, beyond that given above in regard to the firing, in wheeling ashes from furnaces, and, in the case of mixing slack, less loss of insoluble soda, though, for my part, I believe this loss is generally over-estimated. I have stated before that I allow 12½ per cent. of combustible matter being carried away with the ashes. This may to some appear high, but I believe it is not so; and as one firm in Widnes have erected a plant for treating the ashes from the various departments of the works in order to extract this lost fuel, and, I am informed, with eminently satisfactory results, it is evident that the percentage of this combustible matter must be considerable.

In the Chemical Trade Journal for 13th December 1890 appeared a strong article on the adulteration of coal, stating that ordinary house coal, containing 19 per cent. of ash, was freely distributed, and in subsequent weeks several letters were published, corroborating this statement, and further asserting that 50 per cent. of ash was not uncommon. A letter signed "Coal Merchant," while not attempting to dispute the accuracy of the previous writers, set up the apology that the public would have a cheap article and they got it—nasty.

In the case of the alkali manufacture by the Leblanc process, in which the amount of fuel used makes the cost of that fuel of great importance, the saving per ton of 60 per cent. caustic would amount to about 9*s.*, presuming that the figures I have given above are taken as a basis. Such a saving, when the competition of the ammonia-soda process is seriously threatening the industry, means the difference between success and failure.

Before closing this paper I should like to put before you a few points on the general position of coal-mining in this country.

We at present extract from the coal measures of the British Isles somewhere about 180 million tons per annum, and this amount increases yearly by some four or five million tons. At various times alarming statements have been made to the effect that we are rapidly coming to the end of our fossil fuel. Professor Jevons, some 25 years ago, gave the duration of the coal supply at about 100 years, and a Royal Commission was appointed to report on the matter. The inquiry was exhaustive and resulted in an estimate, that within a depth of 4,000 ft. there was sufficient coal to last for 276 years. Other calculations were given, based on different figures, but the one I quote was generally adopted, and it has been verified up to the present time, as far as the increase in consumption is concerned, in a wonderful degree. However, Mr. Henry Hall, Her Majesty's Inspector of Mines, in an address before the Geological Society of Manchester in November 1889, expressed the opinion that the available stock of coal has been over-estimated by the Commissioners, and that in his judgment the coal existing above this depth will become exhausted in 170 years from 1889. Besides, he casts a doubt on the possibility of working at 4,000 ft., asserting that even with good ventilation the temperature would be 115° F. It is urged that the increased difficulty of extracting the coal as the supply narrows will raise the cost, and therefore stop consumption. This is hardly borne out by history, for I find, in the Encyclopœdia Londinensis, coal in 1536 fetched 2*s.* 6*d.* per chaldron in Newcastle and 4*s.* and 5*s.* per chaldron in London, which price was raised by a combination in 1590 to 9*s.* per chaldron, or about 3*s.* 2*d.* per ton. The consumption is not given at this period, but about 1810 it is stated as only 760,000 tons per annum in London at about 26*s.* per ton. At the present time London consumes more than this quantity in a month, at about 20*s.* per ton, though every year makes the coal more inaccessible. It is curious to find in this Encyclopœdia the following statement:—"The Newcastle coal contains sulphur, which gives additional heat and spirit to the natural good qualities of the coal."

A Mr. Beaumont, in his Treatise on the Coal Trade, advocates strongly the conserving of our coal-beds by putting on an export duty, and the same policy is urged by

Mr. Ellis Lever in a letter to "The Times" in October 1888. Mr. Lever states the export as 30,000,000 tons per annum.

It is admitted, then, that the coal supply is limited, and even asserted by some that its exhaustion is probable in the near future. Other sources of fuel are looked for, and a number unhesitatingly decide for natural gas and oil. Mr. Charles Marvin, an authority on petroleum, in an article in the Newcastle "Daily Chronicle" in October 1889, boldly prophesies that within the coming five years petroleum will be so brought before the fuel consumers, both by its great superiority over solid fuel and its low price, that it will prove an exceedingly strong rival to coal, and he further states that there are over 1,000 steamers and locomotives in Russia and America using oil fuel, and that alone. Mr. Urquhart, in a paper read before the Institute of Mechanical Engineers on "Petroleum Refuse as Fuel," gives his opinion that the use of this refuse effects a saving of from 42 to 47 per cent. over coal, and asserts that there is no difficulty whatever in employing it; while a writer in the "Glasgow Herald" a few months previously, under the head of "Fuels of the Future," assures those interested in our fuel supplies that there is a sufficient reservoir of oil and gas beneath the crust of the globe to supply combustible material for untold ages.

However all these speculations may turn out, it is obviously our duty to future generations to endeavour to stop as far as possible the enormous waste of our natural resources. This waste occurs in many ways; but in connection with my subject there is one I wish particularly to bring under your notice. In the Chemical Trade Journal, 2, 1888, p. 196, an interview with a colliery proprietor is reported, in which he is asserted to have made the following startling statement:—"In getting 160 million tons of coal from underground, 50 million tons are lost to the nation, because it does not pay to bring it up, and therefore it is thrown down the 'gob' and left in a position in which it will be impossible to work at any subsequent time." We must hope that this quantity is exaggerated, but even so it is evident that the loss is very serious under this head. Now, I maintain that this can be altogether prevented, and a very large quantity of good fuel added to our supplies by treating in the way I have indicated, at a price remunerative alike to consumer and producer.

I have had my attention drawn to a paper by Professor Munro, or rather a leading article in "The Times" dealing with his paper, from which I gather that the Professor bids us be contented regarding our coal supply, and, in fact, tells us to go on in the same way, for there is no danger ahead. But I hold it is better to make as sure as we can, for if the danger arrives there are no means of retracing our steps.

Glasgow and Scottish Section.

SESSION 1891–92.

1891.
Feb. 2nd (Edinburgh).—Dr. A. P. Aitken. "New Apparatus."
Mar. 1st.—Glasgow.
Mr. C. Watson, jun. "Experiments on different Methods of preparing Pure Phosphoric Acid."
Mr. W. J. A. Donald. "On Barvtes."

Yorkshire Section.

SESSION 1891–92.

1891.
Feb. 1st.—Dr. J. Lewkowitsch. "Certain Buttons in the Analysis of Oils."
Mar. 7th.—Mr. Sidney Lupton. "The Measures employed in Technical Chemistry."

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I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

Corrosion in Steam Boilers. J. H. Paul. Iron, Nov. 6, 1891, 401.

This paper was read at a meeting of the Society of Engineers, held on Nov. 2, 1891. The author first dealt with the molecular structure of iron in its two different forms of α-iron and β-iron, and the hardening effects of manganese and carbon, and touched briefly on the principal chemical properties of iron, including the action of caustic alkalis and the occlusion of gases by the iron. A short account of the manufacture of boiler plates lead to the statement that the "vagaries of corrosion" is merely another way of saying that the molecular arrangement of the particles being invisible, it is impossible to say where the soluble particles lie, that is to foretell the particular spots where most solution will take place. Metals are collections of molecules massed together by fusion and pressure, and the very fact that they are seldom found free in nature, points to the conclusion that in their free state they are in an unstable state of equilibrium, and, therefore, ever ready to enter into fresh combinations.

The second part of the paper was devoted to corrosive natural waters, and rain water was traced from the sea to the steam boiler, the various causes which influence its character being briefly alluded to. Special reference was made to the Huddersfield tramway boiler explosion, and the

* Any of these specifications may be obtained by post, by remitting the cost price, *plus* postage, to Mr. H. Reader Lack, Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C. The amount of postage may be calculated as follows:—

If the price does not exceed 8*d.*	½*d.*
Above 8*d.*, and not exceeding 1*s.* 6*d.*	1*d.*
„ 1*s.* 6*d.*, „ „ 2*s.* 4*d.*	1½*d.*
„ 2*s.* 4*d.*, „ „ 3*s.* 4*d.*	2*d.*

causes pointed out; the following analyses of the waters and deposits being given:—

No. 1.

Feed Water.

	Grains per Gallon.
Sulphate of lime	2·94
Sulphate of magnesia	1·04
Chloride of magnesium	0·18
Chloride of sodium	0·85
Silica	0·30
Oxide of iron	0·29
Free hydrochloric acid	0·46
	6·06

No. 2.

Boiler Water after Three Days.

	Grains per Gallon.
Chloride of calcium	2·00
Sulphate of magnesia	1·53
Sulphate of soda	1·34
Sulphate of iron	1·39
Chloride of sodium	0·18
Silica	6·45
Free hydrochloric acid	1·53
Grease, organic matter, &c.	7·40
	15·82

No. 3.

Ordinary Deposit from this Water.

	Per Cent.
Ferric oxide	57·52
Basic sulphate of iron	2·28
Sulphate of lime	38·47
Silica	1·48
Magnesia	0·25
	100·00

No. 4.

Deposit in Copper Patched Boiler.

	Per Cent.
Ferric oxide	35·34
Ferric hydrate	15·25
Basic sulphate of iron	12·28
Oxide of copper	12·52
Silica	11·56
Magnesia	0·80
Sulphate of lime	12·29
	100·04

Corrosion caused by alkaline artesian well waters was next described and illustrated by the following analyses:—

No. 5.

Artesian Well Water.

	Grains per Gallon.
Silica	0·57
Bicarbonate of iron	1·14
Carbonate of lime	5·14
Nitrate of magnesium	0·06
Bicarbonate of soda	15·69
Sulphate of soda	21·71
Chloride of sodium	17·60
	63·42

No. 6.

Boiler Water at End of a Month.

	Grains per Gallon.
Caustic soda	163·24
Carbonate of soda	703·79
Sulphate of soda	1129·56
Chloride of sodium	1167·08
Nitrate of sodium	3·28
Organic matter	4·75
	3171·70

Referring to corrosion in marine boilers, the author illustrated the exciting condition of the water in marine boilers, using sea water as a make-up, by an analysis, and showed how such a solution would rapidly corrode iron and dissolve zinc.

No. 7.

Marine Boiler Water.

	Grains per Gallon.
Chloride of calcium	58·42
Chloride of magnesium	570·40
Chloride of sodium	5749·98
Sulphate of magnesium	468·67
Silica	29·61
	6277·08

Cylinder oils were also shown to be liable to oxidation by high pressure steam, and the oily organic acids thus produced act upon the engines and when the condensed steam is returned to the boiler, introduce copper and lead and form insoluble soaps with the lime and magnesia in the water. The magnesia soap deposits (the composition of which is given below) are very bad conductors of heat, and by adhering to the plates cause overheating and subsequent collapse.

No. 8.

Cylinder Deposit.

Mineral oil	29·92
Combined oily acids	1·90
Carbonaceous matter	8·90
Oxide of lead	3·60
Oxide of copper	1·12
Oxide of iron	52·66
Oxide of zinc	0·17
Lime	0·13
Silica	1·19
	99·59

No. 9.

Oily Deposit in Marine Boiler.

Magnesia soap	35·78
Basic sulphate of iron	10·25
Oxide of lead	0·20
Oxide of copper	0·30
Oxide of zinc	0·41
Magnesic hydrate	47·56
Magnesia	4·90
	100·20

After a short description of the action of zinc, the paper concludes with an analysis of a piece of perished zinc taken out of a marine boiler.

PATENTS.

Improvements in Multiple Evaporating Apparatus. T. Slaiter, London. Eng. Pat. 16,326, October 14, 1890. 11*d*.

In a horizontal cylindrical vessel in which a vacuum is maintained, the inventor arranges a number of horizontal troughs or tubes open along the top, and fitted into the two ends of the vessel. The troughs are connected at alternate ends to allow the liquid to descend from one to the other. Along the bottom of each trough are placed two tubes, one inside the other, with an annular space between them, within which steam circulates. The liquid entering the uppermost trough passes along the outside of the annular surface until, arriving near the end, it enters the inner tube, after traversing which it falls into the next lower trough and so on until it leaves the vessel below. Several vessels may be connected together for acting in multiple effect, and the shapes and arrangement of the troughs and tubes, as well as the method of their connection with and through the end plates of the vessel, may be varied

whilst all tubes and passages are arranged for easy removal. There are four claims and three sheets of drawings. (See also Eng. Pats. 10,493 of 1888 and 34 of 1889; this Journal, 1889, 759 and 970—971).—B.

Process for Obtaining a New Material from Bituminous Slate, and its Application as a Filtering Medium and as a Colouring Matter. J. Zeller, Eislingen, Germany. Eng. Pat. 17,218, October 28, 1890. 4*d*.

The bituminous slate known as "Posidonienschiefer" is ignited and afterwards slaked with water for the production of a special form of coke. The product is said to form an excellent filtering and clarifying medium equal to if not superior to bone-black. It can be used also in the manufacture of boot blacking and in the finishing of black textile fabrics as a substitute for kaolin.—O. H.

A New and Improved Apparatus for the Clarifying of Liquids. T. Thorp, Whitefield. Eng. Pat. 18,050, November 10, 1890. 8*d*.

This improved clarifier or filter consists of a rotary drum with a double bottom secured to a vertical hollow spindle provided at its lower end with a centrifugal pump which dips into the liquid to be filtered. The drum carries a number of concentric perforated partitions or screens, but the outer cylindrical casing is not perforated. It is by preference closed with a tight fitting cover, which has a gland in its centre through which the exit pipe passes. Filtering material, such as furnace ashes or charcoal, may be placed between two or more of the partitions. On the rapid rotation of the spindle, the centrifugal pump raises the liquid into the drum between the double bottom, whence it passes towards the circumference and is finally forced through the several partitions and filtering material to the outlet pipe. Three claims are made and the apparatus is illustrated by one sheet of drawings.—B.

Improvements in Apparatus for Heating and Evaporating Liquids. J. Kirkaldy, London. Eng. Pat. 19,550, December 1, 1890. 11*d*.

This specification relates to details of construction of evaporating or distilled-water apparatus, in which evaporation is produced by steam-heated tubes or cylindrical vessels immersed in the water under treatment. The object of the invention is to secure easy access to all the surfaces on which deposits can accumulate. For particulars of the details, the specification, which is illustrated by five sheets of drawings, should be consulted. There are four claims.—B.

Apparatus for Agitating or Mixing Liquids, Washing the Interior of Casks and the like, and for other Analogous Purposes. J. Bradbury and C. T. Colebrook, London. Eng. Pat. 20,684, December 18, 1890. 8*d*.

This invention is specially applicable to vessels having only one opening, *e.g.*, a barrel. A series of levers and connecting links, forming an expanding framework, are arranged on a carrying bar and are actuated by a spindle. The apparatus when closed is inserted through the bung-hole, and the spindle, which is screwed, is then revolved by an external handle in order to expand or open the framework. On the spindle and carrying bar being then turned together the framework will revolve about the carrying bar at the centre and thus thoroughly mix and agitate the liquid in the barrel. On revolving the spindle in the contrary direction the framework is again closed and can be readily withdrawn from the vessel.—L. S.

Improvements in Filter Plates. R. Heaton, Malaga, Spain. Eng. Pat. 12,316, July 20, 1891. (Under International Convention, March 2, 1891.) 8*d*.

The object of this invention is to provide filter plates by which the extraction of oil from seeds, juices from fruits, &c., so that operations can be effected more perfectly and expeditiously.

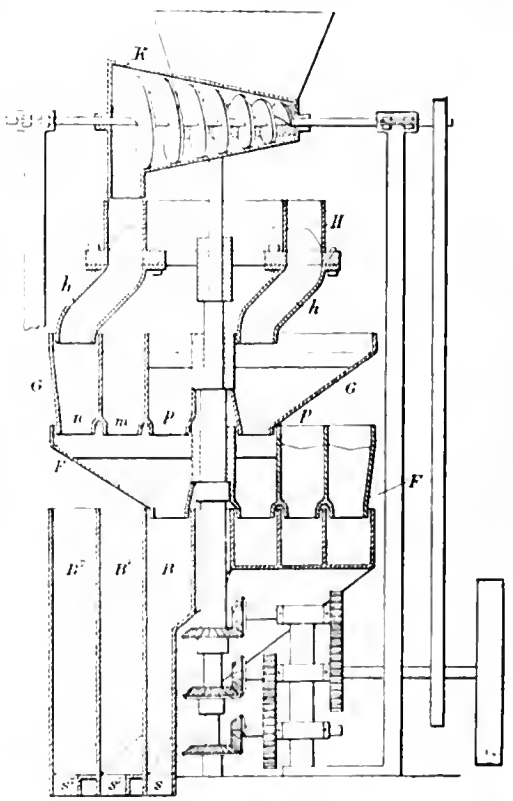
The apparatus consists of a combination of filtering plates, some of which are provided with perforations, and so arranged that the liquid is separated from the solids by flowing between the adjacent surfaces of the plates, which are grooved, or roughened, or have a woven wire cloth placed between them to facilitate the passage of the liquid, whilst preventing that of the solid materials.—E. S.

A Centrifugal Machine for Incorporating or Mixing together Various Substances. C. H. Haubold, Chemnitz, Germany. Eng. Pat. 10,738, June 24, 1891. 6*d*.

An ordinary rotary centrifugal drum has arranged in it a number of sieves or perforated metal sheets. When the drum is rotated the materials placed in it are driven by centrifugal force against the sieves, and thus driven out are broken up for the purpose of being mixed, washed, or brought into intimate contact with one another, and collected in a chamber. The sieves are made of different materials and are constructed, according to the nature of the material to be operated upon.—E. S.

Improvements in Ore Sampling Machines. H. Le Roy Bridgman, Blue Island, U.S.A. Eng. Pat. 13,198, August 4, 1891. 8*d*.

In this apparatus a kind of fractionation of the ore is effected. It consists essentially of three apportioning devices F, G, and H, each rotating in an opposite direction to the one immediately above it. The powdered ore is delivered through K into the shutes *h*, of which there are



Sampling Machine.

eight. Of these, one delivers into the shute *n*, another into *m*, and the rest into *p*, so that only one-eighth part of the ore passes into *n* and *m* respectively. The shutes *n* and *m* are not continued round the whole periphery of G, but only form one-fourth of its total area, consequently only one-fourth of the ore passing through *h* falls in *n*, that is one-thirty-second part of the original ore. The same applies to *m*. In the apparatus F the same sorting is effected, one fourth part of the ore delivered by *m* and *n* falling respectively into the corresponding shutes marked *m* and *n* and thence into the channels B^1 and B^2, whence they are delivered through the apertures s^1 and s^2. Two average samples, therefore, are obtained from these exits, each consisting of one-one hundred and twenty-eighth part of the total quantity of the ore passing through the apparatus. The rest of the ore falls through the apertures *p* into the shute B and issues at *s*.—H. K. T.

A Centrifugal Machine for Separating Acid from Nitrocellulose or for other like Purposes. R. Kron, Golzern, Germany. Eng. Pat. 13,612, August 12, 1891. 6*d*.

See under XXII., *page* 1029.

Improvements in or Connected with Filter Press Cloths. O. D. Droop, Havannah, Cuba. Eng. Pat. 16,581, September 30, 1891. 6*d*.

The filtering cloth is about five centimetres longer than double the length of the filter plate, and having been folded double a seam is made two and a half centimetres from the upper doubled end. This seam forms the handle by which the cloth is lifted and hung over the top edge of the filter plate, half of the cloth then hanging over each side of the plate. By this means the cloths are regularly hung, and can be easily put on and removed as required. The bottom edges of the cloth can also be doubly or trebly hemmed, since the above arrangements effectually prevent any otherwise accidental folds of the cloth getting between the plates or the seam or hems.—E. S.

II.—FUEL, GAS, AND LIGHT.

Preparation of Oxygen, and its Application to Illuminating Purposes. G. Kassner. J. für Gasbeleuchtung, 1891, **34**, 351—353. (Compare this Journal 1889, 885; 1890, 187—188.)

When ordinary coal-gas is burnt with oxygen, and the flame allowed to impinge on zirconium oxide, the intensity of the light produced is 40 times as great as that of an ordinary gas flame consuming an equal quantity of coal-gas; if, therefore, oxygen can be prepared on the large scale, even at double or treble the cost of coal-gas, it would pay to use it for the purpose mentioned above. As a matter of fact oxygen can be obtained in large quantities at a cost only slightly in excess of that of coal-gas, by the process briefly described below.

Porous calcium plumbate is first prepared by heating a mixture of lead oxide and calcium carbonate for about ten minutes at a red heat in a free supply of air; this operation can be carried out either in retorts or furnaces. The calcium plumbate is now allowed to cool down to a medium or dark-red heat, and then a stream of pure carbon dioxide passed through the retort or furnace as long as it is absorbed; in this way calcium carbonate is regenerated and oxygen is liberated, in accordance with the following equation—

$$Ca_2PbO_4 + 2\,CO_2 = O + 2\,CaCO_3 + PbO.$$

The evolution of oxygen takes place in a continuous stream and in a very short time, the contents of the retort being at the same time raised to a bright red-heat by the heat developed in the process; the liberated oxygen is almost free from carbon dioxide when the process is properly carried out, but if required quite pure it can be passed through moist, porous calcium plumbate heated at about 80—100°.

After expelling the oxygen from the calcium plumbate a stream of superheated steam is passed through the residual porous mixture of lead oxide and calcium carbonate, heated to bright redness; in this way the greater part of the carbon dioxide present in the mixture is recovered. Finally air is passed through the porous mixture of lead oxide and calcium oxide, heated at a moderate temperature, in order to reconvert it into calcium plumbate. The whole process is then repeated and can be continued for any length of time; the action of the calcium plumbate is, however, retarded if it is heated too strongly, as its porosity is thereby diminished. One complete series of operations occupies about 15 to 20 minutes.

Instead of employing pure carbon dioxide to liberate the oxygen, waste furnace gases, containing from 15 to 20 per cent. of carbon dioxide by volume may be used; in such cases instead of treating the calcium plumbate with carbon dioxide at a red heat, it is first moistened and then heated at 80—100° C. in a stream of the moist furnace gas, whereby it is converted into lead dioxide and calcium carbonate. This mixture is then treated with highly superheated steam, whereon the lead dioxide is decomposed with evolution of oxygen, the calcium carbonate remaining unchanged. The residual mixture of lead oxide and calcium carbonate can then be reconverted into calcium plumbate by heating it in a stream of air, in which case the carbon dioxide is lost; or it may be raised to a bright red heat (above 600°) and treated with superheated steam, the liberated carbon dioxide being collected; these two processes may also be combined.

After describing a suitable form of apparatus for carrying out the manufacture of oxygen in this manner, the author quotes the following advantages possessed by this, over Boussingault's barium dioxide process, as improved by Brin Brothers.

Calcium plumbate costs about one-third as much as barium dioxide and gives up the whole of its available oxygen, whereas barium dioxide yields only 8 per cent. of its available oxygen (compare Thorne, this Journal, 1890, 246—252). Calcium plumbate is not acted on by steam and is not rendered useless by carbon dioxide; it can be prepared in any kind of furnace or retort, whereas barium dioxide must always be treated in air-tight vessels.

No compression or exhaust pumps are required in the calcium plumbate process, and the cost of the plant and working expenses are less than in the case of the barium dioxide process. (See also this Journal, 1890, 108, 391, and 732.)—F. S. K.

The Naphthalene Question. E. Kunath. J. für Gasbeleuchtung, 1891, **34**, 529—534.

In a paper read at a meeting of "Der deutsche Verein von Gas und Wasserfachmännern," the author discusses the conditions under which naphthalene is deposited from coal-gas.

Although it is frequently stated that an increase in the temperature of carbonisation is accompanied by an increase in the production of naphthalene, this statement is contrary to the author's experience; he considers that such an increase in the deposition of naphthalene is rather due to the fact that the condensers are not enlarged, although the make of gas is greater, and are consequently unable to fulfil their proper function. The deposition of naphthalene in a dissolved state is the more complete the more slowly the gas is cooled; that is to say, the longer it is allowed to remain in contact with the tar, the high specific heat of which prevents any sudden lowering of the temperature of the gas. (Compare this Journal, 1889, 949—954.) The statement of Brémond that solid naphthalene is not deposited from dry coal-gas is without foundation, as gas, dried with calcium chloride, behaves just like the moist gas. It was also found that the deposition of solid naphthalene is

not prevented by the addition of ammonia to ordinary coal-gas, a result which calls into question the statements of Friedleben and Tieftrunk on this subject.

For the deposition of solid naphthalene to take place it is not necessary that the coal-gas should be cooled below 0°; a sudden lowering of its temperature by a few degrees is enough to cause a deposition even when the original temperature is as high as 16° C., so that the gas should be cooled gradually in its passage from the condensers to the purifiers.

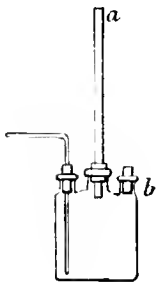
The author then raises the question whether it would be advantageous to employ a further series of condensers after the gas has passed the purifiers; such a proceeding would of course be almost useless unless the surface of the water in the meters, holder-tanks, &c., were covered with petroleum or some such substance to prevent the re-absorption of aqueous vapour. Since the solvent action of the petroleum on the lutings is a serious drawback to its employment, and no other liquid suitable for this purpose is known, it might be advantageous to place the condensers after the town's meter, and perhaps to lower the temperature of the gas by artificial means; if this were done, it would of course be necessary to cover the surface of the water in the traps and in the consumers' wet-meters with petroleum or replace the water by glycerin or otherwise to prevent any re-absorption of water. The advantages of such a thorough condensation would be that not only the deposition of naphthalene, but also the formation of hoar frost in the mains would be prevented; it is true that the consumer would get more light for the same money, the gas being denser, but this would be counterbalanced from the producer's point of view by a considerable saving in wages and materials, which are at present spent in removing stoppages, and also by an increased consumption owing to uninterrupted supply.

Some remarks were made on the author's paper by Hasse, of Dresden, in which he said that he could confirm Tieftrunk's statements on the deposition of naphthalene, and that ammonia and tar certainly do act as carriers of naphthalene. As regards the influence of the temperature of carbonisation on the production of naphthalene, he did not think it was appreciable. With reference to the author's experiments on the addition of ammonia to coal-gas, he pointed out that since the naphthalene is already mixed with tar and ammonia the experiment is not of much value. If the gas be treated with acids just before it passes into the purifiers, so that the ammonia present in various forms will be combined, a considerable deposition of naphthalene will be observed shortly afterwards either in the purifiers, station-meter, holder-pipes, or town's meter. The only way of avoiding the deposition of naphthalene is to cool the gas thoroughly, but as slowly as possible; this has been clearly demonstrated in the case of some gas-works at Dresden, opened 10 years ago: not a trace of crystalline naphthalene has been found either in the meters or in the town mains, owing to the employment of excellent condensers and of large pipes for distributing the gas. The size of the branch pipes must also be carefully chosen and the connections suitably arranged in order to avoid stoppages. Hasse does not believe in the addition of benzene to the finished gas, a course advocated by the author as a means of preventing stoppages, as the benzene is soon condensed again in another part of the mains.—F. S. K.

Flames. N. Techn. Jour. Prakt. Chem. 1891, **44**, 216–255.

While showing the explosion of coal-gas with the apparatus described by Hommann (Anleitung zum Experimentiren, p. 113), the author noticed a peculiar phenomenon, of which no mention is made in the work referred to. When the coal-gas is ignited at *a* (see Fig. 1), the gas then turned off, and the stopper *b* taken out the flame at first becomes larger; soon, however, it becomes smaller, at the same time diminishing in luminosity, and after a few seconds the yellow colour begins to disappear, a bluish zone becoming visible: then the whole flame becomes distinctly blue, and in it there is formed a second greenish conical flame which, becoming continually smaller, passes down the tube into the vessel, and there ignites the mixture of gas and air. During the time that this flame is passing down the tube,

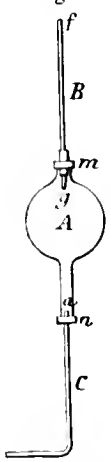
Fig. 1.



the original flame can be observed burning quietly at *a*, but with diminished luminosity.

It is clear, therefore, that under suitable conditions, a flame of coal-gas can be resolved into two parts, one of which continues to burn in its original position, whilst the other passes down the tube.

Fig. 2.



This phenomenon can also be observed with the aid of the apparatus shown in Fig. 2, which consists of a flask A (1 litre in capacity), provided with two tubes C and B (10 mm. in diameter).

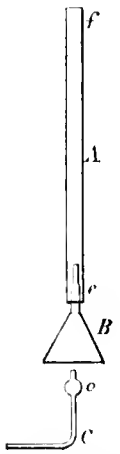
Coal-gas is passed through the tube C, and after the air has been expelled from the apparatus a light is applied to *f*; if now the gas is turned off the same two flames are observed as in the case of Heumann's apparatus. If, however, at the moment when the two flames begin to separate, air is passed into A through C, the descent of the one flame in B is more rapid; if, on the other hand, coal-gas is passed through C shortly after the separation of the two flames takes place, the tube C being at the same time raised until its extremity is at *g*, the flame which was previously descending begins to rise in B.

The apparatus shown in Fig. 3 consists of a glass tube A (60 cm. long and 2 cm. wide), into which is fitted a funnel B (8 cm. in diameter at the broadest part); C is a glass tube (3 mm. in diameter), on which is blown a small bulb *o*, sufficiently large to completely close the funnel B.

Coal-gas is passed through the tube C, the bulb *o* being pressed close to the funnel opening, and the issuing gas is ignited at *f*; if now C is lowered a little so that air is admitted into A, the second flame begins to descend, and by moving C the quantity of air admitted can be so regulated that this flame is kept burning in any desired position in the tube A. The bluish flame, which continues to burn at *f*, has its convex surface turned upwards, whereas the much hotter, greenish flame in the tube has its convex surface turned downwards.

These experiments show that the ordinary flame of a Bunsen burner consists of two superposed conical flames of different heights, but having the same base; this is very clearly shown by holding wooden slabs in various positions

Fig. 3.



in the flame of a Bunsen burner, in which the difference in height between the inner and outer flames is as great as possible; Dessaga's, Maste's, and Terquem's burners are most suitable for this purpose.

The burnt figures obtained in this way show, not only the difference in temperature of the two flames, but also whether the supply of oxygen is obtained from within or from without the flame. In Fig. 4, for example, which shows the burnt impression of the upper flame, it is seen that carbonisation has taken place to a greater extent at the outer surface; in the case of the inner flame (Fig. 5) the contrary is the case.

Figs. 4 and 5.

Fig. 6.

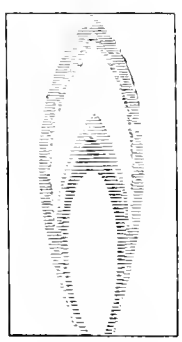


Fig. 6 shows the burnt impression obtained by holding the wooden slab vertically in the flame.—F. S. K.

The Structure and Chemistry of Flames. A. Smithells and H. Ingle. Proc. Chem. Soc. 1891, 159—163.

The authors have been engaged for twelve months in investigating the chemistry of flames produced by burning known hydrocarbons, and are still continuing their experiments. The publication of their results in the present form is consequent on the appearance of a paper by N. Teclu (see preceding abstract), who describes the phenomenon which served as a starting point in the authors' inquiry.

If a long glass tube be fitted by means of a cork over the metal tube of a Bunsen burner, so as to form a wider continuation of it, the flame can be caused to burn at the top of the glass tube. When the gas is turned slowly off, the flame becomes smaller, and develops a sharply defined inner cone of a greenish colour; this cone ultimately becomes almost a flat disc of flame and enters the glass tube. It will, as a rule, descend at a rapid rate for some distance, then begin to oscillate, and finally either detonate and light the gas at the bottom of the metal tube, or else go out. If the gas supply be very carefully regulated, the flame may be got into such a state that it will descend the tube for a short distance and then re-ascend, and in this state it is very easy to see that whilst the lower cone is moving there remains at the top of the tube a steady cone of flame of a pale-lilac colour. By heating the glass tube at one point, so as to *increase* at that point the rate of inflammation, it is possible to fix the oscillating inner cone; that is, to prevent its *re-ascent*. It is also possible to effect this by narrowing the bore of the glass tube at one point, so as to *diminish* the rate of inflammation, *i.e.*, to prevent the *descent* of the inner cone past that point. In this way it is possible to separate the two hollow cones of combustion which constitute the Bunsen flame, and to keep them any distance apart for any length of time. This permits of the aspiration of the gases from the space between the cones without any chance of admixture of outside air or of products of combustion from the upper cone.

The apparatus used by the authors in most of their experiments consisted of two glass tubes, one of which slides very easily within the other. The inner tube *c*, which is the longer one, is united to the outer one by an india-rubber collar *a*, through which it slides freely, and the two tubes are kept co-axial by a ring of asbestos packing *b*. The projecting end of the inner tube may be

fitted to a Bunsen burner, but the authors have usually led separate supplies of gas and air into the apparatus by a T-tube, instead of using a Bunsen burner, in order to have a better control of the flame. With this apparatus a non-luminous flame is easily obtained, and the two cones can be separated in two ways. If the apparatus is arranged so that the flame is formed at the orifice of the wider tube *d* and the orifice of the narrower one *e* is 8 or 10 cm. below it, on increasing the air supply the inner cone of flame will ultimately descend and rest upon the orifice of the inner tube. If, on the other hand, the inner tube be made to project beyond the outer one and the non-luminous flame be formed on it, then, if there be a sufficient air supply, on sliding up the outer tube it will as it passes the flame cleanly detach and carry up the outer cone, leaving the inner one still burning on the inner tube.

The authors have made similar experiments with flames of liquid hydrocarbons by charging air with the vapour of the liquid by passing it through a "saturator" such as is used for producing the ether-oxygen lime-light. The vapour-charged air is afterwards mixed with more air, and by suitably regulating the proportions a non-luminous flame is obtained and divided into two cones. In the case of liquid hydrocarbons, the lower cone of flame usually appears to be divided by dark spaces into several petal-like divisions which are in rapid rotation. In the case of benzene vapour the following sequence of appearances is presented: starting

with the orifice of the inner tube, 8 or 10 cm. below that of the outer one, a luminous smoky flame is first obtained at the latter; as air is gradually added the flame becomes less and less luminous, and an inner cone begins to develop, but before this has become non-luminous it descends to the inner tube; more air makes both it and the upper cone non-luminous, and this state may be maintained. If now somewhat *less* air is supplied, a luminous streak appears at the tip of the inner cone, and passes right up and through the tip of the upper cone. If *more* air is supplied, the upper cone of flame begins to disappear, and only the upper part of it remains; this also gradually fades away, and then there is only the lower cone left. Still more air produces a visible effect on the inner cone, the colour changing and the combustion becoming less intense until the cone rises from its seat, passes upwards, and disappears. There is thus a gradual transition from the richly luminous flame to one consisting of a simple pale-blue cone just on the point of extinction through excess of air.

The hydrocarbons examined by the authors were ethylene, methane, pentane, heptane, and benzene. Coal-gas was also used. The gases from the regions between the two cones of flame were analysed in all these cases volumetrically or gravimetrically.

The results obtained in the preliminary survey show that the products of combustion of the first cone are essentially CO_2, H_2O, CO, and H_2, and that the second zone is due to the combustion of the CO and H_2 with the external air.

The results are in harmony with the conclusions of Bloehmann, obtained indirectly, and with the not generally known work of Dalton on the explosion of methane and ethylene with oxygen in quantities insufficient for complete combustion, which was repeated in 1861 by Kersten.

The authors point out (1) that carbon, according to Baker's experiments, even in excess of oxygen, burns preferentially to CO, and not to CO_2; (2) that the heat of combustion of gaseous carbon to CO is probably greater than that of hydrogen to H_2O; (3) that, according to Dalton, CH_4, when burnt with its own volume of oxygen, gives products represented in the equation—

$$CH_4 + O_2 = CO + H_2O + H_2$$

and they conclude that this equation represents the character of the change first taking place in the inner cone. But as the two substances CO and H_2O act upon one another ($CO + H_2O \rightleftarrows CO_2 + H_2$), the case is one of reversible change, and four products will result, viz., CO_2, H_2O, CO, and H_2.

The conditions of equilibrium of this system, according to Dixon, are expressed by the coefficient $\frac{CO \times H_2O}{CO_2 \times H_2} = 4{\cdot}0$. This is subject to certain conditions of temperature and dilution. The authors in their most reliable experiments (viz., the gravimetric ones), with ethylene and coal-gas, get numbers not greatly differing from 4; but they are still engaged in studying this question.

The authors have succeeded in dividing into two cones flames produced by admixture of air with cyanogen, sulphuretted hydrogen, carbon bisulphide and decomposed ammonia (i.e., $N_2 + 3H_2$). The products of the inner cone in the case of cyanogen were found in one experiment to consist of CO and CO_2 in the proportion of 2 vols. of the former to 1 vol. of the latter.

Professor Smithells is continuing the experiments, with a view of elucidating the following points:—

(i.) The influence of differences of diameter of the tubes and rates of efflux on the fractional combustion.

(ii.) The exact composition of the intercone gases in the case of hydrocarbons, and also of mixtures of $CO + H_2$, so as to ascertain if, and in what way, the coefficient $\left(\frac{CO \times H_2O}{CO_2 \times H_2} = k\right)$ varies with the composition of the gases and other conditions.

(iii.) The composition of the intercone gases from hydrocarbon flames whilst carbon is being liberated, so as to ascertain whether the luminosity of flames is due to simple decomposition of hydrocarbons by heat, to preferential combustion of hydrogen, to partial decomposition, or to other change.

(iv.) The exact nature of the flame of cyanogen, so as to ascertain what governs the proportions of CO and CO_2 formed in the inner cone.

(v.) The manner in which the partition of oxygen takes place in the inner cone between C and H, H and S, C and S, so as to obtain information as to the affinities of C, H and S for oxygen.

(vi.) The spectroscopic appearances of the flames.

Note on the Structure of Luminous Flames. A. Smithells. Proc. Chem. Soc. 1891, 164—165.

The author gives a brief summary of the various views that have been held on this subject. With one or two exceptions, there has been general agreement since the time of Berzelius that an ordinary candle flame, or the flame of coal-gas escaping from a circular hole, is divisible into four chief regions: (i.) the dark inner part; (ii.) the luminous part; (iii.) a small, bright blue part at the base of the flame, thinning off rapidly as it extends upwards; (iv.) a dim, scarcely visible, faintly luminous mantle surrounding the whole flame.

The explanation which the author would give of these regions is as follows:—The gas or vaporised wax, on issuing from the orifice or wick, becomes mixed with air and burns. Whether or not the flame is luminous depends on the rate at which the combustible is supplied. If slowly supplied, sufficient air is admixed with the gas for non-luminous combustion. Thus a very small gas flame is non-luminous, and so also the flame of a candle, with the wick cropped close to the wax. It is conventionally said that coal-gas burns with a luminous flame; it is just as true to say that it burns with a non-luminous flame. The small, non-luminous flame of coal-gas, or of a short wick candle is seen to have the same structure as a Bunsen burner, viz., a bright blue inner cone, and a pale lilac cone superposed upon it. The author supposes that we have here the same chemical changes occurring as are dealt with in the previous paper, viz., that the first combustion in the inner cone is mainly to CO_2, H_2O, CO and H_2, and the final one in the outer cone is mainly that of CO and H_2 to CO_2 and H_2O. This is made more probable by the fact that if the gas supply be increased, the luminous tip appears just at the point where it appears in the experiment with benzene, and that even after it is considerably developed the shape of the flame betrays the persistence of the inner cone. As the gas supply is further increased, the luminous area becomes increasingly great, the relics of the two original cones being very small.

The author's view is further enforced by the simple experiment of taking a flame about 5 cm. high from a Bunsen burner with the air holes stopped, noting the blue region at the base of the flame and the dim mantle outside it and then gradually turning on the air. The gradual transition shows unmistakably that the blue part and the mantle are the "rudiments" of the two cones of a Bunsen flame.

With regard to the luminous part, everything goes to show that it is mainly a region where hydrocarbons are decomposed by the heat of the outer parts of the flame. The precise nature of the change is being studied by the author.

The dark inner zone contains mainly unburned gas, mixed with some products of combustion from surrounding regions.

A commonly held view that the mantle of a luminous flame is due to heated air and products of combustion is inconsistent with the above explanation, and also with the fact that in recent experiments it has been found impossible to render air luminous at the highest attainable temperatures.

The view that carbon is separated in a flame owing to the preferential combination of oxygen with hydrogen, is opposed, the author thinks, to all experimental evidence, which he is of opinion goes to show that if the oxygen supply be limited carbon will burn *before* hydrogen.

The author would describe a luminous flame as follows:—(i.) An outer sheath or mantle, with (ii.) an inner bright blue portion visible at the base of the flame. These

two parts correspond respectively to the outer and inner flame cones of a Bunsen flame, and mark the region where the coal-gas or candle-gas is burning with a large quantity of air.

(iii.) The yellow luminous part marking the region where the heat of the parts (i.) and (ii.) is decomposing hydrocarbons, setting free carbon, which rapidly glows and burns.

(iv.) The dark inner region, consisting of unburned gas, mixed with products of combustion of surrounding parts.

Novelty is not claimed for this description, but the author considers that the experiments described in the preceding paper put the matter in a somewhat new light.

PATENTS.

Improvements in Apparatus for Charging and Drawing Gas Retorts. J. Ruscoe, Hyde. Eng. Pat, 14,720, September 17, 1890. 11*d*.

This specification relates to a modified form of the apparatus described in Eng. Pat. 18,108 of 1889 (this Journal, 1891, 128), in which the latter is adapted to work in conjunction with the moveable division plate for charging inclined retorts, described by Trewby (Eng. Pat. 19,256 of 1889), and is also rendered capable of charging or drawing inclined retorts by means of an ordinary scoop or rack. There is in addition, on the top of the travelling framework on which the division plate or scoop is mounted, a coal-tank carrying sufficient coal to charge all the retorts in a row, and communicating by a sliding door with a measuring hopper which contains the quantity requisite for one charge, and is connected with a shoot delivering the coal at the mouth of the retort.

The mechanical details of the invention are illustrated by six sheets of drawings.—S. B. A. A.

Improvements in the Revivification of Materials Employed for the Purification of Coal-Gas, and in the Treatment of the Residues. C. W. Jones, Milan, Italy. Eng. Pat. 14,906, September 20th, 1890. 6*d*.

According to this invention, the exhausted material is watered and mixed with about 6 per cent. of quicklime. It is then placed in a heap, and "allowed to remain until the reaction is complete, which is noticeable by its change of colour." The lime has now transformed the sulphates and compounds of ferric-cyanide into the corresponding calcium salts of lime, and the oxide of iron is re-formed, and may be washed free from the other compounds. The wash-waters are first heated in a boiler closed by a syphon dipping into a vessel containing sulphuric acid, by which the ammonia is retained; the residual liquors are evaporated down, and the cyanides recovered. Drawings are also given in the specification of a suitable arrangement of lixiviating tanks and boilers.—S. B. A. A.

Improvements in Stoves or Apparatus for Generating or Burning Gas obtained from Petroleum or other like Liquids for Heating Purposes. J. Dheyne, Schaerbeek; V. de Nydprück and F. de la Hault, Brussels, Belgium. Eng. Pat. 16,576, October 18, 1890. 8*d*.

The apparatus consists of an hermetically closed reservoir provided with a screw-stoppered opening for charging the petroleum, an air-pump for compressing the contents, a safety valve, and a long, narrow tube passing through the cover, and reaching almost to the bottom of the reservoir. This tube is prolonged outside the reservoir for some distance, and is then wound round a narrow chimney downwards, the end brought inside the chimney and connected with a regulating nozzle. The worm is arranged in the centre of an ordinary lamp with a circular wick, suitably supported on the top of the reservoir. The upper part of the worm-chimney is provided with a cap covered with wire gauze or perforated sheet metal. The combination of lamp and worm-chimney is enclosed in a cylindrical casing, perforated below and notched above for the reception of objects to be heated. The reservoir being charged with petroleum and pressure applied, the hydrocarbon is forced up the vertical tube and into the worm heated by means of the circular wick lamp, where it is volatilised and discharged through the regulating nozzle into the chimney, at the top of which it is ignited.—S. B. A. A.

Improvements in Setting Inclined Carbonising or Gas Retorts. L. Van Vestraut, Southall. Eng. Pat. 17,201, October 28, 1890. 6*d*.

During the erection of the retort-setting, a core of any required section is affixed to the upper end of the retort so that it is continuous with the inside of the retort, slanting at first in the same direction, and then curving and rising vertically upwards to the top of the setting. This is built in with brickwork, so that when the core is removed, a channel is left through which the retort may be readily charged. The lower surface of the channel may be lined with an iron plate for some distance from the junction with the retort; a lid, &c., is similarly fitted to the mouth.—S. B. A. A.

Improvements in the Manufacture of Combustible Gas for Heating, Lighting, and Generation of Motive Power. H. Guyon and L. Métais, Paris, France. Eng. Pat. 18,360, November 14, 1890. 8*d*.

Instead of damping coke, resulting from the carbonisation of coal, in the open air as is usually done, the patentees effect its extinction in a closed vessel by means of steam and water successively. The steam, acting on the incandescent fuel, gives rise to a gaseous mixture of hydrogen, carbonic oxide, carbon dioxide, &c., which can be mixed with the illuminating gas, or utilised for the production of steam, and for various other purposes. When the coke has been cooled to a certain extent, water is injected into the vessel; the steam obtained in this way can be used as a motive power, or can be employed for damping the coke in the first stage of the process.

The residual coke can be sold at the same price as if it had been damped in the usual way. When, however, the coke is of low quality, it may be advantageously left in the closed vessel and raised to incandescence by injecting a stream of air; in the latter case it is damped again with steam and water successively, and the process continued until the coke is exhausted. For details of the vessel in which these operations are carried out, the specification and drawings must be consulted.—F. S. K.

A Manufacture of Porous Magnesian Bricks for the Linings of Stoves, Furnaces, Fireplaces, and Flues, and the Construction of Stoves and Furnaces with such Bricks. O. Clausen, Paris, France. Eng. Pat. 20,955, December 23, 1890. 8*d*.

The patentee claims a system of stove construction, by which it is alleged the combustion of the fuel is more perfect than in existing arrangements, while the temperature of the products of combustion is but little above that of the surrounding air. For the attainment of these results he uses a form of stove made of porous magnesian bricks in which the combustion chamber is closed at the top, so that the first imperfect products of combustion are forced to pass downwards through the burning fuel, and come in contact with the air entering by a series of small holes surrounding the base of the chamber. In order to avoid excess of air a feeble draught is used, its precise amount being regulated by a valve at the front of the stove, or by plugs in the holes surrounding its base. The products of combustion pass up an annular space surrounding the combustion chamber, and then downwards close to the external wall of the stove, and finally away by a flue starting at its lower part. The magnesian bricks, to which the efficiency of the apparatus is said to be largely due, are formed by plunging bricks of a porous material into water containing magnesia in suspension. When used for heating rooms, the walls of the smoke flues may be covered with thin asbestos millboard,

with the view of transmitting and radiating the heat given off by them. The system is said to be applicable not only to domestic stoves, but to boilers and metallurgical furnaces.—B. B.

Improvements in the Manufacture of Illuminating Gas. J. F. Allen, New York, U.S.A. Eng. Pat. 9716, June 9, 1891. 8*d*.

According to this invention, coal is distilled in a cupola furnace without access of air, and the gas is led through one of a pair of regenerative chambers situated under the cupola, then through the furnace fire employed to heat the regenerative chamber, and finally back to the bottom of the cupola and through the mass of glowing fuel in the interior. This circulation of the crude gas is continued until "a portion of the heat taken up by the crude gas in the regenerative chamber is transferred to the distillation chamber," and until "the water and tarry matters in the crude gas are decomposed."

One of the essential features which distinguish this process from others hitherto used is, "that the necessary heat for the destructive distillation of the carbonaceous material is created in and transferred from another chamber, and is not generated in the distillation."

For details the specification must be consulted.

—S. B. A. A.

Improved Means for Rendering Petroleum or other Liquid Hydrocarbons Non-explosive. S. Kirsch, Hamburg, Germany. Eng. Pat. 12,039, July 15, 1891. 1*d*.

It is claimed that petroleum oil may be rendered non-explosive by the addition of "small but sufficient quantities" of a mixture constituted as follows:—

	Per Cent.
Aniline	0·30
Sulphate of lime	0·92
Sulphate of magnesia	0·22
Bicarbonate of sodium	2·77
Chloride of sodium	92·34
Sal ammoniac	1·84
Water	1·14

The illuminating power of the petroleum is alleged not to be impaired by the addition.—S. B. A. A.

Improvements in the Manufacture of Illuminating Gas. P. Dvorkovitz, London. Eng. Pat. 13,506, August 10, 1891. 8*d*.

The apparatus described in this patent is employed for the continuous production of illuminating gas from steam and hydrocarbon oils; and its construction is such that the temperature of working varies only slightly, and consequently both the quantity and the quality of the gas produced are more constant.

A system of superheaters, in which air and steam are separately heated, and an oil gasifier are arranged in one and the same furnace setting; the air and steam superheaters are in connection with a pair of generators filled with coke. Hot air is blown into one of the generators until the fuel is raised to a suitable temperature, and then superheated steam is forced in; the water-gas formed in this way is mixed with superheated hydrocarbon vapour, and the gaseous mixture passed through condensers and scrubbers. The generator-gas formed in the first stage of the process is employed for heating carburetters, in which the oil vapour from the gasifier is mixed with the water-gas. The two generators are worked alternately, so that the process is continuous. There are four claims and two sheets of drawings.—F. S. K.

Improvements relating to the Manufacture of Ammonia and Gas. W. R. Lake, London. From A. Hennin, Springfield, U.S.A. Eng. Pat. 15,249, September 8, 1891. 8*d*.

The object of this invention is to generate gas and ammonia, simultaneously and continuously, from bituminous coal, shale or other fuel; this is done by forcing air and steam, or oxygen and steam, into a mass of incandescent fuel by means of radial twyers arranged just above the grate of a generator of suitable form. The temperature at this part of the generator is high enough to bring about the complete decomposition of the steam employed, and also to convert the carbon dioxide into carbon monoxide. In the upper part of the generator the fuel is maintained at a much lower temperature, and is gradually carbonised as it passes downwards, the ammonia and other volatile products, together with the generator gas being drawn off near the top of the generator, and then treated in the usual way.

The greatest care must be taken to regulate the temperature of the various zones of the generator in order to prevent the decomposition of the ammonia.

With very crude and imperfect means of separating the ammonia from the gas, a quantity equivalent to about half the nitrogen in the coal has been obtained; the gas produced at the same time having the following composition:—

CO_2	6·5
CO	29·0
CH_4	2·25
H	43·0

This gas is practically free from undecomposed steam, and can be advantageously used for heating and metallurgical purposes. The make of gas per ton of fuel is said to be greater than that obtained by any process of like nature now known.—F. S. K.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

On the Formation of Acid Compounds in Petroleum. R. Zaloziecki. Zeits. f. angew. Chem. 1891, 416—419.

The amount of acid substances contained in the various refined products from petroleum is very small, but from their behaviour towards the two indicators Methyl orange and phenolphthalein, they may be divided into two classes. The larger portion, neutral to the former, consists of lacto-alcohols, of distinctly marked acid character, which form mono-basic salts not only with the alkalis, but also with the oxides of the heavy metals, mixed with the ordinary fatty acids. The remainder, acid to methyl orange, is made up of acids containing sulphur. The oils were examined by treating in a dry separating funnel 100 cc. of the oil with 20 cc. of decinormal caustic soda and shaking vigorously several times. After thorough settling the soda was drawn off, filtered through a dry paper, and titrated back with acid.

To test the effect of exposure to air, some samples of oil were placed in a flask and a current of air passed through them by means of a pump, firstly at ordinary temperatures and afterwards hot, and finally several of the purified products were redistilled in a current of air or oxygen. In the distilled products were found amounts of acid corresponding to from 0·8 to 4·4 cc. of decinormal caustic soda per 100 cc. of oil, and, after exposure to air at ordinary temperatures for 12—24 hours, the average was only slightly higher, the results of the hot treatment being tabulated:—

	Cc. of decinormal acid required to neutralise 5 cc. of the Oil after previous addition of Caustic Soda.	
	Phenol-phthalein.	Methyl Orange.
Intermediate oil, heated to 120°—130° in air for five hours.	3·60	4·8
Heavy oil, heated to 150°—160° in air for six hours.	3·20	4·6
Intermediate oil, refined, distilled in oxygen up to 300° ..... (Distillate	1·4*	0·8
(Residue.	1·5*	..
Intermediate oil (crude) distilled in oxygen.	2·0*	2·2
Heavy oil, distilled in air.....	2·6	3·4

* 10 cc. of caustic soda used.

On heating the heavy oil to a temperature over 350° in oxygen an explosion took place. During the distillations in air, and especially in oxygen, considerable amounts of water were produced at the higher temperatures, which had an acid reaction, due partly to acetic acid, and the distillate had the characteristic smell of fatty acids. These acids are probably derived from the oxidation of the methyl group in the methane hydrocarbons to carboxyl, hence being in proportion to the water evolved, whilst the lacto-alcohols are formed from slight oxidation of the unsaturated compounds present. This is shown by the fact that a purified intermediate oil was almost unchanged by treatment with air at ordinary temperatures, whereas an oil which had been redistilled ten times and hence in all probability contained unsaturated compounds, became strongly acid.

The large amount of acidity shown on titrating some of the products with Methyl orange must be due to the presence of mineral acids, and seeing that some of the crude distillates give almost the same figures as the refined ones, this cannot be the acid used in purification, but must exist in the raw oil, probably in the form of mercaptans and sulphides. By exposure to a current of cold air in presence of caustic soda, the acidity of the oil increases more rapidly, one purified sample giving 10·4 cc. after 12 hours' blowing, and before only 0·4 cc.—F. H. L.

Acids of Low Carbon Percentage occurring in Petroleum from Baku: Hepta- and Octonaphthenecarboxylic Acids. O. Aschan. Ber. 24, 2710—2724. (Compare this Journal, 1890, 597, and 1891, 825.)

Pure heptanaphthenecarboxylic Acid, prepared in a manner similar to that given in the first paper for the lower homologue, is a colourless, viscid oil, the smell of which much resembles that of the fatty acids. Its specific gravity at 0° is 0·9982. It is a strong acid, gradually decomposing calcium chloride, and is isomeric with the synthetical methylhexamethylenecarboxylic acid (1 : 2), boiling at 235°—236°, recently prepared by W. H. Perkin, jun., and Freer. Its boiling point is 237°—239°. The following compounds have been prepared:—The methyl ester boils at 190°—192°; its specific gravity at 18° being 0·9357, and its smell being pleasant but ultimately causing nausea. The potassium, sodium, calcium, barium, silver salts were also prepared, and it seems to be characteristic of the calcium salts of all the acids of the naphthene series, that they are more soluble in cold than in hot water.

By acting on the acid with phosphorus and hydriodic acid, the author has succeeded in preparing *octonaphthene*, identical in all respects with that isolated by Markownikow from Caucasian petroleum. Four grms. of heptanaphthenecarboxylic acid were heated with 0·4 grm. of red phosphorus and 3 cc. of hydriodic acid (sp. gr. 1·7) in a sealed tube for four hours to 200°—210°: after cooling, the end was broken off, and another 0·4 grm. of phosphorus introduced, the tube sealed up and heated to 220° for four hours, this operation being repeated twice again, 0·4—0·5 cc. of water being added the last twice, and the temperature finally raised to 240°. After the final heating, the resulting liquid product was removed with a pipette, washed with caustic soda, and digested in the warm with sodium. On distillation over a fresh amount of sodium, the principal portion passed over at 115°—119°, and another much smaller fraction at 240°—260°. The first of these was repeatedly distilled, and finally a product boiling at 117°—118° (742 mm.) was obtained, which formed about half the total amount of the crude hydrocarbons. On analysis it gave figures closely corresponding with the formula C_nH_{2n}. Concentrated sulphuric acid was found to have no action on it, even in the warm, but it was easily dissolved by an excess of the fuming acid. Bromine was without action on it, and nitric acid only attacked it in presence of concentrated sulphuric acid. Its specific gravity at 0° was 0·7706, Markownikow's product being 0·7714, and boiling at 119°. Additional proof of the identity of these substances is found in the fact that the author has succeeded in preparing trinitrometaxylol (melting point 179°—180°) from his product, just as Markownikow has also prepared it from the naturally-occurring substance by the action of fuming nitro-sulphuric acid.

Octonaphthenecarboxylic Acid boils at 251°—253°; its specific gravity at 0° is 0·9893, and it resembles the lower homologue in every respect. The calcium and barium salts are not decomposed by carbonic acid. By evaporation on the water-bath, the latter is obtained in colourless, sticky lumps, which do not solidify on cooling; only by drying at 100° does it become hard and crystalline, it being then almost insoluble in cold water. The methyl ester boils at 211°—213°, and its specific gravity at 18·4 is 0·9352. The chloride boils at 206°—208°, and the amide melts at 128°—129°.

The author considers that the views expressed by Zaloziecki (Ber. 24, 1808; this Journal, 1891, 825) as to the nature of the acids examined by him, are unjustified. His acids are evidently also naphthene acids. The ease with which the various compounds described above are prepared from one another, their strongly characteristic properties, and their stability, show that these acids must contain a carboxylic group, and although, in the higher homologues, these properties are less strongly marked, as might be expected from analogy, there is absolutely no reason to believe that they are differently constituted (see preceding abstract).—F. H. L.

Petroleum at Baku. Journal de la Chambre de Commerce de Constantinople, November 14, 1891.

However the exhaustion of the supplies of naphtha on the coast of the Caspian Sea may be questioned, the production of petroleum is increasing yearly.

According to data published by the *Kavkaz* there were extracted 205,500,000 pouds in 1889 and 239,000,000 in 1890, which constitutes an increase of 16·3 per cent. The same progress is observed this year. Comparing the yield of the first half of 1891 with that of 1890, 12 months previously, the production of the six months was 126,000,000 pouds (poud = 36 lb. avoirdupois), whilst that for the first half of this year was 190,000,000 pouds, of which 171,000,000 are put down to the Balakhano-Sabountchi district, 13,000,000 to the Bibi-Eybate district, and 6,000,000 to that of Romany. The number of wells in working since the 1st January has increased from 273 to 335 at Balakhano-Sabountchi, from 3 to 13 at Romany, and at Bibi-Eybate they have remained unchanged at 14.

Included in this number of wells in August there were six springs at Balakhano-Sabountchi, four at Bibi-Eybate, and two at Romany.

The average depth of the bored wells in working is 96 sagènes (sagène = 7 ft.) at Balakhano-Sabountchi, 120 at Bibi-Eybate, and 103 at Romany. As regards the average production of naphtha every 24 hours, only including the ordinary bored wells and not the springs, it reaches 2,863 pouds at Balakhano-Sabountchi, 4,007 pouds at Romany, and 5,616 pouds at Bibi-Eybate.

Since the 1st January of the present year new borings have been made, having the following depths: At Balak-

hano-Sabountchi, 11,565 sagènes; at Bibi-Eybate, 690; and at Romany, 1,482.

It should be observed that the district of Romany has not realised the brilliant anticipations held at the time of the discovery of naphtha in that locality a year ago. Naphtha is only found there at a very great depth, which increases the cost of working.

The Arafelor naphtha spring again commenced to run, but only for eight hours, and it has given in this space of time 20,000 pouds of naphtha to its owner; then it stopped again. But as it is hoped that the spring will once again operate, three enormous basins for storing the naphtha which it will give have been prepared.

PATENT.

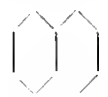
Improved Means for rendering Petroleum or other Liquid Hydrocarbons Non-explosive. S. Kirsch, Hamburg, Germany. Eng. Pat. 12,039, July 15, 1891. 4*d*.

See under II., *page* 996.

IV.—COLOURING MATTERS AND DYES.

Orthoquinolinehydrazine. S. F. Dufton. J. Chem. Soc. (Trans.) 1891, 756—759.

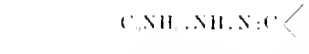
Orthamidoquinoline is diazotised in the usual way, the calculated quantity of stannous chloride dissolved in strong hydrochloric acid is added, and the tin compound obtained is decomposed by hydrogen sulphide. The hydrazine dihydrochloride thus obtained crystallises in thick yellow lustrous prisms. Its formula is—



The free hydrazine forms fine, long, slightly yellow needles melting at 64.

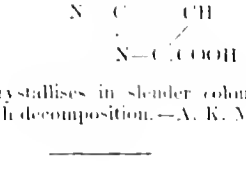
Orthoquinolinsemicarbazide, $C_9NH_6.NH.NH.CONH_2$, is obtained on mixing aqueous solutions of potassium cyanate and of the above hydrazine hydrochloride. It crystallises from hot alcohol in white shining leaflets which melt at 235° with decomposition.

On the addition of pyruvic acid to a strong aqueous solution of the hydrazine hydrochloride, the *hydrochloride of the pyruvic acid hydrazone* is produced. It crystallises from water in beautiful orange needles. The free *hydrazone*—



melts at 174° and possesses both acid and basic properties.

When the pyruvic acid compound of quinolinehydrazine is heated with hydrochloric acid, *orthoquinindole-α-carboxylic acid*—



is obtained. It crystallises in slender colourless needles melting at 286° with decomposition.—A. K. M.

Diazo- and Hydrazine Compounds of the Quinoline Bases. E. Böttiger. Ber. **24**, 1891, 3276—3277.

The author refers to Dufton's paper on "orthoquinolinehydrazine" (see previous abstract), and states that before the publication of the latter, he had already applied for a patent for the preparation of quinolinehydrazines.

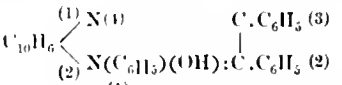
Diazoquinoline chloride, which is not described by Dufton, is formed when sodium nitrite solution is added to a well-cooled solution of orthamidoquinoline in hydrochloric acid. It is not decomposed by boiling with acids, but evolves nitrogen when heated with alkali. It yields azo colours which will dye wool directly but not cotton.

Orthoquinolinehydrazine yields a well-crystallised sulphate and hydrochloride, both of which dissolve readily in alcohol, ether, and in water. The hydrazine melts at 64°, reduces Fehling's solution in the cold, and yields characteristic hydrazones with ketones and aldehydes.—A. K. M.

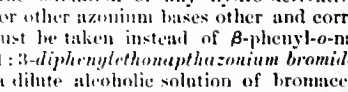
A New Class of Fluorescent Dyes of the Quinoxaline group II. O. Fischer and M. Busch. Ber. **24**, 1870—1874.

The authors have previously described (this Journal, 1891, 535) the formation of dihydroquinoxalines from α-keto-alcohols and unsubstituted or mono-N-substituted orthodiamines of the benzene group, and called attention to the bright colours obtained and the fluorescent properties of these products. The compounds obtained from unsubstituted diamines contain no oxygen and are readily converted by oxidation into quinoxalines; the substances formed from benzoïn and orthamido-*p*-ditolylamine or phenyl β-napthalenediamine are likewise free from oxygen and give rise to a series of unstable salts. None of these derivatives can therefore be identical with Witt's oxidised azonium bases (Ber. **24**, 1511; this Journal, 1891, 827).

When 1:2:3-triphenyl-1:2:hydronaphthoquinoxaline, the product of the condensation of benzoïn and β-phenylorthonaphthalenediamine is treated with ferric chloride, it is converted into an iron derivative of the corresponding azonium base—



The free base crystallises from alcohol in yellow lustrous prisms with a bright green reflex; these lose lustre and turn brown at 110°, soften at 162°, and melt at 167°. The body is insoluble in water but dissolves readily in ether and benzene, and with some difficulty in alcohol, forming yellowish-green fluorescent solutions. The alcoholic solution turns to a clear yellow colour on addition of hydrochloric acid. It forms stable salts the neutral aqueous solutions of which exhibit a strong yellowish-green fluorescence which disappears on addition of mineral acids. The *nitrate* forms a yellow crystalline powder difficultly soluble in water, the *chloride* crystallises from dilute alcohol in large dark yellow needles. The azonium bases may be directly formed from benzoïn, and in this case β-phenyl-*o*-naphthylenediamine, by heating them with zinc chloride at 200°, the zinc chloride acting like the acids in promoting the oxidation of any hydro-derivative formed. Of course for other azonium bases other and corresponding diamines must be taken instead of β-phenyl-*o*-napthylenediamine. 1:3-*diphenylethonapthazonium bromide* prepared by boiling a dilute alcoholic solution of bromacetophenone and β-phenolnapthylenediamine in molecular proportions, crystallises in lustrous yellow plates, and exhibits an intense yellowish-green fluorescence when dissolved in dilute alcohol. The corresponding base 1:3-*diphenylethonapthazonium hydroxide*—

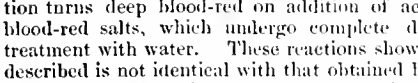


prepared by the action of soda on the bromide, crystallises from absolute alcohol in lustrous transparent pale green prisms which turn brown at 100°, melt at 148°, dissolve

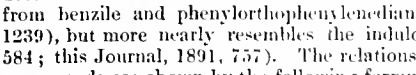
readily in ether, hot benzene, and glacial acetic acid, with difficulty in alcohol and light petroleum, and not at all in water. The alcoholic, and more especially the glacial acetic acid solutions, are highly fluorescent, the others less so. The *nitrate* crystallises in yellow silky lustrous needles difficultly soluble in water.—S. B. A. A.

Azonium Bases. F. Kehrmann and J. Messinger. Ber. **24**, 1874—1876.

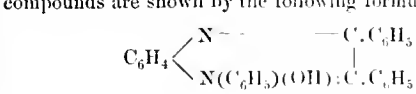
On heating phenyl-*o*-phenylenediamine (5 grms.) with benzoin (6 grms.) for 10 hours at 170°—180°, the product, after purification by O. Fischer's method, separates from 90 per cent. alcohol in yellowish-green fluorescent crystals, which melt at 116°—117° with previous softening, and dissolve readily in ether, benzene, and hot alcohol, but not in water or dilute mineral acids. All the solutions exhibit a magnificent bluish-green fluorescence; the alcoholic solution turns deep blood-red on addition of acids. It forms blood-red salts, which undergo complete dissociation on treatment with water. These reactions show that the base described is not identical with that obtained by the authors from benzile and phenylorthophenylenediamine (Ber. **24**, 1239), but more nearly resembles the indulones (Ber. **24**, 584; this Journal, 1891, 757). The relations between these compounds are shown by the following formulæ:—



Azonium base from benzile and phenylorthophenylenediamine—



Quinoxaline base from benzoïn and phenylorthophenylenediamine—



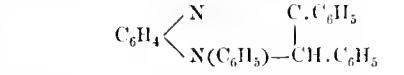
Indulone from oxyquinone and phenylphenylenediamine.

—S. B. A. A.

Tetrahydro-orthamidoquinaldine. E. Bamberger and P. Wulz. Ber. **24**, 2049—2055.

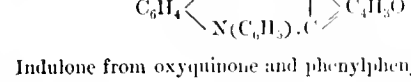
The authors have prepared tetrahydro-orthamidoquinaldine and investigated its reactions more especially with the object of testing the applicability of Bamberger's "theory of hydrogenation" to the entire quinoxaline series. According to the theory, tetrahydro-orthamidoquinaldine should behave like an alkyl-substituted orthophenylenediamine, and the following results show that such behaviour does actually take place:—

Tetrahydro-orthamidoquinaldine—



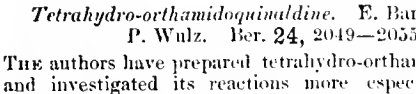
is prepared by repeatedly boiling orthamidoquinaldine with excess of tin and hydrochloric acid, collecting the deposit of tin double salts, which separate from the solution on cooling, triturating with soda, and extracting the resulting emulsion with chloroform. On adding an acid solution of ferric chloride or potassium bichromate, it immediately yields the intense red coloration characteristic of ortho-diamines.

α-Methyltetrahydro-periquinaldimidazole—



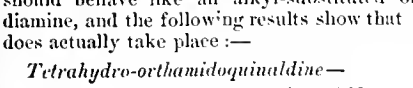
This is an anhydro-base or imidazole formed on boiling the preceding compound with glacial acetic acid, sodium acetate, and a few drops of acetic anhydride. It crystallises from ether in large flat prisms with an adamantine lustre, dissolves in alcohol, chloroform, and hot water, and melts at 110°. It is a very powerful and stable base, dissolves readily in acids, and possesses the general characteristics of an imidazole. It gives no coloration with ferric chloride or potassium bichromate.

The *platinochloride* crystallises in lustrous orange-coloured prisms, soluble in hot water. The methyl group in the methylated imidazoles of the benzene series, like the corresponding group in quinaldines, readily undergoes condensation. By melting the preceding imidazole with phthalic anhydride, a deeply coloured *phthalone* of the composition—



is formed. This colouring matter is obtained in ill-defined yellow crystals, and dissolves readily in boiling glacial acetic acid and in concentrated sulphuric acid, forming orange-coloured solutions from which the phthalone is precipitated on addition of water. On heating it sublimes in slender lustrous needles. It generally resembles the quinophthalones in its behaviour towards reagents, in colour, &c.

It is improbable that the condensation occurs between the methyl group of the quinaldine nucleus and phthalic anhydride, since on heating tetrahydroquinaldine with phthalic anhydride the product is not a phthalone, but probably has the composition—

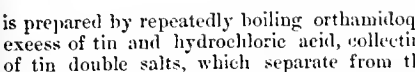


—S. B. A. A.

Homologues of Tetrahydroquinoline. E. Bamberger and P. Wulz. Ber. **24**, 2055—2076.

Communication No. IV.—Hydrogenised Quinolines.

Tetrahydro-o-methylquinoline—



is prepared by reducing orthomethylquinoline with granulated tin and hydrochloric acid, decomposing the tin double salt formed with aqueous sodium hydrate, and extracting the distillate with ether. The operation is repeated upon the partially reduced product so obtained. The pure base is a colourless pungent-smelling oil which boils at 255°—257° under 717 mm. pressure, does not solidify in a freezing mixture, dissolves readily in organic solvents, and with some difficulty in water. It is quickly turned yellow by atmospheric oxygen. The *hydrochloride*, $C_{10}H_{13}N.HCl$, crystallises from alcohol in highly refractive monoclinic plates, melts at 214°, dissolves readily in water and hot alcohol or chloroform, but is insoluble in benzene, ether, and light petroleum. In acid solutions potassium dichromate and ferric chloride produce a brownish-yellow coloration changing to dark brownish-green and olive green respectively. The *acetyl* derivative, $C_{10}H_{12}N.COCH_3$, crystallises in prisms, melts at 53°—54°, boils at 297°—299° under 718 mm. pressure, and dissolves readily in alcohol, benzene, &c. The moist crystals turn blue on exposure to the air. The *nitroso derivative*, $C_{10}H_{12}N(NO)$, forms thin hexagonal plates or vitreous prisms, melts at 51°, and dissolves readily in organic solvents. The *diazo-amido derivative*—

$$C_{10}H_{12}N.N_2C_6H_5$$

is obtained in orange-coloured, oily drops on shaking a mixture of the chloride of the base (2 grms.) and sodium acetate (7 grms.) with the theoretical quantity of diazobenzene chloride. It crystallises in very soluble, slender, yellow needles melting at 99°. The alcoholic solution is at once coloured violet-red by a trace of mineral acid, the isomeric azo-dye being formed. It is coloured red by fusion

with resorcinol, violet-red by glacial acetic acid and α-naphthylamine, and generally exhibits the typical reactions of a diazo-amido compound.

Tetrahydro-o-methylquinoline-p-azobenzenesulphonic acid, $C_9NH_4CH_3.N_2.C_6H_4SO_3H$, is prepared by treating the hydrochloride of the base suspended in cold water with an equal quantity of paradiazobenzenesulphonic acid. The yield is about 155 per cent. of the hydrochloride used. It strongly resembles the homologous colouring matter from tetrahydroquinoline, crystallises in brownish-violet glistening needles, and dissolves sparingly in hot water and in alcohol, forming orange-coloured and fuchsine-red solutions respectively; it is readily soluble in alkalis, and is re-precipitated from its solutions on addition of hydrochloric acid in tufts of dark violet needles with a metallic reflex. In an acid bath it dyes wool and silk orange-yellow, and exhibits the bad tinctorial properties of the tropæolines in a high degree. The *sodium* salts forms brick-red flakes, soon changing to thin plates with a green reflex.

Tetrahydro-o-methyl-p-amidoquinoline—

$$C_9NH_4CH_3.NH_2$$

is prepared by reducing the azo dyestuff with tin and hydrochloric acid, decomposing the resulting tin salt with soda, and extracting with ether. The *hydrochloride* crystallises in monoclinic vitreous prisms, which do not solidify at 310°. The free base has the properties of a paradiamidobenzene, giving with hydrochloric acid, ferric chloride, and hydrogen sulphide a fine violet colouration (thionin), and with potassium dichromate and acetic acid an intense green changing to red on heating (indamine and safranine). An aqueous solution of the hydrochloride also yields with *m*-tolylenediamine chloride and potassium bichromate a deep blue colouration and precipitate changing to violet and red on heating (tolylene blue and red).

Tetrahydro-p-methylquinoline, $C_9NH_{10}CH_3$, is prepared from *p*-methylquinoline like the *o*-compound. It crystallises in silvery prismatic tables, melts at 38°, boils at 262°3 under a pressure of 712 mm., dissolves readily in alcohol, chloroform, &c., but only sparingly in water. The *hydrochloride*, $C_{10}H_{13}N.HCl$, crystallises in long silvery needles, melts at 189°, and dissolves readily in water, alcohol, and hot chloroform, but is insoluble in ether, benzene, and light petroleum. Ferric chloride colours the neutral solution deep reddish brown changing to olive-green, and the acid solution yellowish-brown; potassium dichromate and sulphuric acid give a dark brown to Bordeaux red colour, which gradually becomes greenish. The *acetyl* compound, $C_{10}NH_{12}.C_2H_3O$, is a colourless viscid oil boiling at 302°—305° under a pressure of 719 mm.; the *nitroso* derivative, $C_{10}NH_{12}NO$, crystallises in thin, pale yellow, monoclinic tables or flat prisms, and melts at 65°; the *diazoamido* compound, $C_{10}NH_{12}.N_2C_6H_5$, is prepared like the *o*-compound, and crystallises from alcohol in pale yellowish, flat, lustrous prisms melting at 74°5, and readily soluble in organic solvents. Unlike the *o*-compound, it does not yield an isomeric azo-dyestuff on warming with acids, but splits up into phenol and tetrahydro-*p*-methylquinoline. It further resembles the diazo-amido compounds in giving the characteristic reactions with resorcinol, α-naphthylamine, and glacial acetic acid, &c.

Tetrahydro-p-methylquinoline-o-azobenzenesulphonic Acid, $C_9NH_4(CH_3).N_2C_6H_4SO_3H$, is prepared by adding diazobenzenesulphonic acid (3 grms.) suspended in water (100 grms.) to a well-cooled solution of the hydrochloride of the base (3 grms.) in water (40 grms.) acidified with fuming hydrochloric acid (2 cc.). The yield is only 122 per cent. of the hydrochloride used. This dyestuff forms a deep violet-black crystalline powder insoluble in ether, but readily soluble in alcohol, and sparingly so in water. The aqueous solution is of a deep wine-red colour, changing to violet on addition of acid. It forms dark cherry-red solutions in concentrated sulphuric acid and in alkalis. In an acid bath it dyes wool and silk Bordeaux red. The *sodium* salt crystallises in Bordeaux red needles with a brownish-green metallic reflex.

o-amidotetrahydro-p-methylquinoline, $C_9NH_4(CH_3)NH_2$, is prepared by reducing a solution of the azo-dyestuff in aqueous soda with zinc dust. The *hydrochloride* forms colourless prisms which decompose at 216°. The neutral solution is coloured deep Bordeaux red by ferric chloride or potassium bichromate like other orthodiamido compounds; on warming with a drop of nitric acid the same effect is produced, but the colour changes to yellow on cooling. The red colour is also obtained on addition of a small quantity of calcium chloride, and is changed to yellow by an excess. The alcoholic solution gives with sodium acetate and hydroxynaphthaquinone the intense red colouration characteristic of alkylated orthodiamidobenzenes, a rosindone being probably formed.

α-methyl-m-methyltetrahydroperiquinimidazole—

$$C_9H_3CH_3\begin{cases}N\\ \\ N\end{cases}CCH_3$$

This is an anhydro-base or imidazole prepared by the action of acetic acid on the preceding compound. It crystallises in silky needles or flat prisms, melts at 163°, distils unchanged at 360°, sublimes in beautiful needles, dissolves readily in hot water, alcohol, chloroform, but only very sparingly in light petroleum. The *picrate* is a yellow sandy crystalline powder, the *chromate* forms tufts of yellow needles, the *platinochloride* crystallises in orange-coloured needles freely soluble in hot water, a *phthalone dyestuff*, $C_{12}H_{11}N_2.CH:(C_2O_2:C_6H_4)$, is formed by the action of phthalic anhydride on the base; it crystallises from glacial acetic acid in golden yellow prisms which do not melt at 310°.

Benzenediazo-amidotetrahydro-p-methylquinoline Sulphonic Acid, $C_{10}NH_{12}.N_2.C_6HS_4O_3H$, is formed together with the isomeric azo-dyestuff described even in presence of an excess of acid, the *barium* salt crystallises in glistening white plates. With resorcinol and α-naphthylamine, the characteristic red and violet colours of the respective sulphophenylazo-dyestuffs are obtained, in other respects it also behaves as a sulphonated diazoamido compound.

Tetrahydro-o-p-dimethylquinoline, $C_9NH_4(CH_3)_2$, prepared by the reduction of *o-p*-dimethylquinoline, is a colourless oil boiling at 272°—273° under a pressure of 720 mm., the *hydrochloride* crystallises in rhombic prisms, and when pure melts at 272°. Ferric chloride produces in its neutral solution a yellowish to an emerald-green colouration which changes to yellow on warming. With potassium bichromate and sulphuric acid a brownish-green colouration is produced on warming. The *acetyl derivative* is a viscid colourless oil boiling at 313°5° under a pressure of 719 mm., the *nitroso* derivative crystallises from alcohol on dilution with water in thin lustrous plates and melts at 42°, the *diazoamido-compound*, $C_{11}NH_{14}.N_2C_6H_5$, crystallises in slender prisms and melts at 88°—89°. On warming with mineral acids it breaks up into phenol and *o-p*-dimethylquinoline, with evolution of nitrogen.

From the above results it appears that tetrahydro-*o*-methylquinoline, tetrahydro-*p*-methylquinoline, and tetrahydro-*o-p*-dimethylquinoline respectively behave like an alkylated *o*-toluidine, *p*-toluidine, and asymmetrical xylidine (see following abstract).—S. B. A. A.

Methyl-para-toluidine. E. Bamberger and P. Wulz. Ber. **24**, 2077—2086.

It was previously shown (see previous abstract) that the action of *p*-diazobenzenesulphonic acid on tetrahydro-*p*-methylquinoline results in the formation of a mixture of an *azo-dyestuff*, and an isomeric diazo-amido compound. Paradiazobenzenesulphonic acid acts in a similar way on methylparatoluidine, the "monocyclic" analogue of tetrahydro-*p*-methylquinoline.

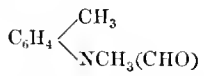
Formoparatoluidide—

$$C_6H_4\begin{cases}CH_2\\ \\ NH(CHO)\end{cases}$$

An almost theoretical yield of this compound is obtained by boiling equal weights of paratoluidine and crystalline

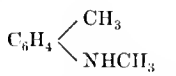
formic acid at a low pressure (20—30 mm.), removing any unaltered toluidine, and heating for a short time to 250°.

Methylformoparatoluidide—

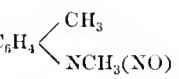


prepared by heating an alcoholic solution of formotoluidide (13·5 grms.) with methyl iodide (15 grms.), and strong alcoholic potash (5·6 grms.) crystallises in large prisms, which melt at 30°, and distils at 273°—277° with slight decomposition.

Methylparatoluidine—

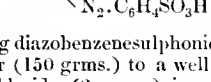


is obtained in a state of purity by digesting the preceding compound with fuming hydrochloric acid. It distils at 207°—209° under a pressure of 715 mm., the *hydrochloride* crystallises in large prisms of vitreous appearance, melts at 119·5°, and dissolves readily in water and alcohol. In aqueous solution it is coloured reddish-brown by ferric chloride, and chestnut brown by potassium bichromate and sulphuric acid. The *nitroso* derivative—



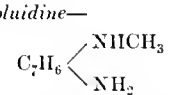
crystallises from ether in brownish-yellow lustrous plates, and melts at 52°—53°.

Methylparatoluidine-o-azobenzenesulphonic acid—



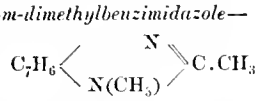
prepared by adding diazobenzenesulphonic acid (2·3 grms.) suspended in water (150 grms.) to a well cooled solution of methyltoluidine chloride (2 grms.) in water (20 cc.), and dilute sulphuric acid (1 cc.). 5·5 grms. of the acid are obtained from 6 grms. of the chloride. It crystallises from boiling water in deep violet-black vitreous-looking prisms, melts at 198°—199°, and dissolves readily in most solvents; the aqueous solution is dark raspberry-red, the alcoholic solution dark wine-red, the sulphuric acid solution cherry-red. It dyes wool and silk a dark orange colour in an acid bath, the *sodium* salt forms deep red crystalline flakes, converted by prolonged standing under water into small iridiscent plates.

o-amidomethyl-p-toluidine—



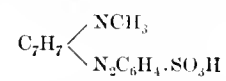
is prepared by reducing the preceding dyestuff with stannous chloride and hydrochloric acid. The *hydrochloride* crystallises when pure from alcohol in small colourless and vitreous-looking prisms, which begin to melt at 175°, and decompose at 180°—185°. The free base is obtained by hydrolysing the hydrochloride. It crystallises from ether in colourless prismatic tables, melting at 43°, and is identical with the compound prepared by Gattermann from nitromethyl-*p*-toluidine (Ber. **18**, 1487). In acid solutions it is coloured deep red by oxidising agents, like other ortho-diamido compounds.

α-β-dimethyl-m-dimethylbenzimidazole—



prepared by boiling the hydrochloride of the preceding base with sodium acetate and glacial acetic acid crystallises in lustrous needles and melts at 141·5° to 142°. It is identical with the anhydro-base or imidazole prepared by Niementowski from methylnitro-*p*-acetotoluidide.

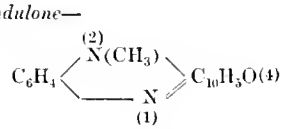
Benzenediazo-amidomethyl-p-toluidine sulphonic acid—



The *sodium* salt is obtained by treating the filtrate from the azosulphonic acid with soda. When pure it forms white plates very sparingly soluble in alcohol or water; the aqueous solution gradually turns red on standing, and the isomeric azo-dyestuff is deposited. The *silver*, *lead*, *barium*, *calcium*, and *cadmium* salts crystallise in needles, the *copper* salt forms a light green crystalline precipitate; the solutions of all these salts turn red on warming. This sulphonic derivative yields the colour reactions of diazoamido compounds with resorcinol and α-naphthylamine; on boiling with acids it splits up into methyltoluidine and phenolsulphonic acid with evolution of nitrogen.—S. B. A. A.

Relations of the Eurhodines to the Indulines and Safranines. F. Kehrmann, and J. Messinger. Ber. **24**, 2167—2175.

Methylrosindulone—



is prepared by mixing saturated alcoholic solutions of hydroxynaphthaquinone and methyl-*o*-phenylenediamine in molecular proportions, and allowing it to stand for 3—4 hours. It crystallises from a mixture of alcohol and benzene in cinnabar-red needles with a metallic green reflex, melts at 257°—259°, and dissolves with some difficulty in alcohol, ether, and benzene, forming yellowish eosin-red solutions with a brick-red fluorescence. The *hydrochloride* crystallises in brown needles with a green reflex, and is decomposed by water. The concentrated sulphuric acid solution of methylrosindulone is dichroic, being greyish-green in thin and dark purple in deep layers, it becomes orange-coloured on dilution. A *bromo*-derivative is obtained by acidifying the alcoholic solution with hydrochloric acid, saturating with bromine water and adding excess of sulphurous acid. It crystallises in green needles, decomposes at 250° without melting, and dissolves sparingly in most organic solvents forming fuchsin-red solutions.

α-Naphtho-eurhodole dissolves in dilute aqueous soda, forming blood-red solutions; on addition of a concentrated solution of soda a *sodium* derivative is precipitated in gold coloured leaves with a metallic lustre strongly resembling the crystallised rosindulones. On heating α-naphtho-eurhodole suspended in methyl alcohol with soda and excess of methyl iodide and diluting the product with water an indistinctly crystalline red precipitate is thrown down consisting of a mixture of methylrosindulone and *methoxynaphthophenazine*. These products are separated by dissolving in boiling alcohol, adding concentrated hydrochloric acid, and then carefully precipitating the azine with water; on adding ammonia to the filtrate methylrosindulone is precipitated. *Methoxynaphthaphenazine* crystallises from alcohol in pale yellow lustrous needles, melts at 176°—177°, and sublimes at a higher temperature. It is insoluble in alkalis, but dissolves in concentrated sulphuric acid, and is reprecipitated on dilution; it also dissolves in boiling alcohol, benzene, &c. It is not acted on by bromine water.

The preceding reaction provides a new method of synthetically preparing indulones from eurhodoles, and the authors consider that the formation of both methylrosindulone and methoxynaphthaphenazine from α-naphtha-eurhodole conclusively proves the tautomeric character of the latter compound, which may be regarded as alternating in constitution between an imidoquinone and a hydroxyazine (this Journal, 1891, 757).—S. B. A. A.

Bromisatine Blue and the Compounds of Mono- and Dibromisatine with Piperidine. C. Schotten. Ber. 1891, **24**, 2604—2607.

The author recently showed that a blue colouring matter—Isatine-blue—is readily produced either by the action of heat alone or by the action of acid anhydrides on dipiperidylisatine (this Journal, 1890, 690).

Dipiperidylmonobromisatine, $C_6H_3BrNO.(C_5H_{10}N)_2$, obtained on heating an alcoholic solution of monobromisatine (1 mol.) with piperidine (2 mols.), forms colourless needles. When this is heated with acetic anhydride, *Bromisatine blue* is produced, the formula of which the author has not succeeded in establishing.

Dibromisatine and piperidine react in equimolecular proportions, yielding the *piperidide of dibromisatinic acid*—

$$C_6H_2Br_2\begin{cases}CO.CO.NC_5H_{10}\\NH_2\end{cases}$$

This is sparingly soluble in alcohol, soluble with moderate ease in ether, and insoluble in water. It is not decomposed by boiling with dilute mineral acids, alkalis, glacial acetic acid, or acetic anhydride, but when it is heated with a mixture of glacial acetic acid and hydrochloric acid it becomes decomposed and apparently yields dibromisatin. It melts at 152° to a brown coloured liquid.—A. K. M.

Pyonol. W. N. Nagai. Ber. 1891, **15**, 2847—2853.
See under XX., *page* 1024.

Benzene-azo-α-Naphthylglycine. A. Donner. Ber. 1891, **24**, 2902—2904.

A solution of aniline in nine parts of dilute hydrochloric acid is diazotised and combined with a solution of α naphthylglycine in dilute hydrochloric acid. After a short time the mixture is coloured intensely reddish blue, and after 12 hours' standing a considerable amount of a dark blue crystalline precipitate is formed. The body melts after purification at 170° C. with evolution of gas. The analysis proved it to be the hydrochloride of benzene-azo-α-naphthylglycine ($C_6H_5.N:N.C_{10}H_6NHCH_2.CO_2H)(HCl)$.

The compound is with difficulty soluble in water, more easily in concentrated hydrochloric acid, and abundantly in alcohol. All the solutions exhibit a reddish-blue colour, changing on addition of alkalis into a yellowish-red, concentrated sulphuric acid dissolves the compound with a deep blue colour, changing into violet on dilution. The hydrochloric acid solution of the body dyes silk a violet, its alkaline solution a golden yellow. The hydrochloride dissociates on washing with water, the melting point of the substance being lowered about 20° C. On treating the hydrochloride with the theoretical amount of potassium hydrate, evaporating to dryness and exhausting the residue with hot alcohol, crystals separate from the filtrate in the shape of small, bright, green needles, melting at 133° C. with evolution of gas. The author believes this compound to be represented by the formula—

$$C_6H_5.N:N.C_{10}H_6.NH.(CH_2CO_2K)$$
$$\quad\quad\quad

On adding the diazonaphthalenesulphonic acid to boiling dilute sulphuric acid, a blue solution is obtained, yielding after purification—

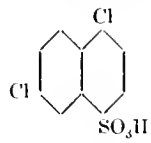
α-, β-Naphtholsulphonic Acid, $C_{10}H_6(OH)SO_3H$

Ferric chloride produces in its solution an indigo blue colour changing soon into a dirty red. The combination with diazotised naphthionic acid is of a magenta-red colour.—A. L.

On 1:6:4 *Dichloronaphthalenesulphonic Acid.* P. T. Cleve, Ber. 1891, **24**, 3477—3479.

On sulphonating 1:6 dichloronaphthalene with a mixture of equal volumes of fuming and ordinary sulphuric acid a sulphonic acid is obtained with difficulty soluble in dilute sulphuric acid. A great number of salts and other derivatives of this compound are described, amongst them—

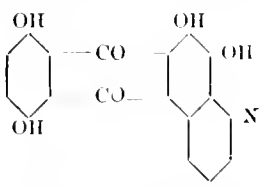
1:4:6 *Trichloronaphthalene*, melting at 56° C. if cooled rapidly, at 65° C. if cooled slowly. This compound proves that the constitution of the dichloronaphthalenesulphonic acid is—



—A. L.

Hydroxy-Derivatives of Alizarin Blue. R. E. Schmidt and L. Gattermann. J. Prakt. Chem. 1891, **49**, 103—109.

The authors have previously shown that by the action of strongly fuming sulphuric acid on anthraquinone and on its hydroxy-derivatives, a new class of colours, the *Alizarin Bordeaux* result. (This Journal, 1891, 537 and 759, and J. Prakt. Chem. 1891, **43**, 237 and 240.) Alizarin bordeaux is tetrahydroxy-anthraquinone and yields both a nitro- and an amido-derivative, from the latter of which the corresponding anthraquinoline compound can be prepared. This Dihydroxy-alizarin blue is almost insoluble in the usual reagents, but dissolves in nitrobenzene, which is the best solvent for the various members of this group of bodies. It separates from this solution in blue needles having a copper-like metallic lustre and closely resembling indigo in appearance. Concentrated sulphuric acid dissolves it with a bright greenish-blue colour, and this solution gives two sharp absorption bands in the spectrum, one in the red and one in the orange. When heated it yields a violet-coloured vapour resembling that of iodine. Analysis and the method of formation point to the following constitutional formula—



Dihydroxyalizarin blue.

When alizarin blue itself is treated with fuming sulphuric acid in a similar manner to that in which Alizarin bordeaux is prepared from alizarin, the above compound does not result, but a Trihydroxy-alizarin blue $C_{17}H_6NO_4(OH)_4$ is formed, which closely resembles the dihydroxy-compound in physical properties.

The manufacture of colours of a somewhat similar nature (alizarin blue-green, alizarin green, and alizarin indigo-blue) has been patented by the Badische Soda und Anilin Fabrik. (Eng. Pat. 14,353 and 15,121 of 1888; this Journal, 1889, 770 and 772), but beyond a short note by Graebe (Ber. 1890, **23**, 3739) no work has been done on the nature of these colours. Graebe's experiments pointed to the colours being derived from a mono- or dihydroxy-alizarin blue. The result of the authors' investigations is to show that the "*Alizarin blue-green*" is the mono-sulphonic acid of monohydroxy-alizarin blue. When heated with hydrochloric acid to 160°—170° C. the sulphonic acid group is removed and monohydroxy-alizarin blue formed. This body crystallises from nitrobenzene in glittering copper-like plates, which dissolve in concentrated sulphuric acid with a violet colour. Like Alizarin blue its alkali salts are insoluble in an excess of alkali. "*Alizarin green*" is also a mono-hydroxy-alizarin blue monosulphonic acid, and therefore isomeric with Alizarin blue-green. It results, as stated in the patent, by the action of mono-hydrated sulphuric acid on Alizarin blue-green, and its formation is the first instance of an intramolecular change in the anthracene group. "*Alizarin indigo-blue*," which is produced by the further action of sulphuric acid on Alizarin blue-green is a mixture of two trihydroxy-alizarin blues, one identical with and the other isomeric with the body obtained by the authors direct from alizarin blue. The product of the action of sulphuric acid at 200° on Alizarin green is not identical with the above as stated in the patent, but consists of the monosulphonic acid of a dihydroxy-alizarin blue. The constitutional formulæ of these products is under investigation.

—C. A. K.

PATENTS.

Production of a Novel Pyrazolon. O. Imray, London. From the "Farbwerke vormals Meister, Lucius und Brüning," Hoechst-on-the-Maine, Germany. Eng. Pat. 18,024, November 8, 1890. 4*d*.

See under XX., *page* 1027.

Production of Sodium-formylphenylhydrazine and of Symmetric Alkylphenylhydrazine and of Analogous Compounds. O. Imray, London. From the "Farbwerke vormals Meister, Lucius und Brüning," Hoechst-on-the-Maine, Germany. Eng. Pat. 18,025, November 8, 1890. 6*d*.

See under XX., *page* 1027.

Manufacture of Diaethyldibenzyldiamido-diphenylmethan Disulpho Acid and Violet Dye Stuffs therefrom. J. R. Geigy, Basle, Switzerland. Eng. Pat. 21,284, December 31, 1890. 4*d*.

The process depends upon the discovery that formaldehyde can be condensed with ethylbenzyl-aniline sulphonic acid forming diethyldibenzyldiamido-diphenylmethane disulphonic acid, which, by suitable treatment, yields a violet dye for wool. The various stages for the production of the colouring matter, which can all take place in the same aqueous solution, are as follows:—(1.) Condensation of ethylbenzylaniline sulphonic acid with formaldehyde. (2.) Oxidation of the diethyldibenzyldiamido-diphenylmethane disulphonic acid thus formed to diethyldibenzyldiamido-benzhydrol disulphonic acid. (3.) Condensation of this last product with dimethyl- or diethyl-aniline, forming dimethyldiethyldibenzyl- or tetraethyldibenzyl-paraleuk-aniline disulphonic acid. (4.) Oxidation of these leuco-disulphonic acids into the sulphonic acids of the colouring matter.—T. A. L.

Production of Azo Colouring Matters. O. Imray, London. From the "Farbwerke vormals Meister, Lucius, und Brüning," Hoechst-on-the-Maine, Germany. Eng. Pat. 20,889, December 22, 1890. 6*d*.

Blue to bluish-violet colouring matters are obtained by combining the diazo compounds of diphenylamine, phenyltolylamine and ditolylamine, their isomers, and homologues with various hydroxynaphthalene sulphonic acids, all of which are the subjects of German patents.—T. A. L.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

Colour-Photometry. Captain Abney. Proc. Chem. Soc. November 19, 1891.

See under XXIII., *page* 1031.

PATENTS.

Process for Obtaining a New Material from Bituminous Slate, and its Application as a Filtering Medium and as a Colouring Matter. J. Zeller, Eislingen, Germany. Eng. Pat. 17,218, October 28, 1890. 4*d.*

See under I., *page* 990.

Improvements in the Manufacture and Production of Saponaceous Matter applicable for Use in or connected with the Dyeing of Textile Fabrics or Materials, and for other Purposes. C. E. Maistre and J. M. Campagne, Paris, France. Eng. Pat. 21,062, December 24, 1890. 8*d.*

See under XII., *page* 1015.

VII.—ACIDS, ALKALIS, AND SALTS.

Oxidation of Cobalt Salts by Electrolysis. H. Marshall. Jour. Chem. Soc. 1891, 760—771.

In the course of some experiments on the electrolytic separation of copper and cobalt by Claisen's method, it was observed that a solution containing at the outset the sulphates of these metals together with potassium sulphate and sulphuric acid assumed a greyish green colouration though the copper had been completely precipitated. On addition of a reducing agent to such a solution the colour changed from green to pink, and in the particular case of hydrogen sulphide, sulphur was precipitated. Analytical results also showed that oxidation had taken place, and further experiments showed that the solution was decomposed by easily oxidisable substances; for example, hydrogen peroxide caused a rapid evolution of oxygen and hydrochloric acid of chlorine. It appeared that in the course of electrolysis the cobaltous sulphate was oxidised to the cobaltic salt, possibly in accordance with the equation $CoSO_4 + 2CoSO_4 = Co_2(SO_4)_3$. To confirm this supposition a solution of cobaltous sulphate was subjected to electrolysis, and solution of ammonia was then added to form ammonium sulphate with the free acid, and the current continued as before. Small dark-blue crystals were produced which were found to be the ammonium alum of cobalt. Again, by the electrolysis of cobaltous sulphate by itself a cobaltic salt, $Co_2(SO_4)_3 \cdot 18\,H_2O$, was obtained, which would be analogous to natural aluminium sulphate, $Al_2(SO_4)_3 \cdot 18\,H_2O$, known as *hair salt*.

Simultaneously with the author's experiments, Kehrmann, (Ber 19, 3101) had prepared a double cobaltic potassium oxalate, which forms a green solution, and by the electrolysis of a saturated solution of cobaltous and ammonium oxalates the author obtained an ammonium cobaltic oxalate, $Co_2(NH_4)_6(C_2O_4)_6 \cdot 6\,H_2O$ corresponding in composition to the potassium salt. It forms nearly black prisms dissolving readily in water, to give a dark-green solution; in thin films the salt exhibits dichroism. Its solution is slowly decomposed, when boiled, depositing the cobaltous salt; it is unaltered by ordinary reducing agents in the cold; when heated with strong hydrochloric acid the solution changed from a green to a blue colour with formation of anhydrous cobaltous chloride.—V. H. V.

The Persulphates. No. 5. H. Marshall. J. Chem. Soc. November 1891, 783—783.

The fifth part of a series of papers, concluded for the present with promise of future work and communications.

Though the persulphates would seem not to be isomorphous with the perchlorates, they offer many close resemblances to them, as *e.g.* in the matter of solubility. Barium persulphate is a soluble and unstable salt. Sodium, lithium, and magnesium persulphates could not be prepared directly by electrolysis. The zinc salt was obtained by double decomposition between zinc sulphate and barium persulphate, but it rapidly decomposed. Efforts to prepare the copper salt were as unsatisfactory.

The Persulphates. H. Marshall. J. Chem. Soc. **59**, 771—786.

The general method adopted by the author for preparing persulphates consisted in the electrolysis of the acid sulphates in an apparatus in which the cathode was represented by a stout platinum wire contained in a porous cell placed in a platinum basin, which was made the anode and was kept cool by immersion in a vessel through which water was allowed to circulate.

Potassium Persulphate, KSO_4.—The salt prepared by the electrolysis of potassium hydrogen sulphate forms colourless crystals, usually tabular, but sometimes assuming the shape of long prisms; their exact geometrical character has not yet been determined. 100 parts of water at 0° C. dissolve 1·77 parts of the salt; the solution decomposes slowly with formation of potassium hydrogen sulphate and liberation of oxygen, but even in contact with a zinc-copper couple the completion of decomposition is slow. Potassium persulphate is more insoluble than the corresponding salt of any other metal, and the precipitates it yields with metallic solutions are therefore not persulphates, but result from the formation of decomposition products. It is a powerful oxidant, precipitating lead, silver, and copper, as peroxides, and behaving similarly with salts of manganese, cobalt, and nickel in the presence of an alkali. It liberates iodine from potassium iodide, bleaches organic colouring matters such as litmus and turmeric, and oxidises potassium ferrocyanide to ferricyanide, and causes paper and cloth to become rotten after having been dipped in its aqueous solution. Aqueous alcohol is oxidised by it to aldehyde, but absolute alcohol is not attacked, the persulphate being insoluble in that liquid. Pure potassium persulphate is odourless, but after having been kept for some time a peculiar smell is noticeable on opening the bottle containing it; in the case of a not very pure product ozone is slowly evolved; the salt has a cooling saline taste, but leaves a peculiar after-taste possibly due to persulphuric acid.

Ammonium Persulphate, NH_4SO_4, is prepared in the same way as the potassium salt, and forms colourless prisms or lozenge-shaped tables. 100 parts of water at 0° C. dissolve 58·2 parts of ammonium persulphate; its great solubility makes it difficult to purify, and causes it to give, as a rule, more marked reactions than the potassium salt; it is moreover less easy to keep.

Barium Persulphate, $Ba(SO_4)_2 4\,H_2O$, is best formed by treating a saturated solution of ammonium persulphate with barium hydrate. During the evaporation of its solution a certain amount of decomposition takes place, barium sulphate separating out and persulphuric acid being liberated. It forms prisms sometimes deeply striated or arranged in stellate groups. The crystals decompose on keeping, and are best preserved in a damp atmosphere. 100 parts of water at 0° C. dissolve 52·2 parts of the crystallised salt, corresponding to 39·1 parts of the anhydrous body; the solubility is considerably greater at higher temperatures, and the salt readily forms supersaturated solutions. The crystallised salt is soluble in absolute alcohol without decomposition, a portion being, however, precipitated on standing in the dehydrated state. It is decomposed, however, by dilute alcohol, aldehyde being formed and oxygen liberated. The salt, after dehydration by means of alcohol, has the formula $Ba(SO_4)_2H_2O$, the last molecule of water being eliminated only when the salt is decomposed; in this respect it resembles the perchlorate.

The persulphates of lead, zinc, and copper have been prepared, though with difficulty, and have not yet been obtained pure on account of their tendency to decompose; attempts to prepare the persulphates of sodium, lithium, and magnesium directly by electrolysis proved unsuccessful.

From these results the author concludes that the peroxide of sulphur, S_2O_7, forms a true acid, persulphuric acid HSO_3, in the manner indicated by Berthelot, contrary to the assertions of Mendeleëf and Traube.—B. B.

On the Changes of Colour of Nitric Acid. L. Marehlewski. Ber. 1891, **24**, 3271—3276.

When water is gradually added to concentrated red fuming nitric acid, the acid, as is known, first assumes a green colour; next, as the further additions of water is continued, a blue colour supervenes, and finally, when further diluted, the liquid becomes colourless. If the experiment be reversed, *i.e.*, if concentrated fuming acid be added little by little to water, first a blue colour appears, then a green, and finally a red-brown colour.

It has been usual to explain these colour changes on the assumption that a portion of the nitrogen peroxide in the red acid becomes decomposed by the addition of a little water, forming nitrous acid, the blue colour of which blending with the brown colour of the still undecomposed nitrogen peroxide in the fuming nitric acid produces a green colour in the latter. On a further addition of water more of the nitrogen peroxide is decomposed, and the blue tint becomes stronger.

Similar changes of colour take place when nitric oxide is led into nitric acid. Nitric acid of sp. gr. 1·25, when treated with nitric oxide, gives a blue colour, acid of sp. gr. 1·35 gives a green colour, whilst concentrated acid (sp. gr. 1·48—1·50) gives a red-brown colour. These degrees of concentration correspond to those which give the same colours respectively when concentrated acid is diluted with water. The action of nitric oxide on a dilute nitric acid produces nitrous acid, $2\,NO + HNO_3 + H_2O = 3\,HNO_2$, whilst nitric oxide and a concentrated acid yield nitrogen peroxide and water, $2\,NO + 4\,HNO_3 = 3\,N_2O_4 + 2\,H_2O$. The explanation given above to account for the colours would hold good also, therefore, in the case of the colours produced by leading nitric oxide into nitric acids of various strengths.

The author has endeavoured to obtain a verification of this explanation by driving out the gases from the various coloured acids by a stream of carbonic acid gas, and absorbing the evolved gases in sulphuric acid. Bearing in mind that nitrous acid and concentrated sulphuric acid yield pure nitrosylsulphate, whilst nitrogen peroxide and sulphuric acid yield an equal number of molecules of nitrosylsulphate and of nitric acid, we have a basis for estimating the relative quantities of these two gases in the coloured nitric acid—

$$2\,H_2SO_4 + N_2O_3 = 2\,SO_2OHNO_2 + H_2O$$
$$H_2SO_4 + N_2O_4 = SO_2OHNO_2 + HNO_3$$

If, now, the nitrosylsulphate be estimated in the first place by determining the nitrogen in a Lunge gas volumeter, and next by titration with potassium permanganate, the relative proportions of nitrogen trioxide and nitrogen peroxide that have been expelled from the nitric acid can be calculated.

The following table shows the results obtained. The first column gives the kind of gas by which the colour of the acid was produced; column two gives the specific gravity of the nitric acid used; the third column states the colour produced, and the last column gives the ratio of the nitrous acid calculated by the method of titration to the quantity as determined by the gas-volumetric way. When the ratio equals 1 the sulphuric acid contains only nitrosylsulphate, and the corresponding coloured nitric acid contained only nitrous acid; when the ratio is less than 1, nitric acid was also present in the sulphuric acid, and the corresponding coloured nitric acid contained a mixture of nitrous acid and nitrogen peroxide; when the ratio equals 0·5, the corresponding coloured nitric acid contained only nitrogen peroxide:—

1. NO.....	1·210	Blue	1·002
2. NO.....	1·275	Blue-green	1·008
3. NO.....	1·375	Green	0·808
4. NO.....	1·400	Dark green	0·721
5. NO.....	Highly conc.	Red-brown	0·551
6. N_2O_3	1·210	Blue	1·010
7. N_2O_3	1·275	Blue-green	1·004
8. NO_2.....	1·275	Green	1·001

These results do not bear out the accepted explanation of the colours of the nitric acid. Although it is shown that the blue solutions really seem to contain only nitrous acid, yet it is also shown that the blue-green and green solutions, which according to the theory ought to contain a mixture of nitrous acid and nitrogen peroxide, contain in reality only nitrous acid, or at any rate mixed with only a very small quantity of nitrogen peroxide. The last experiment gives a result in direct opposition to the accepted theory.

The author next endeavoured to find out whether nitric oxide was also present in the gases evolved from the blue-green and green coloured acids, and he found that this was the case. He estimated this oxide by absorbing it in a solution of semi-normal potassium permanganate, after removing first of all the nitrous acid and nitrogen peroxide by absorption with sulphuric acid. The amount of potassium permanganate consumed showed the quantity of nitric oxide present. In two cases given in the paper, considerable amounts of nitric oxide were found to be present. Whether it plays a part in the production of the colours or not, or is a product of decomposition of some unknown nitrogen compound, or whether its presence is due to the manner of preparing the coloured acids, has not been elucidated. It is possible that here, however, may be found a rational chemical explanation of the fact noticed by Gernez (Compt. Rend. **74**, 465) that red fuming nitric acid does not give the characteristic absorption spectrum of nitrogen peroxide until after a drop of carbon disulphide has been added to it.

—H. S. P.

Heat of Evaporation of Liquid Ammonia. H. von Strombeck. Journ. Franklin Inst. 1891, **131**, 470—476.

From a series of 12 carefully made experiments, the author deduces an average value of 533·7 English thermal units for the heat of evaporation of liquid ammonia. The author's previous experiments (Journ. Franklin Inst. 1890, **130**, 481; this Journal, 1891, 638) gave a mean of 526·32 thermal units.—S. B. A. A.

PATENTS.

An Improved Artificial Asphalte. H. P. and E. G. Williams, London. Eng. Pat. 13,595, August 29, 1890. 4*d*.

See under IX., *page* 1008.

Improvements in the Manufacture of Glass Retorts as used in Chemical Works for the Concentration of Acids and other Analogous Purposes. T. G. Webb, Manchester. Eng. Pat. 17,407, October 31, 1890. 6*d*.

See under VIII., *page* 1007.

Improvements in the Manufacture of Chlorine. J. Simpson, Liverpool. Eng. Pat. 19,776, December 4, 1890. 4*d*.

Chloride of sodium is decomposed by means of phosphoric acid at a red heat, as described in the inventor's patent 18,835 of 1890 (this Journal, 1891, 768), sodium phosphate being formed and hydrochloric acid gas evolved. The hydrochloric acid thus obtained "is practically free from nitrogen and will work much better in the Deacon decomposer for the production of chlorine than the gas from the ordinary salt-cake process." As an alternative method for obtaining chlorine, hydrochloric acid gas is generated as above described, and is conducted together with a sufficient quantity of oxygen to combine with the hydrogen of the hydrochloric acid through a heated chamber filled with marbles (preferably glazed). Chlorine is thus liberated as expressed by the equation $2\,HCl + O = H_2O + 2\,Cl$. Oxygen produced by any known means may be used, but that made by the method known as Brin's process is preferred.—H. S. P.

Improvements in and connected with the Treatment of Crude Bicarbonate of Soda to obtain Caustic Soda, Carbonic Acid, and other Products. A. Campbell, Glasgow; W. Boyd, Thornton; A. J. Kirkpatrick, Glasgow. Eng. Pat. 21,071, December 27, 1890. 6*d*.

Sodium bicarbonate from the ammonia-soda process is charged in a series of wrought or cast iron vessels, and there treated with a current of steam, which enters the series at the bottom of the particular vessel which is next to be emptied; after passing through all the vessels, it escapes from the newly charged one, to which sufficient water has been added, to enable the final formation of a solution of say 10 Tw. The escaping gases consist of carbonic acid and traces of ammonia; the latter is retained by washing with brine, which returns to the ammonia-soda process, and the remaining nearly pure carbonic acid is available for other purposes. Hot lime-kiln gases may be used instead of steam, whereby the escaping gases will be considerably richer in carbonic acid. When the conversion into monocarbonate is sufficiently completed, the charge is run off into an agitator and causticised with milk of lime. Caustic soda and calcium carbonate are formed; the sludge may be washed and elutriated and used for distilling off ammonia as carbonate from the ammonium chloride of the ammonia-soda process; or the lime sludge may be filter-pressed "in which presses it is made as free as possible from soda;" the filter cakes are then moulded into bricks which may be burnt in a kiln into caustic lime and carbonic acid; or the sludge may be used for making cement.—H. A.

Improvements in the Treatment by the Claus Process of Gases containing Sulphuretted Hydrogen and Recovery of Valuable Products therefrom. C. W. Heaton, London. Eng. Pat. 21,217, December 30, 1890. 8*d*.

The invention relates to the treatment of the gases passing from the Claus kiln. After the sulphur has been condensed in the usual way the cooled gases containing small but varying quantities of free sulphur, sulphuretted hydrogen, and sulphurous acid, are mixed with sufficient or more than sufficient air to oxidise all the sulphur and sulphuretted hydrogen, and are then led through heated tubes or chambers packed with oxide of iron or an oxide of manganese, the apparatus being designated by the inventor a "supplementary Claus kiln." The whole of the sulphur, free and combined, in the gases is thus converted into sulphurous acid, after which the gases are caused to ascend a tower packed with limestone, chalk, or flint, where they meet a descending stream of water, or a solution of carbonate of soda, or of caustic soda, or other alkaline liquid which dissolves the sulphurous acid. If the tower be packed with limestone and the wash-liquor be water, the solution obtained may be run away, but if an alkaline liquor be used, alkaline sulphites are recovered, which will be of commercial value.—H. S. P.

Process for obtaining Pure Nitric Acid Direct in Nitric Acid Reaction Apparatus. O. Imray, London. From the "Chemische Fabrik Griesheim," Frankfort, Germany. Eng. Pat. 891, January 17, 1891. 4*d*.

Attached to the producing apparatus is a collecting vessel into which flows the acid condensed by a reflux cooler. The acid in the collecting vessel is maintained at a temperature of about 80° C., and the reflux cooler is worked so that the lower oxides of nitrogen, and the halogen compounds, as free from nitric acid as possible, escape. "The production of a pure acid, even at the temperature of 80° C., is considerably facilitated by conducting air or other gases into the acid in the collecting vessel."—H. S. P.

Improvements in the Manufacture of Sodium Biborate or Borax, Sodium Crystal Carbonate or Soda, and other Compounds containing Sodium or Boron, or both. J. Ascouth, Birmingham. Eng. Pat. 3230, February 23, 1891. 6*d*.

The object of this invention is the manufacture of compounds containing sodium or boron, or both, in small crystalline or granular masses, or in a pulverulent state. For the production of granular borax 4 mols. of boracic acid and 1 mol. of crystallised sodium carbonate (or also dry sodium carbonate, in which case sufficient water has to be added to replace the water of crystallisation) are dissolved in water, and the mass, "if needful," evaporated "to such a consistency that on cooling it will readily form into small crystals, crystalline, or granular masses, or become pulverulent sodium biborate or borax." The solution may be cooled in shallow pans, and any means may be applied to "bring about the state most favourable for small crystals," &c. For the production of granular sodium crystal carbonate the inventor takes 100 parts of dry sodium carbonate, 250 parts of water, or a sodium carbonate solution containing these proportions, and proceeds "to bring about combinations and crystallisation, as already described for sodium biborate." Or the process of crystallising may be continued in the ordinary way until large crystals begin to form, and then the solution is evaporated "to such density that small crystals will readily form." The patentee wishes it to be distinctly understood that he does not bind himself "to the exact details here given," but simply claims to "avoid the production of mother-liquors and the consequent waste and loss of time inseparable from the manufacture of large crystals."—H. A.

Improvements in the Production of Alkaline Carbonates and Chlorine, and their Derivatives. F. M. Lyte, London. Eng. Pat. 5352, March 25, 1891. 8*d*.

The invention is based on a reaction described by Lunge, wherein two equivalents of sodium nitrate and $2\frac{1}{2}$ equivalents of calcium carbonate are heated together to form sodium carbonate, caustic lime, and oxides of nitrogen: by lixiviating the resulting mass with a large quantity of water caustic soda is obtained. The escaping gases (oxides of nitrogen) are converted into nitric acid by the simultaneous action of air and water in suitable chambers. It is proposed to utilise this nitric acid for dissolving litharge, and to decompose the resulting lead nitrate with salt, forming insoluble lead chloride, and a solution of sodium nitrate. The latter is evaporated and returns to the process along with the calcium carbonate left on lixiviation of the above melt. The lead chloride is fused and subjected to electrolysis, whereby it is split up in its constituents, chlorine separating at the anode and lead at the cathode, from whence it may be continually run off. The recovered lead is oxidised into litharge with some of the recovered nitric acid, and entering into solution returns to the process.

The electrolysis of the fused lead chloride may be performed in a graphite, earthenware, or enamelled iron vessel, heated to a suitable temperature. The graphite anode is fastened to the inside of a bell which is immersed in the fused mass; the cathode is made of tinned iron and passes in at the bottom of the electrolysing vessel. An electromotive force of 2—5 volts is sufficient for the purposes of the electrolysis.—H. A.

Improvements in Lead Chambers used in the Manufacture of Sulphuric Acid. K. Walter, Milan, Italy, and E. Boenig, Bad Nauheim, Germany. Eng. Pat. 14,944, September 4, 1891. 4*d*.

To insure the more perfect and continuous circulation of the gases within sulphuric acid chambers, double walls of acid-proof material are built right across the chambers. The space between the double walls is filled with suitable acid-proof materials such as brick or coke. Openings are provided in these walls over their whole width, the openings in the front wall being at the top, and those in the back wall at the bottom of the wall or *vice versâ*. The gases enter the openings in the front wall, and traversing vertically the interstices of the packing pass onward through the openings in the back wall, while at the same time some portion of the gases may penetrate horizontally through cracks and joints in the walls.—H. S. P.

Improvements relating to the Manufacture of Ammonia and Gas. W. R. Lake, London. From A. Hennin, Springfield, U.S.A. Eng. Pat. 15,249, September 8, 1891. 8*d*.

See under II., *page* 996.

Process for Purifying Brine. C. G. Collins, Woodsburgh, U.S.A. Eng. Pat. 15,251, September 8, 1891. 8*d*.

The most common impurities of brine consist of the bicarbonates of iron, calcium and magnesium, calcium sulphate, calcium chloride, and magnesium chloride. The inventor finds that an electric current having an electro-motive force not exceeding 2½ volts is sufficient to decompose these impurities, rendering them insoluble, whilst the sodium chloride is not acted upon at all. As an instance the electrolysis of calcium bicarbonate proceeds in such a manner that carbonic acid is given off on the anode, and calcium hydrate on the cathode, which acting on another molecule of bicarbonate, converts it into insoluble calcium monocarbonate which settles out. The sediment is collected on the bottom of the electrolytic vessel, from whence it may be discharged at intervals, whilst the purified brine is tapped off at a higher level. An alternate method of working consists in forcing the liquor and precipitate, by hydrostatic pressure, through a filter bed, in which are embedded the electrodes of another battery, by which means the redissolving of the precipitated impurities is prevented. A sheet of drawings accompanies the specification.—H. A.

Improvements in and Relating to the Art or Process of Manufacturing Phosphoric Acid from Phosphatic Material. C. Glaser, Baltimore, U.S.A. Eng. Pat. 15,644, September 15, 1891. 4*d*.

In the ordinary process of manufacturing phosphoric acid from phosphatic material the phosphatic material is treated with dilute sulphuric acid, yielding a weak solution of phosphoric acid which is then concentrated by evaporation. The improvement on this process consists in using the weak solution of phosphoric acid obtained by the action of dilute sulphuric acid on phosphatic material, to dilute the sulphuric acid for the treatment of a second batch of phosphatic material, instead of using water as the diluent. The treatment of the second batch yields a stronger solution of phosphoric acid than that obtained from the first batch, and this solution is again used to dilute the sulphuric acid for the treatment of a third batch, again yielding a still stronger acid. This process may be advantageously continued until a solution of phosphoric acid of about 30° B. is obtained, beyond which point filtration from the insoluble residue becomes difficult, and it becomes advisable to continue the further concentration of the phosphoric acid by evaporation in the usual way.—H. S. P.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

PATENTS.

A New or Improved Portable or Fixed Continuous Firing Kiln for Burning or Staining Glass, China, Tiles, Enamels, and Ceramic Ware, also applicable to other Purposes. J. W. Payne, London. Eng. Pat. 16,131, October 11, 1890. 6*d*.

The kiln consists of a number of chambers placed over each other in small kilns, and side by side in large ones, one of which is directly heated, whilst the others receive the waste heat in succession. These chambers are provided with doors and ledges for the metal plates, which carry the articles to be fired, to rest upon, and are supported on a heat-spreading and accumulating arrangement, which facilitates the rapid heating by the furnace gases. The articles to be burnt are introduced into the coldest chamber and gradually transferred to the hotter ones, and the process is thus conducted without the products of combustion coming into contact with the objects fired. In the specification illustrations are given of the details and also of an arrangement for facilitating the removal of the chambers when worn out and the substitution of new ones.—S. B. A. A.

Improvements in the Manufacture of Glass Retorts as used in Chemical Works for the Concentration of Acids and other Analogous Purposes. T. G. Webb, Manchester. Eng. Pat. 17,407, October 31, 1890. 6*d*.

The object of this invention is to make a chemical manufacturer's retort which shall be of the same thickness of glass throughout, instead of being thicker towards the shoulder and mouth, as heretofore, and which is in consequence more durable than a retort of the old form. The operation is effected by taking from the furnace the quantity of "metal" needed to make a finished retort, and at once shaping the neck "by hanging the metal downwards, which draws out the neck to the required length, and to a form tapering outwards, instead of by rolling and shaping the neck on the edge of a plate by a series of heatings, and to a shape tapering inwards as heretofore, whilst the remaining portion of the retort is reheated, rolled and shaped, and simultaneously blown to the desired form and size."—H. S. P.

Improvements in and relating to Enamel for Metals, Glass Ware, Earthenware, and other Materials. G. Gehring, Landshut, Germany. Eng. Pat. 8090, May 11, 1891. 4*d*.

These improvements relate to various compositions used for the production of enamels. One particularly fine enamel is said to be produced by using graphite, cold-pressed Hungarian linseed oil, and oxide or borate of lead. The inventor claims the "process for enamelling metals, earthenware, and glassware, consisting in mixing a powder of graphite, coke, slag, alum, and kaolin, or one or more of these materials, with a flux, rubbing up the mixture with a compound obtained by boiling linseed oil with an oxide or a borate of lead, and laying on, drying, and burning the same;" or powdered kaolin may be mixed with a flux and the mixture "rubbed up" with water afterwards laying on, drying, and burning.—O. H.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

PATENTS.

Improvements in the Manufacture of Decorative Material for Walls and other Decorative Purposes, and in the Machinery or Apparatus Employed in the said Manufacture, the said Improvements being in part applicable to the Manufacture of Felt Papers and Millboard. T. J. Palmer, Carshalton. Eng. Pat. 4227, September 3, 1883. (Second Edition.) 8*d*.

See under XIX. *page* 1022.

An Improved Artificial Asphalte. H. P. and E. G. Williams, London. Eng. Pat. 13,595, August 29, 1890. 4*d*.

An asphalte which is said to resist the action of acids is produced by mixing silver sand or other suitable sand with pitch, from which all creosote or "creosote salts" have been removed.

The product is stated to be especially suited for the lining and flooring of rooms containing electric batteries, for the construction of tanks to contain acids, &c.—O. H.

Improvements in or Relating to the Manufacture of Cement and the Means employed therefor. T. Arnold, West Hartlepool. Eng. Pat. 18,603, November 18, 1890. 8*d*.

The improvements claimed by the patentee comprise the use of a kiln for burning cement by means of coal, the products from which are passed into a chamber termed the drying chamber, thence under floors in the ordinary way, and finally to the chimney. The slurry from the drying floors is moulded into bricks in the drying chamber, and is transferred thence to the calcining kiln, which may be situated at a level below the drying chamber; and the floors, or should the configuration of the ground render this arrangement costly, may be separated from the drying chamber by means of an arch. It is claimed that the imperfectly burned products of combustion from the kiln deposit carbonaceous matter in the interstices of the bricks in the drying chamber, and subsequent combustion of which completes the drying process. The patent also includes a claim for the use of a large door at the entrance of the calcining kiln, capable of removal when the contents of the latter have reached a clinkering temperature, thus causing their disintegration and facilitating the grinding. It is also stated that the temperature in the calcining kiln can be gauged by the state of the slurry on the drying floor, and thus the process of burning regulated. The improvements are said to be applicable to many forms of kilns and drying apparatus.—B. B.

X.—METALLURGY.

On the Use of Liquid Fuel in Copper Smelting. C. Schnabel. Zeits. des Ver. Deutsch. Ing. 1891, 1027, and Abs. Proc. Inst. Civil Eng. 1891, **105**, 55.

At Messrs. Siemens' copper-smelting works at Kedabeg, in the Transcaucasus, the residues from naphtha distillation have been applied experimentally both in the calcination and fusion of pyritic ores, the furnaces for both operations being combined into one structure, having a chimney stack in common.

The smelting furnace has a circular bed 6 metres in diameter, covered by a domed roof, having a maximum height of 2½ metres in the centre. The heating is done by two of Lenz's atomising burners placed about 3 metres apart on the same side of the furnace, with the up-take flue between them. The jets are not quite square to the admission port, so that two eddying bores of flame are produced under the roof, which unite and pass out by the flue over the bed of the calcining furnace. The latter is 16 metres long, with a bed 2·8 metres wide, and 0·95 metre height of roof, which is laid with an upward slope of nearly 1 in 7.

The ore, containing 7 per cent. of copper, is in the ordinary way, first roasted and then run down to coarse metal containing 25 per cent. of copper; but when the roasting is omitted the regulus contains only 18 or 20 per cent. of copper.

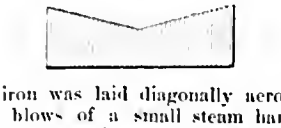
With this furnace in 33 working days 938·6 tons of ore were smelted, yielding 368·2 tons of coarse metal, averaging 25 per cent. of copper, with a consumption of 185·6 tons of naphtha residues, or rather more than 10 ewt. (50·43 per cent.) of the weight of the product.

The Effects of Abnormally Low Temperatures on Constructional Iron. F. Steiner. Iron, 1891, **38**, 269—270.

The author communicates the results of some interesting experiments which he made with a view of determining the influence exercised on iron and steel by a very low temperature. The tests were conducted with three different materials, viz., welded iron, ingot iron, and English cast steel. Strips of each sort, measuring 20 centimetres in length, 3 to 5 centimetres in width, and 7 to 10 millimetres in thickness, were used, and a separate strip of each class was laid on one side for the purpose of comparison. In the first place the static qualities of the three metals were established as follows:—

Metals.	Breaking Strength.	Extension.	Sectional Contraction.
		Per Cent.	Per Cent.
Welded iron....	3,500	18	20
Ingot iron	3,600	30	60
Cast steel.....	6,000	4	9

Half of the test pieces were experimented upon in an undamaged condition; the other half were notched about one millimetre deep with a chisel on one side in the middle. It will be seen from the results that these notches substantially influenced the subsequent behaviour of the metals. The pieces of iron and steel were refrigerated in a so-called freezing bag composed of two velvet wrappers. The pieces were placed in a row in this bag. At its upper end a flask filled with liquid carbonic acid was brought in connection with the bag in an inverted position; on opening a valve the liquid carbonic acid flowed from the flask, entered the freezing bag, and either immediately evaporated, or escaped through the pores of the velvet. So much heat was thereby imprisoned that a portion of the carbonic acid in the freezing bag was transformed into a snow-like mass of solid carbonic acid, which attached itself to the iron and steel test pieces. This process was continued until the metallic strips were completely enveloped in solid carbonic acid. The double velvet wrappers constitute so bad a conductor of heat that the carbonic acid remains for hours in a solid condition. After a test piece had been left in the freezing bag for 30 minutes, it was taken out with a squeezer and trials were made of its solidity. To this end it was laid concavously over a mould of the following form. A piece



of round bar iron was laid diagonally across, to receive the very light blows of a small steam hammer, and to transfer them to the test piece. The most important results

were as follows:—(1) The three classes of iron, after being powerfully refrigerated, and then allowed to gradually regain their normal temperature, showed no appreciable alteration in the bending test. (2) Undamaged welded iron in the refrigerated state was bent to an angle of 180° without breaking; the notched piece could not be bent further; the broken surface, fibrous in the unrefrigerated condition, presented a granular appearance in the refrigerated state. (3) Soft, undamaged ingot iron, and also the steel, after undergoing a slight bending, on receiving the third weak blow of the hammer sprang asunder with a crackling noise as of glass. The notched or damaged test pieces of these two sorts burst in two in the same manner at the first light blow without submitting to the bending experiment. The broken surfaces of the refrigerated pieces showed a grain formation, the steel an almost coarse-grained structure. These trials clearly demonstrated the prejudicial effects of intense cold upon these building materials, and the following conclusions are to be drawn—namely, that ingot-iron bridges should be crossed but slowly when abnormally low temperatures prevail, and that every care should be taken in building to avoid external fractures of the ingot-iron constructional parts of a bridge.

The foregoing details originally derived from the "*Wochentschr. des österr. Ing. und Archit. Vereins*," are also reported in "*Stahl und Eisen*," in which, after the statement that the trials probably need further confirmation, the following further details are given:—The refrigerating tubes in the ice machines, and also the iron cylinders for the transport of liquid ammonia, compressed oxygen, liquid sulphurous acid, and liquid carbonic acid are now only made of the best fibrous welded iron. Many explosions of iron cylinders containing liquid carbonic acid are to be explained by the action of the low temperatures, and this danger can be avoided by the use of proper kinds of soft but sufficiently strong-welded iron. Although refrigeration experiments with the three different kinds of iron and steel referred to were tried at the low temperatures of $-40°$ to $-50°$, yet under other and very unfavourable circumstances though at temperatures of less depression, even in the best iron considerable crystalline alterations and localised looseness of texture may be brought about, when the metal is at the same time subjected to sudden and powerful concussions. In the very cold winter of 1880 (in the Rhine valley in some places it was $-26°$ C.) many experiences of this kind were encountered in rails and connexions. But iron is not the only metal so affected that a crystalline texture is the result of strong cooling. Tin behaves in the same way though in a still higher degree, as shown by Fritsche in 1869 (Ber. 1869, **2**, 112). In the very cold winter of 1867—68 some blocks of barred tin became entirely crystalline, or nearly so, suffering dilation or swelling up in the process, and becoming in parts converted into a sandy crystalline or granular powder. A similar crystalline conversion was noticed also in a tin tube. Erdmann, of Leipsic, observed the same thing in organ pipes made of tin.—O. H.

An Undescribed Phenomenon in the Fusion of Mild Steel. F. J. R. Carulla. Proc. Iron and Steel Inst. "The Ironmonger," 1891, **57**, 98—99.

In 1773, H. Horne found that on heating ingots of cast iron about ¾ in. thick in contact with calcined bones and powdered charcoal, their outer portion was so far changed in nature that they were capable of withstanding a welding heat without suffering fusion, whereas the core, when submitted to this temperature, melted and ran out. The author has observed a similar phenomenon with Bessemer scrap. A crucible charged with this steel (of varying carbon contents) having given way in the furnace, was withdrawn from the furnace under the supposition that it was empty, but was found to contain a number of shells having the shape of the pieces of steel originally charged; from which it was apparent that the inner portion of the pieces had undergone fusion, while the outside envelope had remained solid, presumably owing to a difference in their fusing points. One piece which, from the size of the shell left, must have weighed about 41 oz. before it was put in the crucible, only weighed 14½ oz. when taken out, while another was reduced from 26½ oz. to 8¾ oz. The quantities that fused and ran out were therefore 64½ and 66½ per per cent. of the original masses respectively. Analysis showed that both these shells contained less than 0·1 per cent. of carbon, this fact accounting for their infusibility. The change in composition may have been due to the concentration of the carbon and other non-metals in the interior of the metal, or to their being burnt out by the surface action of the air. The author considers that the phenomenon in question points to the desirability of retaining the natural skin of castings and forgings whenever it is possible to avoid removing it by machinery.—B. B.

The Elimination of Sulphur from Pig Iron. J. Massenez. Proc. Iron and Steel Inst. "The Ironmonger," 1891, **57**, 100—103.

In both acid and basic Bessemer processes the varying proportions of non-metals in the pig iron charged into the converter are a constant source of trouble, which can, however, be obviated by the use of W. R. Jones's mixing process, in which 70—120 tons of pig iron, sufficient for 7—12 charges, are placed into one common mixing vessel and taken for consumption into steel as required. In the treatment of phosphoric pig iron which is employed in the production of basic steel, it is, however, not sufficient merely to conduct the molten pig iron in large quantities to the converter in a mixed condition, but the problem here is to render the proportion of sulphur also independent of the blast-furnace process, to such an extent that the proportion of sulphur in the finished steel is so low that the quality of the steel is in no way influenced by it. This is especially important on the Continent, as, on account of the strike of the coal miners in 1889, an improved position of the strikers has resulted, the coal is less carefully mined and contains more sulphur, the amount in the coke having risen from 1 to 1·8 per cent.

It has been found that manganese will act upon the sulphur in pig iron, removing it as manganese sulphide. This operation is best conducted outside the blast furnace, as when effected therein the furnace has to be worked out, resulting in the production of iron "hotter" than is desirable for conversion. Accordingly, at Hoerde, where the process is at work, a vessel of the form of a converter, lined with refractory bricks, is used for the reception of the pig from the blast furnace, and to this ferromanganese is added. The quantity of manganese theoretically required is merely that needed to convert the sulphur into manganese sulphide, and in practice it has been found that 0·2 per cent. suffices, so that as 1·5 is the quantity that should be in the pig as it passes to the converter, the addition of 1·7 per cent. is necessary for the desulphurisation. The operation is completed in 15—20 minutes, even with pig high in sulphur. The bath of metal usually retains sufficient heat for the purpose of desulphurisation, thus rendering external sources of heat unnecessary. The following table shows some of the results obtained:—

From Blast Furnace.	Percentage of Sulphur in the Charges poured into the Vessel (10—11 Tons of Pig Iron).	Percentage in Basic Charge (10—11 Tons) taken from the Vessel.	In Finished Steel.
	Per Cent. Sulphur.	Per Cent. Sulphur.	Per Cent. Sulphur.
II.	0·276	0·056	0·039
IV.	0·137	0·044	0·027
II.	1·022	0·043	0·034
II.	1·020	0·043	0·057
I.	1·530	0·043	0·041
IV.	0·680	0·054	0·032
IV.	0·352	0·054	0·018

Some of the samples were purposely made rich in sulphur to test the process. In a series of tappings, the details of which are given in the paper, from a total weight of 138,500 kilos. of pig iron containing 179·576 kilos. of sulphur, 80·923 kilos. of sulphur were eliminated, *i.e.* 45 per cent. of the total sulphur. Most of the sulphur appears in the slag, but little being volatilised as sulphurous acid. The following is an analysis of an average sample of slag:—

Manganese sulphide	28·01
Manganese oxide	20·23
Ferrous oxide	25·35
Alumina	5·00
Silica	18·30
Lime	3·53
Magnesia	0·43
Total	101·85

—B. B.

The Bismuth of Commerce and Purified Bismuth, together with some Remarks on the Atomic Weight of Bismuth. R. Schneider. J. Prakt. Chem. 1891, **44**, 23—48.

Reply to R. Schneider's Paper on the Bismuth of Commerce, &c. A. Classen. J. Prakt. Chem. 1891, **44**, 111—114.

See under XXIII., *pages* 1040—1041.

A New Use for Aluminium. Eng. and Mining J., November 21, 1891, 585.

A new use has been found for aluminium in the manufacture of cups, canteens, cartouche boxes, &c., for military equipments, a large order for metal for this purpose having recently been given in the United States by the German Government. It is the constant study of military experts to reduce the weight which the common soldier is obliged to carry, and the new departure of the Germans has this object.

Antimony in Nevada. Eng. and Mining J., November 21, 1891, 585.

Rich veins of antimony ore have been known to exist in Utah and Nevada for some time, but antimony mining has at last become a regular and profitable industry there. Early in the present year an English company was organised to acquire and work an antimony mine near Austin, Nevada. A good body of ore of excellent grade has been exposed in the mine, and regular shipments were commenced soon after the new company took possession of the property, the ore being sent to England for reduction. Last month the company declared its first dividend. The mine is said to be improving, and is now making an output of about 100 tons of ore per month.

PATENTS.

Improvements in or Connected with Reverberatory Furnaces for Puddling or Smelting Iron, and for other Purposes. J. von Langer and L. Cooper, Leeds. Eng. Pat. 17,380, October 30, 1890. 8*d*.

This is a reversible furnace of the Pietzka type and consists of two hearths, which can be rotated on a vertical axis so as to change their position with relation to the flues. The chief features of this invention consist in having the hydraulic apparatus for lifting the hearth placed above instead of below the furnace, in having beneath the hearth-plates a rectangular chamber of sheet iron through which the air passes on its way to the furnace, the chamber being divided by partitions so that the air takes a zigzag course, and in having the line of junction of the furnace shaped so that the surfaces in contact form parts of two parallel and co-axial cones joined by a narrow annular strip.

—H. K. T.

Process for the Manufacture of Metallic Nickel, together with Alloys of Nickel and Iron, Utilisable either direct or for the Manufacture of Nickel Steel or Nickel and Carburised Iron Castings. J. Garnier, Paris, France. Eng. Pat. 17,623, November 3, 1890. 6*d*. (Compare Eng. Pat. 1194 of 1876.)

This process applies chiefly to the ferruginous nickel oxide ores discovered by the patentee in New Caledonia. When these ores are fused in the blast furnace the product contains nearly the whole of the sulphur, arsenic, and phosphorus of the coke and of the fluxes of the bed of fusion, owing to the affinity of nickel for these elements. In order to remove these impurities the crude nickel is smelted in a water-jacketed furnace having a basic lining of magnesia, calcined dolomite, or chrome iron ore. A hot-blast is injected through tuyères arranged in superposed planes, and in order to thoroughly remove arsenic and silicon, the lowest series of tuyères are immersed in the fluid metal, the apparatus being so arranged that the slag and metal run off at the same time into a fore-hearth. The crude nickel containing nickel, iron, and sometimes copper, is charged into the furnace with coke and lime, magnesia or baryta, together with fluorspar or sea-salt, so that the ratio of the bases to the silica and fluorspar, or sea-salt is 3 : 1. The regulus obtained in this way is quite free from non-metallic elements, and is suitable (with or without the addition of iron) for the production of castings which are very slightly oxidisable. The cost of using pure nickel is thus avoided. When nickel steel is required, the regulus is simply added to the crucible, Siemens furnace, or Bessemer converter, as the case may be.

When comparatively pure nickel is required the above regulus is submitted to an energetic oxidising action in a refining furnace or Bessemer converter, whereby the iron and last traces of carbon and silicon are oxidised. Admixed oxides are then removed by the addition of a reducing agent such as manganese, magnesium, aluminium, or zinc. The nickel so obtained is very soft.—H. K. T.

Improvements in Furnaces for Smelting Copper and other Ores. E. Richards, Middlebank, Swansea. Eng. Pat. 17,625, November 3, 1890. 6*d*.

This is a furnace for the smelting of copper ores in one operation, instead of using the usual reverberatory and metal furnaces and metal roaster. It consists of an oblong furnace with tuyères at the top and sides, and resembles in shape a number of square cupola furnaces placed side by side with their partition walls removed. The bottom of the furnace slopes towards one end, and there the rich molten metal collects and is drawn off, whilst the slag, containing some metal, flows over a bridge into a smaller furnace. It is here mixed with more fuel and inferior slag or ore when the rest of the metal separates and is tapped. The slags are sufficiently free from metal to render further purification unnecessary.—H. K. T.

Improvements in the Extraction of Metals from Ore. W. Paterson and E. Starke, Glasgow. Eng. Pat. 18,934, November 22, 1890. 8*d*.

This is a combination of leaching vessels for the systematic extraction of ores by solutions of chlorine, bromine, or iodine. The vessels are arranged in a circle, and their upper ends are connected with a pipe or pipes, taps being placed between each vessel; the lower ends are similarly connected with a circular pipe. The upper end of each vessel can also be put in communication either with a force pump or a vertical tube to convey the liquor to a reservoir. At starting, the vessels are charged with ore and the taps are arranged so that the liquor from the force pump enters the top of one vessel, passes down it, and is led to the bottom of the next, up which it flows, and is then led to the top of the third vessel, and so on to the last vessel which is put in communication with the vertical tube. When the ore in the first vessel is exhausted, the vessel is cut out of the series and is re-charged through manholes

with which it is provided, and is then re-connected with the stream of fluid, but this time it is made the last of the series, and in this way each vessel is in rotation made the first to receive the extracting fluid.—H. K. T.

Improvements in the Manufacture of Steel. H. C. S. Dyer, Westhope. Eng. Pat. 20,393, December 13, 1890. 4*d*.

When using the acid or basic process in an open-hearth furnace the metal bath is first charged with carbon to a high degree. This is effected by charging in coal, coke, graphite, or charcoal, but preferably the latter, and then scrap or pig iron on top of it. As the metal melts it takes up the carbon, the process being then carried on as usual. In the basic process a good deal of the carbon is eliminated along with the phosphorus, but sufficient remains to enable the charge to be "boiled down" with ore in a manner similar to the boiling down of a charge of pig in a siliceous-lined furnace. In this way any percentage of carbon may be obtained within certain limits, whereas with the ordinary basic process it is difficult to obtain a percentage higher than 0·15. It is generally believed that phosphorus will not leave iron in the presence of carbon, but the author has found this opinion to be erroneous.

—H. K. T.

Improvements in the Construction of Furnaces for Puddling or Heating, and other Purposes. H. R. Haigh, Derby. Eng. Pat. 20,415, December 15, 1890. 6*d*.

These improvements consist in the supply of hot air to the furnace fire, the air deriving its heat from the walls of the furnace. For this purpose an outer casing of brick or suitable metal is constructed round the sides and crown of the furnace, and air is allowed to enter through convenient openings in this casing, circulate round the furnace one or more times until it becomes highly heated, and pass into the interior of the furnace through openings constructed in the crown of the furnace near the bridge.—S. B. A. A.

New or Improved Manufacture of Articles of Nickel and of Nickel-Plated Goods. L. Mond, Northwich. Eng. Pat. 21,025, December 24, 1890. 6*d*.

Articles of nickel are manufactured by the new process by exposing suitable moulds in the heated state to the action of the vapour or solution of nickel carbon oxide and detaching the deposit of nickel when of sufficient thickness. An adhesive coating of nickel is similarly deposited upon articles by the action of nickel carbon oxide.

The process is conveniently carried out as follows:—A cast-iron cylinder capable of rotating about its axis and fitted internally with a number of longitudinal ribs or projections is partly filled with oxide of nickel, heated to 400° C., and a current of water-gas passed in until the nickel has been reduced. The cylinder and contents are then allowed to cool down to the ordinary temperature and a current of carbon monoxide (prepared by passing carbonic anhydride over coke) is led through the cylinder into an air-tight cast-iron chamber filled with water-gas, on the bottom of which the moulds are disposed and heated from underneath to 200° C.; the gas is then led back into the cylinder, a constant circulation of the gas being kept up by a fan or other device. In its passage through the cylinder the gas takes up nickel, which is subsequently decomposed by the heated goods and wholly or partly deposited on them. On passing through the cylinder the gas is again charged with the nickel compound. After a time the nickel is less readily taken up by the gas, but its activity may be restored by heating the cylinder to 350° C. and then cooling down to the ordinary temperature, the current of carbon monoxide being maintained during the interval. Before their introduction into the chamber the moulds are coated with graphite or other substance to which nickel does not adhere; to obtain coherent deposits, air must be carefully excluded from the chamber, intermediate layers of oxide being otherwise formed. Iron and other goods on which a particularly firm coating of nickel is required are preferably tinned in the first instance, and the nickel deposited upon them at a temperature higher than the melting point of tin, the nickel being thus practically soldered to the article. The temperature must not, however, exceed 300° C., or the deposit becomes pulverulent. It is advantageous to heat these goods in a current of hydrogen to about 400° before removing them from the chamber, as the nickel is rendered very ductile by this treatment.

Nickel may also be deposited upon articles by immersing them in liquid nickel carbon oxide or in a petroleum or benzene solution, or by sprinkling the latter on them. The deposit forms at a lower temperature (60°—70° C.), but is less white in colour than that obtained from the gas. Gases containing less than 5 per cent. of the nickel compound give a more uniform deposit than when more heavily charged.

—S. B. A. A.

Utilisation of Refuse or Scoria of Copper-Smelting Furnaces as a Grinding or Polishing Agent, or as a Substitute for Emery. E. A. Bath, Sketty. Eng. Pat. 21,234, December 30, 1890. 4*d*.

The refuse or scoria of copper furnaces is sorted and the pieces ground in any suitable manner, this operation being followed by elutriation if necessary. The polishing powder so obtained may be used as such, or it may be mixed with glue dissolved in methylated spirit and acid, or with any other cement, and cast into blocks or wheels, or the polishing powder may be fixed to paper or linen by means of glue, &c.

—H. K. T.

Improved Fusible Mass for Case-hardening Purposes. T. Langer, Nimburg, Austria. Eng. Pat. 210, January 5, 1891. 6*d*.

The addition of borax to known case-hardening mixtures is particularly claimed, and the following proportions are given as the most advantageous:—

I.

	Parts.
Common salt	71·4
Yellow prussiate of potash	23·8
Borax	4·8

II.

	Parts.
Common salt	66·15
Yellow prussiate of potash	22·15
Carbonised horn dust	7·35
Borax	4·45

III.

Common salt	About 10 parts by weight.
Yellow prussiate of potash	About 3 parts by weight.
Borax	About 2 parts by weight.
Sugar	About 0·2 parts by weight.

The borax (which may be replaced by some borate or silicate, as for instance powdered glass) assists the carburisation of the iron by keeping the surface free from oxide and preventing the access of air. Mixture II. produces a steel coating of a rather coarser grain than No. I., but is cheaper. No. III. gives a much tougher coating than the others; it yields a steel coating $\frac{1}{2}$ to 1 mm. thick in about two hours in an ordinary forge. The thickness of the coating may be increased by adding about one-seventh of the original quantity of the mixture employed every half-hour. The objects to be hardened should be heated to a blue heat in a charcoal fire before being immersed in the case, and the mixture should also be previously heated to the point of fusion.—S. B. A. A.

Improvements in the Manufacture of Aluminium. E. Meyer, Berlin, Germany. Eng. Pat. 1785, January 31, 1891. 4*d*.

According to the inventor, metallic aluminium is produced when a mixture of an aluminate of an alkali or alkaline earth with carbon is smelted in a reducing flame, the following reactions being alleged to occur:—

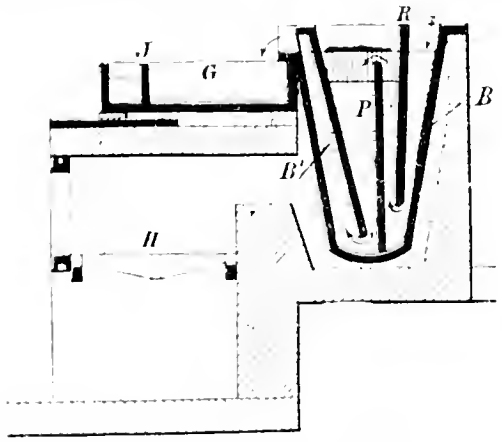
(1) $Al(NaO)_3 + 2C = AlO + 3Na + 2CO$

(2) $AlO + C = Al + CO$

—S. B. A. A.

An Improved Process and Apparatus for Desilverising Lead. E. Edwards, London. From E. Honold, Stollberg, Germany. Eng. Pat. 2049, February 4, 1891. 8*d*.

This is an apparatus in which lead is desilverised by treatment with zinc. The most important part of the apparatus is shown in the Figure. The lead to be treated is delivered into B, passes under the partition B, and then



An Improved Apparatus for Desilverising Lead.

over the top of P, and in so doing passes through a quantity of molten zinc represented by the vertical lines. It then passes through the channel B' into the trough G, which is protected from the furnace H. Here the lead becomes cooled, and the zinc which it contains separates and solidifies on the top; the still molten lead passes round the end of the partition J, and is led to a second apparatus, where it undergoes a treatment similar to the above. It is finally received into a pan and treated with steam, which passing through the hot lead oxidises the remainder of the zinc, antimony, and other impurities, which are removed. The silver is separated from the zinc in the usual way.—H. K. T.

An Improved Method or Process for the Production of Refined Copper. C. James, Swansea. Eng. Pat. 11,337, July 3, 1891. 6*d*

According to this invention the operation of treating the rich regulus (white metal) in a "roaster furnace" for pimple or blister copper previous to refining is replaced by a calcination so conducted that quantities of sulphur and oxygen are left in the calcined charge in the proportions necessary for the formation of sulphurous anhydride. The matte is crushed through a ¼ sieve, or smaller, if convenient, calcined in the way proposed in any ordinary calciner, and then taken directly to the refining furnace. Mattes poor in copper may after calcination be made into bricks with clay, &c., and run down in a cupola, the resulting metal being either cast into ingots, &c., or further refined.

Poor refractory precipitates may be advantageously treated by mixing with a corresponding portion of raw matte, calcining the mixture until sulphur and oxygen are present in the requisite proportions, and refining the product. The reaction of the sulphur and oxygen in the charge when melted in the refinery furnace eliminates nearly all the impurities (especially the volatile ones, arsenic, antimony, bismuth, &c.) usually found in poor precipitates. The non-volatile impurities are got rid of by arranging that the oxide of copper shall predominate in the calcined charge. The inventor claims that by the above process "more copper is at once obtained in a saleable form at less than a third of the usual cost, that the expense of re-working the roaster slag is dispensed with, and that the locking up of large amounts of capital in roaster furnaces and bottoms is entirely avoided."—S. B. A. A.

Improvements in Ore-Sampling Machines. H. Le Roy, Bridgman, Blue Island, U.S.A. Eng. Pat. 13,198, August 4, 1891. 8*d*.

See under I., *page* 990.

An Improved Method of Treating Plumbiferous Copper "Mattes" and Ores. C. James, Swansea. Eng. Pat. 13,739, August 14, 1891. 4*d*.

Plumbiferous copper mattes containing 15 per cent. of lead and upwards are now generally treated by melting them in a specially constructed reverberatory furnace, and treating with metallic iron, by which means about one half of the lead is reduced to the metallic state. The resulting copper regulus still contains from 8 to 12 per cent. of lead, which is entirely lost, as is also the whole of the lead in mattes originally containing less than 15 per cent. of that metal, these products not being capable of economic treatment by the above process, and requiring to be gradually mixed in small quantities with other material, and smelted in the ordinary way.

The inventor proposes the following process for the recovery of the whole of the lead and the separation of the copper in a pure form: The matte is crushed and partially calcined, preferably in a revolving calciner, the object being to convert the whole of the lead and iron into oxides, and to leave sulphur enough to combine with the whole of the copper. The partially calcined matte is then mixed with silica, a siliceous ore, or a highly siliceous slag, &c., and melted when the copper combines with the sulphur, and forms a rich regulus (white metal) almost free from lead, and containing nearly all the gold and silver (if those metals were originally present), whilst the slag consists of a double silicate of iron and lead, from which the latter metal may be extracted by the usual methods.

The proportion of silica to be added will entirely depend upon the percentage of lead and iron in the matte, the object being to form a double silicate.—S. B. A. A.

XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

Electrolytic Determination of Metals as Amalgams. G. Vortmann. Ber. 1891, **24**, 2749—2765.

See under XXIII., *page* 1036.

PATENTS.

Improvements in Galvanic Dry Elements. C. Smith, London. Eng. Pat. 1306, January 24, 1890. Amended July 15, 1891. 6*d*.

A zinc pot as positive electrode contains a tubular carbon with the depolarising substance held on its outer surface by a canvas wrapping. The space between the zinc and

the wrapped-up carbon is filled with the electrolyte containing a small amount of a slimy substance, such as tragacanth slime, mixed with plaster of Paris. The interior of the tubular carbon is filled with some absorbent material, such as slag wool impregnated with a saline solution. The top of the tubular carbon is closed by a carbon plug with a terminal attached. The outer vessel is closed first with plaster of Paris, and over all with pitch. Any gases generated have to travel a short distance through plaster of Paris to holes near the top of the zinc pot, where they escape into a casing containing the whole cell. The space between the casing and the zinc is filled with sawdust or other absorbent material.

The amendation seems to consist in the deletion of a contradictory sentence in the text.—E. T.

An Improved Artificial Asphalte. H. P. and E. G. Williams, London. Eng. Pat. 13,595, August 29, 1890. 4*d*.

See under IX., *page* 1008.

Improvements in the Manufacture of Electrical Insulating Materials. J. R. Thame, London. Eng. Pat. 16,747, October 21, 1890. 4*d*.

The improved insulating material is made from pure or nearly pure cellulose, with which are incorporated gums, drying oils, or resins. When the material is intended to replace slate, it is made by mixing together slate dust, drying oils, or resins and silicate of potash, the mass being slowly dried and heated to redness.—E. J. B.

An Improvement in Mercury Vacuum Pumps. E. C. C. Baly, London. Eng. Pat. 20,309, December 12, 1890. 6*d*.

See under XXIII., *page* 1032.

XII.—FATS, OILS, AND SOAP MANUFACTURE.

On a Nitrogenous Substance in Train Oil. W. Fahrion. Zeits. f. angew. Chem. 1891, 446—448. (See also this Journal, 1891, 557.)

Jahoda (Zeits. f. angew. Chem. 1891, 325) finds a nitrogenous substance, insoluble in petroleum ether, to be contained in train oil and in *dègras;* the same is likewise insoluble in ether. The author still upholds that this substance is an impurity, for he himself has been able to recognise the presence of a nitrogenous body, but only in dark-coloured masses, which were found at the bottom of a vessel containing train oil several years old. He considers that such "impurity" has its origin in the skin of the fish.

At the same time, it is to be remembered that Gautier and Mourgues have found various nitrogenous substances, chiefly amines, in blubber (Compt. Rend. **107**, 110, 254, 626 and 743).—T. L. B.

Glycerin. J. Schenkel. Zeits. f. angew. Chem. 1891, 505—508.

The author points out that, although glycerin is used in many industries, by far the largest quantity of it is consumed in the production of nitroglycerin. The following figures show the rapid increase in the manufacture of dynamite. There was produced in—

1868 about 220 cwt. of dynamite.
1870 about 8,500 cwt. of dynamite.
1873 about 41,000 cwt. of dynamite.
1874 about 62,000 cwt. of dynamite.
1876 about 100,000 cwt. of dynamite.

and for 1886 the quantity is estimated to have been at least 10,000 tons. The large consumption of glycerin in this industry encouraged the adoption of processes for its recovery in the soap and candle manufacture, and the waste liquors are now everywhere worked up for the glycerin contained in them. Two general methods are in use: 1. The splitting up of the fats at a high temperature and pressure, whereby fatty acids and glycerin are produced; and 2. The saponification of fats by alkalis for the production of soap from the lyes, of which the glycerin is recovered by evaporation. The crude glycerin obtained by these methods requires to be distilled in order to purify it sufficiently for most of its uses. According to French journals a good and practical process has been invented enabling soap-makers to recover the whole of the glycerin in a nearly pure condition in a cheap and simple apparatus, but at present the method is kept secret. The author mentions a universal complaint by the glycerin producers against the unreasoning stringency of the German official test for the purity of glycerin for pharmaceutical purposes, which requires that 1 cc. of glycerin heated to boiling with 1 cc. of ammonia solution and three drops of silver nitrate solution must give neither colour or precipitate within five minutes. The author states that it has not been possible to prepare glycerin capable of passing the prescribed tests, and the matter is being officially investigated by the German Office of Health in the interests of all concerned. The following table shows the relative production of glycerin in the countries of the world:—

	From the Stearin Manufacture.	From the Soap Manufacture.
	Tons.	Tons.
France	6,000	3,500
Germany	3,000	2,000
United States	3,000	3,000
Netherlands	2,000	.. ..
Austria	2,000	.. ..
Russia	2,000	.. ..
Belgium	1,800	.. ..
Italy	1,800	.. ..
England	1,200	5,500
Spain	1,500	.. ..
Sweden and Norway	350	.. ..
Switzerland	300	.. ..
Argentine	300	.. ..
Australia	300	.. ..
Portugal	200	.. ..
Roumania	150	.. ..
Greece	100	.. ..

The principal commercial centre for glycerin is Paris. The price of glycerin has been subject to great fluctuations and varied between 35 fr. and 205 fr. for 100 kilos. crude

glycerin from 1861 to the present time, at which the price fluctuates between 50 and 100 fr. The want of steadiness in the value of glycerin is a source of great difficulty to the refiner.—W. M.

The Determination of Unsaponifiable Matter in Fats. M. Honig and G. Spitz. Zeits. f. angew. Chem. 1891, 565—568.

See under XXIII., *page* 1039.

The Valuation of Lubricating Materials with Special Reference to Petroff's Process. A. Künkler. Dingl. Polyt. J. 1891, **281**, 297—300.

In the author's opinion the various criteria, and the apparatus described by Lew (Dingl. Polyt. J. **280**, 16 and 40; this Journal, 1891, 777), which form Petroff's method for examining lubricating materials, are to a large extent valueless, owing to a mistaken idea as to the true part played by a theoretically perfect lubricator. Of all properties necessary for efficient lubrication, by far the most important is that the oil or grease should possess sufficient capillarity or adhesion (Schlupfrigkeit), while considered from the purely theoretical standpoint the lower the viscosity or cohesion, the smaller the internal friction and therefore better the material. The external friction is partly a factor of this latter, being smaller when the viscosity is high, but at the same time it is dependent on the adhesion varying with it; its amount, however, is a matter of little consequence.

Considering the matter from the economical point of view, it is evident that what is required is that the lubricating material possess sufficient adhesion to prevent contact of the metallic surfaces, and also that the viscosity be as high as possible without increasing too much the internal friction, so that the amount consumed may be as small as possible; and yet the power required for driving not increased. Hence it may be seen that under different circumstances different oils are preferable, so that whilst rape oil is absolutely a better lubricating material than a Russian mineral oil of sp. gr. 0·908—10 whose viscosity at 40° C. is double the former, yet at a low speed with a moderate load and a high temperature the latter is more economical in use; but if the load be increased sufficiently, a point will be reached when the adhesion of the mineral oil is overcome, so that it is rendered useless, while the rape oil will still continue to act efficiently.

The adhesion of the lubricating material being the most important factor to be considered, and the various machines in use for testing oils, indicating only the viscosity, these become of little or no value; they help one to choose between two oils of the same class, but even then their indications are uncertain, Petroff's apparatus being no better than the simpler forms. The choice of a lubricator must therefore be left to experience, from which we know that the majority of vegetable and animal oils employed possess far more adhesion than mineral oils, and that these latter when of the same colour, *i.e.*, the same degree of purification, are the more adhesive the more viscid they are. It is this latter fact that has given rise to the viscosimeters, and hence it is evident that they must be strictly kept for the testing of mineral oils. While in the case of these oils the internal friction increases with the adhesion and the viscosity, they cannot be compared as lubricating materials with rape oil by means of this factor, as is done in Petroff's method, with the idea that they are the more suitable for lubrication, the closer they resemble the curve of the internal friction of rape oil, as exactly the reverse is the case, for the greater the internal friction of a mineral oil, the more its curve differs from that of rape oil, and yet the more alike are their lubricating properties.—F. H. L.

Analysis of Russian Waxes. J. Antoushevich. J. Russ. Chem. Soc. 1891, **23**, 223—235.

The author has had opportunity to study a great variety of pure waxes brought from all parts of Russia and Siberia. The results obtained by him are as follows:—

The pure wax is entirely soluble in chloroform, turpentine, carbon bisulphide, and only partially soluble in alcohol, ether, petroleum ether, and benzene. The specific gravity of yellow wax is 0·956—0·964, and that of white 0·969. The melting point of yellow wax, 60°—65°; of white, 65°—70°, but the purity of the wax cannot be deduced from this property.

Since the specimens of wax were undoubtedly quite pure, the author has undertaken to analyse them in order to decide whether Russian wax is identical with the Austrian product.

This method proposed by Becker (Dingl. Polyt. J. **234**, 79; ibid. **249**, 383; this Journal, 1883, 418), consists in neutralising the acid of the wax with alcoholic solution of caustic potash, in order to determine the acidity of the wax in mgrms. of the caustic potash used per 1 grm. of wax; and further, it consists in boiling the melted wax with six times its weight of caustic potash for one hour, in order to determine in mgrms. of caustic potash used the amount of ether contained in 1 grm. of wax. Having obtained both these figures the saponification value can be determined, and also the ratio of the acid to the ether in the wax. Whilst using this method the author has found that it is absolutely necessary to boil the wax with water previous to analysing it, in order to get rid of the glucose of honey always present.

Besides, it has been found that one hour's boiling of wax with caustic potash, as suggested by Gueble, is far from being sufficient to complete the saponification of the ether; at least two boilings of two hours' duration each with fresh caustic potash are necessary. Under these conditions of analysis the Russian and Austrian waxes are found to be identical.

——	Pure Russian Waxes.	Pure Austrian Waxes by Gueble.
Acidity	19—21	19—21
Ether value.....	70—77	73—76
Saponification value.	92°—97°	92°—97°
Ratio	1 : 3·6 —1 : 3·8	1 : 3·6—1 : 3·8

The ratio higher than 3·8 indicates admixture of tallow or Japanese or Carnauba wax. The ratio below 3·6 indicates the presence of stearic acid or tar. The point of saponification below 92° (the ratio being regular) indicates the presence of paraffin or ceresin.—N. W. T.

PATENTS.

Improvements in the Manufacture or Production of Lubricating Compounds. R. Irvine, Royston, Granton. Eng. Pat. 3116, July 29, 1880. Second Edition. 6*d*.

Dehydrated soaps are dissolved in hydrocarbon oils. —K. E. M.

An Improved Soap Powder. W. Wright, Droylsden. Eng. Pat. 16,579, October 18, 1890. 4*d*.

The patentee mixes and powders common bar soap with concentrated soda, the latter being pure dry carbonate of soda, not containing free caustic soda.—K. E. M.

A Process for Bleaching Palm-oil and other Vegetable Oils. E. Hermite, E. J. Patterson, and C. F. Cooper, London. Eng. Pat. 17,160, October 27, 1890. 4*d*.

Palm oil and other vegetable oils are bleached by agitating them in a steam-jacketed vessel with "electrolysed

chlorides" such as a mixture of magnesium chloride with sea salt. It is preferable to electrolyse the chlorides before being mixed with the oils. (See also Eng. Pat. 1993 of 1887; this Journal, 1888, 126).—K. E. M.

Improvements in the Treatment of Soapmakers' Waste Lyes for the Recovery of Glycerin and other Substances. J. Taylor, Leith. Eng. Pat. 19,382, November 28, 1890. 4*d*.

Boiling "soapmakers' waste lye" is neutralised with bisulphate of soda (nitre cake). After saturation with either alkali or sulphate of soda, or after adding an excess of bisulphate of soda and neutralising with carbonate of lime, the liquor is allowed to cool in order to separate out the soda salts. The mother-liquor is treated in the usual way for recovering the glycerin and sodium chloride.
—K. E. M.

A Washing Jelly. A. R. Waddell, Airdrie. Eng. Pat. 19,830, December 5, 1890. 4*d*.

To $\frac{1}{4}$ lb. of soap, preferably soda soap, dissolved in 1 lb. of boiling water, add 1 oz. of turpentine, and before this mixture has set by cooling, stir in 1 oz. of strong liquid ammonia. The resulting compound, when cold, forms a jelly which may be rendered more homogeneous by repeating and allowing to cool a second time.—K. E. M.

Improvements in the Manufacture and Production of Saponaceous Matter, applicable for Use in or connected with the Dyeing of Textile Fabrics or Materials and for other Purposes. C. E. Maistre and J. M. Campagne, Paris, France. Eng. Pat. 21,062, December 24, 1890. 8*d*.

The specification describes the recovery of unfixed indigo on textile materials by the use of a specially-prepared soap solution in the indigo dyeing-vat. The soap solution may also be used for cleaning and scouring textile materials, skins, &c., as well as for oiling wool. The soap is obtained by mixing solutions of sulphydrate of soda, caustic soda, and carbonate of soda with oleine in suitable proportions.
—K. E. M.

Improvements in Apparatus for Purifying Waste Oil. O. K. Thomassen, Christiania, Norway. Eng. Pat. 14,365, August 25, 1891. 6*d*.

Waste oil such as collects in the drip-cups under bearings is filtered by an apparatus consisting of three cylindrical vessels loosely placed upon one another. The oil passes through a fine then a coarse iron-wire gauze, between which a layer of cotton wool is placed, secured by means of a conical ring. After filtering through two more sieves of similar construction but made of flannel or other suitable material and placed vertically, the oil is conducted by means of wicks through a number of pipes passing through the bottom of the second vessel to the lowest one. A drawing of the apparatus accompanies the specification.
—K. E. M.

XIII.—PAINTS, PIGMENTS, VARNISHES, RESINS, INDIA-RUBBER, Etc.

Antimony Pentasulphide. T. Wilm. Zeits. Anal. Chem. 1891, **30**, 428—446.

See under XXIII., *page* 1035.

The Examination of Linseed-Oil Varnish. W. Fahrion. Zeits. f. angew. Chem. 1891, 540.

This process for examining the degree of boiling, to which the linseed oil has been subjected, depends on the fact that the unsaturated fatty acids yield on oxidation oxy-fatty acids which are insoluble in petroleum ether, while the unoxidised acids as well as the products of the oxidation of the saturated fatty acids are soluble. It is in all probability the linolenic and iso-linolenic acids (Hazura, Zeits. f. angew. Chem. 1888, 315; this Journal, 1888, 506 and 681) which are first attacked on boiling, and seeing that these substances make up 80 per cent. of the total unsaturated fatty acids present in linseed oil, the oxy-fatty acids contained in the varnish must consist in great measure of their derivatives.

In a porcelain basin of a capacity of about 150 cc., 3—5 grms. of the varnish are saponified with 15—25 cc. of 8 per cent. alcoholic soda with continual stirring. When the alcohol has been driven off, the soap is dissolved in 50—70 cc. of hot water and washed into a separating funnel of 500 cc. capacity. Dilute hydrochloric acid is then added, and after cooling 100 cc. of petroleum ether (distilling below 80°), after thorough shaking, the whole is left at rest for an hour till the petroleum has become clear. The aqueous liquid is run off, when the oxy-acids will be found sticking to the walls of the funnel, so that the petroleum can be poured away without filtering. After washing two or three times, the acids are dissolved in a small quantity of warm alcohol and the solution evaporated in a tared basin and the residue dried for one hour at 100—105°. In different kinds of varnishes the author has found from 0·6 to 31·6 per cent. of oxy-acids; prepared in large quantities, they form a thick, dark-red oil, completely soluble both in alcohol and ether. The author hopes to continue his researches on these substances.—F. H. L.

Colour-Photometry. Captain Abney. Proc. Chem. Soc. November 19, 1891.

See under XXIII., *page* 1031.

PATENTS.

Improvements in obtaining White Compounds of Lead and Zinc suitable for Making Pigments, and for other Purposes, from Lead and Zinc Ores or from their Products or Residues and in Apparatus therefor. A. French, Morriston. Eng. Pat. 2494, June 8, 1881. (Second Edition.) 8*d*.

The inventor claims "the process for producing white compounds or pigments composed of sulphite of lead and sulphite of zinc, in which process calcined ores or materials containing lead and zinc are partly reduced and partly sublimed in a cupola smelting furnace, air being introduced amongst the volatile matters above the charge as well as at the tuyere, combined with the use of a wet condenser in which the sublimate is collected and simultaneously purified by means of water."

For details of the apparatus the specification must be consulted.—O. H.

Improvements in the Preparation of Rapidly Drying Resinous and other Oils or Varnishes. G. M. Cruikshank, Glasgow. From E. Pietzeker, Hamburg, Germany. Eng. Pat. 12,123, August 2, 1890. 4*d.*

The patentee claims "the preparation of rapidly drying resinous and other oils or varnishes, consisting in dissolving in the oil resin, a dryer, and in treating the oil with one of the following sulphur compounds," sulphite, hyposulphite, and "sulphuret of potash, sodium ammonia, strontium, baryta, calcium."—O. H.

An Improved Material for Use as a Substitute for Gutta-Percha, Rubber, Oiled and other Transparent Tissues, and for other Purposes. T. Christy, London. Eng. Pat. 12,230, August 5, 1890. 6*d.*

This invention consists of further improvements in the manufacture of a material, "Christia," described in Eng. Pat. 13,917 of 1888 (this Journal, 1889, 992). The chief ingredients used are gelatin, glycerin, chromic salts, preferably potassium bichromate, and antiseptics, such as ammonium sulphite.

Methods are described for the production of waterproof and fireproof material, very full details of which are given in the specification.—E. G. C.

Improved Blacking for Leather. J. P. Bayly, London. From J. Baulch, St. Louis, U.S.A. Eng. Pat. 15,564, October 1, 1890. 4*d.*

This waterproof compound consists of two parts by weight of beeswax, four of neat's foot oil, one and a half parts of drop black, two of beef-ball, and one part of molasses.

The combination so produced is stated to be especially suited for harness, &c.—E. G. C.

Improvements in Compounds to be Used in Vulcanizing Rubber and other Substances or Compounds. C. A. Fawsitt, Glasgow. Eng. Pat. 17,197, October 28, 1890. 4*d.*

When iodide or bromide of antimony or the bromide or iodide of certain other metals is intimately mixed with the sulphur to be used for the vulcanising or "curing" process, better results are obtained, and in the case of the waterproofing of woven fabrics, the rubber compound may be made more or less transparent so as not to greatly obscure the colour or texture of the fabric. In some cases it is found advantageous to add a small quantity of aniline or suitable organic base to the other ingredients, and instead of sulphur a sulphide, thiosulphate, thiocarbonate, or organic sulphide may be used.—O. H.

Process for Obtaining a New Material from Bituminous Slate, and its Application as a Filtering Medium and as a Colouring Matter. J. Zeller, Eislingen, Germany. Eng. Pat. 17,218, October 28, 1890. 4*d.*

See under I., *page* 990.

Improvements in the Manufacture of Waterproof Garments, and in Apparatus Employed therein. I. Frankenburg, Salford. Eng. Pat. 18,216, November 12, 1890. 6*d.*

The inventor claims "the use and application of a steam-pipe trough or chest flat on the top supplied with steam or its equivalent heating medium fitted in and level with the surface of a table for the use of operatives engaged in coating and cementing waterproof garments."—O. H.

Process and Apparatus for the Manufacture of Ultramarine. O. Imray, London. From the Firm of "Julius Curtius," Duisberg, Germany. Eng. Pat. 18,527, November 17, 1890. 8*d.*

The patentee describes a retort furnace for the manufacture of ultramarine, containing metal retorts lined with refractory material, and suitably connected with a common cooling and oxidising chamber and absorption vessels. The refractory material consists preferably of so-called "refractory cement," or silicate of alumina, coke, graphite, &c., "cemented together with carbonisable cementitious substances, such as dextrine, syrup, and the like."—O. H.

Improvements in the Preparation of Pigments or Colouring Compounds. W. Grimshaw, Manchester. Eng. Pat. 4334, March 11, 1891. 4*d.*

This invention consists in the admixture of glucose, glycerin, &c., with pigments for the purpose of bringing the colours into a suitable condition for blending easily with water, or thick and semi-pasty substances, such as starch, flour, or gum.—E. G. C.

Improvements in the Manufacture of White Lead. H. H. Lake. From C. W. Dahl, New York, U.S.A. Eng. Pat. 8161, May 12, 1891. 6*d.*

A solution of basic and neutral lead acetates, prepared by exposing metallic lead to the successive action of dilute acetic acid and air, is precipitated as basic carbonate of lead by means of a carbonate of an alkali.

The patentee also claims the use of "dilute acetic acid and hot air," and the use of "hot diluted acetic acid and hot air;" for details the specification must be consulted.

—E. G. C.

Improved Process of Manufacturing Lead Sulphate from Metallic Lead. H. Pennington, Chicago, U.S.A. Eng. Pat. 8510, May 19, 1891. 8*d.*

This inventor claims, by the modifications introduced by him into the method of treatment of the lead with acetic acid and air, and afterwards with sulphuric acid, to produce an amorphous, dense, and superior form of lead pigment. The lead is kept in a loose condition "by suspending it between downwardly converging supports during the acetation and aeration," in a "frusto-conical or tapering polyhedral" vat or "corroder;" and in the sulphating tank the solution is subjected to the action of a mechanical agitator.—E. G. C.

Improvements in Cleaning Kauri Gum. J. C. Firth, Auckland, New Zealand. Eng. Pat. 9115, May 29, 1891. 4*d.*

The pieces of Kauri gum are subjected to a "revolving, rotating, or reciprocating action in a cylinder, into which is introduced granulated scoria, pumice, silver sand, and a variety of other cleaning materials."—E. G. C.

A Method of and Apparatus for the Purifying of Gutta-Percha. R. Haddan, London. Eng. Pat. 9231, June 1, 1891. 6*d.*

The crude or raw gutta-percha is treated with bisulphide of carbon in a suitable agitating vessel. The solution is run off from the foreign insoluble matters, such as earthy matter, sand, &c., into depositing vessels, where the heavier solution of oxidised gutta-percha separates below the lighter solution of unoxidised gutta-percha. The latter solution is then removed, and the carbon bisulphide distilled off, leaving a residue of "pure gutta-percha containing however still some resinous matter."

Carbonic oxide is passed into the vessel containing the solution of oxidised gutta percha to reduce the latter, which,

after evaporation of the solvent, is mixed with the residue of pure gutta-percha, and the mixture treated with "benzine, or essence of thérébentine, or any other essential oil which dissolves resin." The solutions are treated as described above, and evaporated for the recovery of the solvents. Instead of mixing the deoxidised product with the pure gutta-percha, it may be treated separately for the removal of the resin and to form a product of secondary quality.—O. H.

Improved Manufacture of Hard Natural Resins as Substitutes for Natural Resins, such as Copal, Amber, and the like. H. Beck, London. From E. Schaal, Fuerbach, Germany. Eng. Pat. 9747, June 9, 1891. 4*d*.

Crude or purified resin acids are combined with "equivalent proportions of mixtures of alcohols (especially glycerol, phenols, sugar), and metallic oxides."—E. G. C.

An Improvement in the Manufacture of India-Rubber. A. J. Rath, Hyde. Eng. Pat. 10,524, June 20, 1891. 4*d*.

Greater toughness, strength, and durability are imparted to the india-rubber by the admixture with it, while in the state known as "dough," of a small proportion of fibres of waste silk.

The product thus obtained is said to be particularly adapted for protecting "pneumatic" cycle tyres, "noiseless tyres," &c. of vehicles.—E. G. C.

Improved Process of Devulcanising Vulcanised India-rubber, Gutta-Percha, and similar Gums, and Reclaiming the Rubber therefrom for Re-manufacture without the Addition of Pure Rubber. A. F. B. Gomess, London. Eng. Pat. 10,528, June 20, 1891. 4*d*.

The rubber is first boiled with an alkaline carbonate, sulphite, or hydrate. It is then washed and treated with dilute sulphuric acid and cast iron scrap. After being allowed to remain for a time in a dark place, the rubber is removed, treated with a solution of caustic alkali, washed again, and the last-described operation repeated till the sulphur has been removed.—E. G. C.

Improvements in Anti-Fouling and Anti-Corrosive Compounds for Ships' Bottoms and other Purposes. M. E. Dejouge, Stapleton, U.S.A. Eng. Pat. 13,513, August 11, 1891. 4*d*.

The composition employed consists of fine zinc dust (6 parts) and paraffin wax (1 part). The paraffin wax is simply used as a binder; the mixture is applied hot and scrubbed in.
—O. H.

Composition of Matter for Waterproofing Pulp and other Fibrous Articles. J. C. Chapman, London. From the "United Indurated Fibre Company," Portland, U.S.A. Eng. Pat. 14,272, August 24, 1891. 4*d*.

The high cost of waterproofing, when linseed oil alone is used for this purpose, and the objectionably brittle character of a mixture consisting of linseed oil and resin are obviated by the substitution of a compound containing linseed oil, resin, and cotton-seed oil. The latter softens the resin and frees it from brittleness. In order to facilitate the operation of mixing the resin may be dissolved in naphtha. The entire mixture is heated to about 150° F., when the ware, after being soaked in it, is allowed to stand in the air in order to volatilise most of the naphtha and then baked at a temperature of 250° F., until the mixture is oxidised throughout.—K. E. M.

XIV.—TANNING, LEATHER, GLUE, AND SIZE.

PATENT.

A New or Improved Method and Apparatus for Shrinking Leather by means of Fat. J. de Hesselle, Duesseldorff, Germany. Eng. Pat. 15,661, September 15, 1891. 6*d*.

This invention relates to an apparatus in which leather may be "shrunk" with fat, without the danger of over-heating which accompanies the methods hitherto employed.

Two concentric metal cylinders, capable of revolving on axial trunnions, are constructed of such relative diameter that an annular space between them may serve for the circulation of the heating liquid, such circulation being ensured by a rib wound helically round the outside of the inner or stuffing chamber. The outer cylinder is covered, and the inner cylinder lined, with wood. The circulating heating liquid is introduced by pipes through one of the trunnions. The other trunnion is hollow, is in direct communication with the stuffing chamber, and contains a thermometer, whose indication must be carefully watched through a glass window in the wall of the trunnion. The leather and fat are introduced into the inner chamber through a man-hole and revolution is maintained throughout the process.—A. G. B.

XV.—MANURES, Etc.

Absorption of Ammoniacal Nitrogen by certain Plants. A. B. Griffiths. Chem. News, 1891, **64**, 147.

In the author's experiments, bean seedlings, previously immersed 30 minutes in a solution of copper sulphate to destroy all nitrifying organisms, and washed in sterilised distilled water, were supported on pieces of cork in sterilised glass vessels containing sterilised solution composed of:—

Distilled water	1,000 cc.
Potassium chloride	1·00 grm.
Ferrous carbonate	0·03 „
Sodium chloride	0·50 „
Calcium sulphate	0·50 „
Magnesium sulphate	0·50 „
Tricalcium phosphate	0·50 „
Ammonium sulphate	0·50 „

Each glass vessel being placed under a sterilised bell-jar closed below by a glass plate and above by a sterilised cotton wool plug. Under these circumstances, with only ammoniacal nitrogen supplied and nitrification impossible, the beans grew well for four weeks, without developing any nodules indicative of absorption of atmospheric nitrogen. At the end of the experiments the solutions were free from nitric nitrogen, but the ammonium sulphate was reduced from 0·050 to 0·027 per cent. These results indicate that nitrogen was absorbed as ammoniacal nitrogen by the roots of the plants.—D. A. L.

Ammonium Phosphate as a Manure. J. H. Vogel. Zeits. f. angew. Chem. 1891, 568–573.

The investigation arose out of an attempt to ascertain whether the use of the two most valuable ingredients in artificial manures, namely, nitrogen and phosphoric acid, combined in the form of ammonium phosphate, was commercially practicable. In the course of this work experiments were made to compare the manurial effect of ammonium phosphate with that of an equivalent mixture of sulphate of ammonia and superphosphate; as much gypsum as was present in the superphosphate used, was added to

the ammonium phosphate to make the result strictly comparable, a precaution the more necessary inasmuch as the soil experimented with was poor in lime. Contrary to expectation the effect of the ammonium phosphate was found to be less favourable than that of the superphosphate mixture, the inferiority being increased rather than diminished by the addition of gypsum. Under these circumstances it was decided to examine the action of calcium sulphate upon ammonium phosphate in order to throw light upon the results observed. The method adopted was as follows: Ammonium phosphate and calcium sulphate were digested with water in a litre flask, filtered, and the salts present in the filtrate determined. They might comprise ammonia, phosphoric acid, sulphuric acid and lime; the same bodies might be present in the residue with the exception of ammonia. Starting on this assumption the author has made a large number of analytical observations on the composition of the filtrate and the insoluble residue, and has obtained results that lead him to consider that the decomposition occurs in the manner represented by the following equations:—

I.

$$2\,NH_4H_2PO_4 + CaSO_4 = (NH_4)_2SO_4 + Ca(H_2PO_4)_2$$

II.

$$(NH_4)_2HPO_4 + CaSO_4 = (NH_4)_2SO_4 + CaHPO_4$$

from which it is plain that calcium sulphate at the ordinary temperature, and in contact with water, acts upon ammonium dihydrogen phosphate with the production of the corresponding calcium salt, and similarly when diammonium hydrogen phosphate is used calcium monohydrogen phosphate is formed. The like is true with neutral ammonium phosphate. The practical deduction from these results is that only ammonium dihydrogen phosphate should be used as a manure when gypsum has to be added to the soil, as is commonly the case. The possible proportion which ammonium can advantageously bear to phosphoric acid is therefore comparatively low.—B. B.

The Phosphates of Algeria and Tunis. Eng. and Mining J. October 31, 1891, and Bull. de la Soc. Geol. de France, I. 1891.

It is significant of the interest now being taken in the deposits of phosphates of lime, that the greater part of the *Bulletin de la Société Géologique de France* for the first half of this year should be given to a description of the phosphates of Algeria and Tunis by M. Philippe Thomas, and that at the same time in the quarterly Journal of the Geological Society of England should be a paper on the phosphatic chalk at Taplow by Mr. A. Strahan, of which a brief synopsis by the present writer was printed in the *Engineering and Mining Journal* of October 31st, 1891.

These deposits recently found in Tunis and Algeria bid fair to rival those of Florida, and though they are both primarily Eocene deposits, they differ considerably in geological conditions; both, however, seem to be derived from the leaching of a phosphatic limestone. The new beds described by M. Thomas resemble very closely the deposits of Ciply in Belgium and Taplow in England, except that they seem far more extensive. They are found on the *hauts plateau* of Tunis, and are distant about 20 kilometres from a seaport. A portion of them has been exhaustively examined by competent engineers. There are other tracts discovered but not yet thoroughly examined.

The phosphate occurs in well-defined strata, overlaid and underlaid by a more or less crystalline limestone, all tilted at an acute angle, so that the outcrop is distinct and readily traced, examined, and worked. This outcrop has been carefully examined and measured for a distance of 30 kilometres, though traced for about 60 kilometres. The beds in which the belts of phosphatic chalk occur have a thickness of from 30 to 50 metres. The richest bed had a mean width of 10 metres, and will average 50 per cent. of phosphate of lime. This, by washing, can readily be increased to 60 per cent. or 65 per cent. tricalcic phosphate, and there is an abundant and constant supply of water. These phosphates contain less than 1 per cent. of iron and alumina and very little silica. The engineers sent by the French Geological Survey estimate that there are at least 10,000,000 *tons of 60 per cent. phosphate in sight*, and it is presumed that, as the strata are tilted, the deposit will continue in depth, but they have only estimated what can be extracted without machinery. A railway is projected to reach these beds. Concessions for mining them have already been secured from the Government by a French syndicate, and it is expected that very shortly active development will begin, and these phosphates placed on the market. Native unskilled labour is abundant and cheap.

MM. Tissot and Mercier, who have also examined these beds, prophesy that Tunis, which in the time of the Romans was known as the granary of the world, but which is now sterile, will regain its old fertility, as it is phosphate which has been lacking.

A great number of fossils were found and determined in the phosphate beds, and there is a large amount (8 per cent.) of organic matter present in composition. The phosphate is of a greyish to yellowish colour, with brownish pebbles, and seems to be physically identical with the deposits at Taplow and Ciply; there is the same matrix of phosphatic chalk, with fish coprolites and broken fragments of bone and teeth, fish scales, &c. The occurrence is also noted of a number of "pebbles" of a phosphatic chalk, covered with a crust of dark-coloured, resinous phosphate which seems identical with some varieties of Florida "pebble."

The discovery is very interesting, and this section will probably provide at no very distant date vast quantities of phosphate, and may prove a formidable rival to South Carolina and Florida.

XVI.—SUGAR, STARCH, GUM, Etc.

On the Chemical Nature of Barley-Gum or "Galactoxylane." C. Lintner and G. Düll. Zeits. f. angew. Chem. 1891, 538—539.

See under XVII., *page* 1019.

PATENTS.

Process for Obtaining a New Material from Bituminous Slate, and its Application as a Filtering Medium and as a Colouring Matter. J. Zeller, Eislingen, Germany. Eng. Pat. 17,218, October 28, 1890. 4*d*.

See under I., *page* 990.

An Improvement in the Manufacture of Invert Sugars. F. W. Tompson, Burton-on-Trent. Eng. Pat. 21,101, December 27, 1890. 4*d*.

In a previous patent (Eng. Pat. 8686 of 1884; this Journal, 1885, 291), the present inventor described a process for inverting cane sugar by yeast. The present invention relates to a means of clarifying the inverted solution. For this purpose precipitated calcium sulphate (such as is produced by neutralising with whiting the sulphuric acid used in the manufacture of glucose), is added to the solution, or calcium sulphate may be precipitated in the solution itself.

The mixture yields a perfectly clear solution, which is concentrated in the usual way.—A. L. S.

Improvements in and relating to the Automatic Discharge of Charcoal Kilns. A. Orkney, Greenock. Eng. Pat. 11,495, July 7, 1891. 6*d*.

The patentee describes kilns for reburning and revivifying charcoal for the clarification of sugar consisting of chambers containing a series of vertical cast-iron pipes or retorts, round which pass the hot gases from the furnace, and which communicate below with vertical iron cooling pipes from which the re-burnt charcoal is finally drawn off by an automatic discharge apparatus and stored in a suitable receiver. This invention consists in arranging beneath the cooling pipes a hopper divided into corresponding compartments from which the charcoal is discharged on to a revolving roller, past escape plates which may be adjusted either individually or collectively.—S. B. A. A.

Improvements in or connected with Filter-Press Cloths, O. D. Droop, Havannah, Cuba. Eng. Pat. 16,581, September 30, 1891. 6*d*.

See under I., *page* 991.

XVII.—BREWING, WINES, SPIRITS, Etc.

On the Chemical Nature of Barley-Gum or "Galactoxylane." C. Lintner and G. Düll. Zeits. f. angew. Chem. 1891, 538—539.

Lintner has already described (this Journal, 1890, 1053) a semi-soluble gum which is found in barley, and which passing through all the brewing operations finally remains in the beer. Owing to the difficulties attending the preparation of the substance, experiments on its crystallisation have been unsuccessful, and it has had to be identified by conversion into osazones. Three grms. of the gum, prepared from malt and purified by two precipitations, were heated with 15 cc. of hydrochloric acid (sp. gr. 1·125) and 200 cc. of water for three hours on the water-bath, neutralised, and, after cooled, treated with yeast. No fermentation taking place, the liquid was decolourised with animal charcoal, concentrated and heated for one hour on the water-bath with about 6 grms. of phenylhydrazine acetate. The resulting osazone, after cooling, was removed by the pump and extracted with 40 per cent. alcohol. The soluble portion after repeated crystallisations gave an osazone melting at 160° and crystallising in long matted yellow needles, yielding on analysis figures agreeing with a pentose compound, the alcoholic solution of which showing no left-handed rotation, it could only be xylosazone The portion insoluble in alcohol gave an osazone melting at 193°—194°, which proved to be galactosazone. No other substances being present, the gum may be called "galactoxylane," having the empirical formula $C_{11}H_{20}O_{10}$, with which the figures obtained on ultimate analysis agree closely.

Lippmann has already described a gum obtained from an exudation from beets, which yields on inversion galactose and arabinose (Ber. 1890, **23**, 3564, this Journal, 1891, 375).—F. H. L.

PATENTS.

Improvements in or relating to Wines and Spirits. H. A. Snelling, London. Eng. Pat. 18,795, November 20, 1890. 4*d*.

Two oz. of either fresh or dried hops are added to one gallon of a strong wine, such as sherry, or half the quantity to a light wine, such as hock, and allowed to remain for from one to four weeks. The wine is then decanted off the hops and is said to be improved in aroma and flavour. Spirits may be treated in the same way, a larger proportion of hops being used. A small proportion of glycerin may be added with advantage in certain cases.—A. L. S.

Improvements relating to the Production of Dry Yeast, Cattle Food, and Spirit from Vegetable Products containing Starch. R. Genge, Halle, Germany; A. and D. Sigmond, Klausenburg, Hungary. Eng. Pat. 20,073, December 9, 1890. 8*d*.

A wort is prepared from starchy substances either by the action of malt or mineral acids. This is filtered and pitched at 20°—24° R. with dry yeast. Air is blown through the wort as it ferments, the air having been previously purified by passing through a strong mineral acid. The fermentation is complete in 8—12 hours, when the yeast is removed by either being allowed to deposit in shallow vessels or by means of centrifugal machines. The fermented liquor is distilled to obtain the alcohol.—A. L. S.

Improvements in the Production of Ferments and of Fermented Alcoholic Liquors. J. Takamine, Chicago, U.S.A. Eng. Pat. 5700, April 2, 1891. 6*d*.

The cereals used to prepare "Moyashi" (either before or after being steamed) are sprinkled with a solution containing 25—35 parts K_2O, 10—30 parts CaO, 10—30 parts MgO, 50—75 parts P_2O_5, 2—10 parts NH_3 or N; the solution is to be made slightly alkaline, and from 1—4 per cent. is used. The ferment spores are then added, and after a little time the "Moyashi" is formed; it consists of a grain or cereal with a green mould. This is dried at a low temperature, and the grain sifted from the green powder, which consists of the ferment spores.

The ferment spores may be preserved by mixing them with some hygroscopic invert substance, such as roasted starch or anhydrous calcium sulphate.

Koji is prepared from any starchy substance by first steaming it, in order to thoroughly gelatinise the starch, allowing this to cool to 30° C., and seeding with $\frac{1}{50000}$ part pure moyashi prepared as above.

The mass is placed in a chamber ranging 20°—40° C. and after 24 hours is spread out in a thin layer, and is allowed to remain thus until the koji ferment develops. This is indicated by the formation of a white mould over the same. It is then ready for use.

The koji acts as a diastatic and alcoholic ferment.

Moto is prepared by mixing 2 parts of koji with 4—5 parts of gelatinised starch; or gelatinised starch and sugars; or malt and gelatinised starch; or malt, gelatinised starch and sugars; or malt; or malt and sugars. The mixture is ground to a soft paste, and kept at 25°—40° C. until it acquires a proper condition of maturity. The fermented liquor will contain 15—20 per cent. alcohol. There are 23 claims in the specification.—A. L. S.

Improvement in the Purification of Yeast. H. Elion, Rotterdam, Holland. Eng. Pat. 12,668, July 25, 1891. 4*d*.

The yeast is mixed with water, well shaken, passed through a sieve, and conducted into a centrifugal machine which separates the yeast from the water. The yeast is obtained in a pasty mass. This treatment is said to render beer yeast suitable for baking purposes.—A. L. S.

A Process and Apparatus for the Production of Sparkling Wines and other Sparkling Beverages. A. Bruns, Halle, Germany. Eng. Pat. 14,276, August 24, 1891. 8*d*.

The wine is placed in a vat which is enclosed in an air tight metal envelope. The wine is seeded with a yeast, which is obtained by adding squashed raisins to a light sugared wine, and keeping the mixture in a warm place until it ferments. A little alum and tannin is added at the same time. Fermentation takes place, and the tannin and alum cause the yeast to settle in a pulverent state. When clear, the wine is bottled by means of an apparatus similar to that used in the manufacture of mineral waters.

—A. L. S.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

(A.)—CHEMISTRY OF FOODS.

The Suitability of Flour for Baking. Zeit. Anal. Chem. 1891, **30**, 509—510.

This property of flour being best investigated by baking a small sample, Kreusler has devised a process for its convenient manipulation. A dough is prepared by mixing 25 grms. of the flour, 12·5 of water, 0·6 of yeast, and 0·3 of common salt. This is introduced into a cylindrical "tin" about 60 mm. in diameter and the same height, the bottom and top of which are closed by smooth tinned plates. The lump of dough, which should fill from ½—⅔ of the tin, is rammed down with a small pestle and dried for two hours at 30°; it is then tied round with wire and introduced into an oil-bath heated to 250° for 20 minutes. The better or worse quality of the flour is judged by the greater or smaller volume of the baked mass, and to this end when cold it is introduced into a cylinder which is filled up to the top with small round glass beads. The beads are then poured off into a graduated measure, and the total contents of the cylinder being known, the volume of the marked sample is found by difference.—F. H. L.

The Calorific Value of the Constituents of Food and of their Derivatives. T. Stohmann and H. Langbein. J. Prakt. Chem. 1891, **44**, 336—399.

The paper contains the results of a large number of experiments on the heat of combustion of food-stuffs, such as elastin, serum-albumen, hæmoglobin, milk casein, yolk of egg, meat, peptone, &c., together with analyses of the bodies experimented with. Stohmann has previously carried out a similar series of experiments, employing his own modification of Frankland's potassium chlorate calorimeter (J. Prakt. Chem. **31**, 273), whilst the determinations detailed in the present paper were carried out with a Berthelot's bomb (this Journal, 1886, 159). The values obtained by the latter method are all about 1·4 per cent. higher than those previously obtained, and the author regards the methods as equally accurate as far as the relative values are concerned. The paper concludes with determinations of the heat of combustion of derivatives of albuminoid substances, such as glycocoll and its homologues, hippuric acid, urea, uric acid, asparagine, creatine, guanine, and caffeine. The results obtained agree well with those previously got by Berthelot and André (Ann. Chem. [6], **22**, 5), except in the case of asparagine, in which case the authors' result is considerably higher. The heat of formation of several of these bodies in relation to that of their corresponding acids or homologues is also dwelt upon.—C. A. K.

Composition of Milk. L. Shishkoff. J. Russ. Chem. Soc. 1891, **23**, 261. Preliminary Communication.

The author has succeeded in obtaining the fat of milk by the action of chloroform or carbon bisulphide in a peculiar active state in which it is capable of forming very easily an emulsion with the weakest solution of alkaline carbonate. This state being very inconstant, the fat loses it very soon. The author is inclined to regard such fat as an allotropic variety.

He further presumes that the close union of fat, albuminous substance, and mineral salts in milk is easily explained if we admit that a sort of dissociation is going on in the milk vesicles; the mineral acids of the salts combining with casein, sugar, and altered fat, act on the glucerol portion of the latter, whilst on the other hand the bases of the salts form separate compounds with albumen, which also act upon fat. This co-existence of acid and basic compounds in milk explains its peculiar reaction.

It is also asserted that the souring of milk is caused, not by the formation of lactic acid from sugar, but by decomposition—under the influence of a ferment—of the compounds thus formed between the phosphoric and hydrochloric acids of salts in process of dissociation with casein and sugar, resulting in coagulation of the casein and formation of more acid compounds, which gradually neutralise the bases. Casein of milk is regarded by the author as merely a specific variety of albumen, and not as a special compound.—N. W. T.

PATENTS.

An Improvement in the Production of Butter and Apparatus therefor. T. T. Watson, Jabalpur, India. Eng. Pat. 15,121, September 24, 1890. 4*d*.

Butter is produced by blowing air through unskimmed milk, preferably at a temperature of 70°—80° F.—K. E. M.

An Improved Cooling or Refrigerating Vessel or Chamber for Use in the Manufacture of Cream, and the Preservation of Cream, Milk, Butter, Fish, and other Perishable Articles. G. W. Homer, Athelhampton Hall, and J. Hazel, Dorchester. Eng. Pat. 16,508, October 17, 1890. 8*d*.

This invention relates to a process of regulating the temperature of milk during the raising of the cream, and for protecting it and other perishable articles "from injury or contamination, dirt, insects, excessive cold, &c." A covered vessel holding the milk or other perishable article is placed in another vessel containing water (or ice); the cover is so constructed as to allow the water to entirely surround the inner vessel, whilst it admits a current of air, the temperature of which may be regulated.—E. S.

A Raw Extract of Meat Preparation. J. H. Niemann, Nagambie, Victoria. Eng. Pat. 17,774, November 5, 1890. 4*d*.

The juice of raw lean beef or other meat is expressed mechanically in the cold, and mixed with pure cane-sugar in the proportion of 1 lb. of juice to 2 lb. of sugar. The mixture is stirred until the sugar is dissolved, and 15 drops of oil of lemon or other essential oil are then added for each pound of sugar used. This preparation can be completely manufactured in a day. It is said to be readily digestible and not subject to putrefactive fermentation. If fermentation should set in, it will be alcoholic in character, and consequently quite harmless.—H. T. P.

Improvements in the Preparation of Diastase for Use in the Manufacture of Bread and Biscuits, and for other Purposes. T. Fletcher, Birmingham. Eng. Pat. 20,803, December 20, 1890. 6*d*.

Low dried (130° F.) malt, or a mixture of low dried malt and green or undried malt, is extracted with water at 120°—135° F., with or without the addition of carbonate of soda in the proportion of 5—15 grms. per gallon of water, or of an equivalent quantity of carbonate of potash or carbonate of ammonia. The infusion thus obtained is evaporated to a solid or semi-liquid at a temperature not exceeding 120°—135° F., preferably under reduced pressure. When evaporated to a specific gravity of 1·35—1·4, such an extract of diastase keeps well.—A. G. B.

Improvements in the Treatment of Cereals for Food and other Purposes, and in Apparatus therefor. A. J. Boult, London. From J. J. Sheppard, Calais, France. Eng. Pat. 6417, April 15, 1891. 8*d*.

The improvements claimed consist in "first cleaning the whole or untreated grain, steeping in or moistening with water, steaming to destroy the germs, and finally grinding and drying." The cleaning is done by any known process;

the steaming is done in a specially constructed cylindrical wire or other cage, revolving in a cylindrical kettle on axles, in one of which is a universal joint, and the other capable of being raised or lowered so that the cage may be inclined, to facilitate removal of the grain; the grinding is done in a specially constructed mill. For details the drawings in the original specification must be consulted.—A. G. B.

Improvements relating to the Preservation of Meat, and to Apparatus therefor. J. Falcimagne, Bordeaux, France. Eng. Pat. 14,521, August 27, 1891. 6*d*.

The meat to be preserved is suspended from bars inside a closed cylindrical chamber, and is smoked by means of burning sulphur candles, lighted at their lower ends, which are suspended underneath a perforated false bottom placed just above the base of the apparatus. The false bottom is covered with wire gauze, on which is spread a layer of sodium carbonate or of lime; the fumes from the burning sulphur during their passage through this layer, form a sulphite, which spreads over the whole of the apparatus, and effectually preserves the meat. Drawings and details of the apparatus are given in the original specification.—H. T. P.

Improved Method of Preserving Eggs and other Articles of Food. V. C. H. Jessen, Copenhagen, Denmark. Eng. Pat. 15,580, September 14, 1891. 4*d*.

A solution of caoutchouc, rubber, or gutta-percha in a suitable solvent, such as naphtha or "benzine," is spread on one face of a tough, thin, and, preferably, transparent paper. Such paper is then wrapped closely round the egg or other article to be preserved, and so bent or twisted that the coated surfaces of the overlapping portions shall come together and adhere firmly, thus forming an air-proof and water-proof envelope for the egg. The egg is not in any way affected by coming in contact with the coating and does not crack when boiled, as is the case with eggs preserved by other methods. If thin and transparent paper be used the egg can be examined by means of a light for the purpose of ascertaining its condition.—A. G. B.

(*B.*)—SANITARY CHEMISTRY.

PATENTS.

Improvements in the Purification of Sewage and other Waste Liquors, and in the Recovery of Ammonia therefrom. W. E. Adeney, Dublin. Eng. Pat. 18,983, November 22, 1890. 4*d*.

The sewage, &c., to be treated is "rendered neutral or but slightly alkaline by means of chalk or some mineral acid, as the case may require," and allowed to settle in a tank. The supernatant liquor is then mixed with 5 grains to the gallon of permanganate or manganate of soda or of potash, and run into a second tank. In 3—4 hours the whole of the manganese will have been deposited in the form of hydrated manganese dioxide, provided the amount of manganate or permanganate added was carefully regulated. Even a slight excess of these reagents renders the precipitation very incomplete. "The effluent may be discharged into a river or other watercourse without fear of after putrefaction being set up." The precipitated oxide is reconverted into manganate or permanganate in the usual way, and during the course of this operation the co-precipitated nitrogenous matters are recovered in the shape of ammonia.—H. T. P.

Improvements in and connected with the Cleansing of Filters and Filtering Material employed in the Filtration or Purification of Impure or Foul Liquids. C. H. Beloe and F. Candy, London. Eng. Pat. 19,220, November 26, 1890. 11*d*.

This patent relates more particularly to filters for purifying large quantities of water, such as are used in water-works. The special features of the invention are as follows:—

1. The sand of any one filter-bed may be readily cleansed by flushing through it from below the combined effluent water from several adjacent filters.

2. The dirt, scum, &c., collecting on the surface of the sand may be readily removed by swilling with large volumes of water supplied from a suitably-placed trough.

3. If it be required to thoroughly wash the sand, it is shovelled into a trough in which a rapid current of water is flowing. The mixture of sand and water is discharged into a box placed in the centre of the filter-bed; and the sand which settles in the box is afterwards replaced on the filter.—H. T. P.

Improvements relating to the Purification of Sewage and the Consumption of Town Refuse, and to the Utilisation of Sewage and Town Refuse for Obtaining Motive Power, and to Apparatus therefor. E. Chrisfield, Milton. Eng. Pat. 11,716, July 9, 1891. 1*s*. 1*d*.

By this invention all kinds of sewage and town refuse are said to be completely utilised: the liquid portion for the production of steam for motive purposes; the solid portion as fuel for evaporating and boiling down the sewage. The apparatus required is somewhat complicated and can only be properly understood by reference to the original specification.—H. T. P.

Method of Purifying Liquids, more particularly Sewage and Waste Water, and Apparatus appertaining thereto. A. Mylius, Berlin, Germany. Eng. Pat. 13,757, August 14, 1891. 6*d*.

Two series of narrow troughs are arranged inside and near the top of a closed vessel. One series is maintained full of the sewage, &c., previously treated with milk of lime, whilst the other series contains dilute sulphuric acid. Cloths of some suitable material (asbestos in the case of the sulphuric acid) dip into each series of troughs, and, hanging over the sides, reach nearly to the bottom of the large containing vessel. The respective liquids gradually syphon over by capillary action through these cloths, and as a vacuum is maintained in the containing vessel, the ammonia contained in the sewage rapidly passes by evaporation to the sulphuric acid, forming ammonium sulphate. In practice, a number of these contrivances are placed in series, being so arranged that almost saturated acid and fresh sewage enter the first apparatus; whilst fresh acid and almost ammonia-free waste enter the last one.—H. T. P.

Method of Sterilising Liquids, particularly Sewage, and Apparatus appertaining thereto. A. Mylius, Berlin, Germany. Eng. Pat. 13,758, August 14, 1891. 6*d*.

The object of this invention is to render innocuous micro-organisms still contained in liquids which have already been subjected to the ordinary purifying processes. The liquid to be treated is pumped into a closed tank, and from thence into a boiler where it is sterilised by heating. The hot water leaving the boiler is passed through "a ribbed pipe system," which is enclosed in the tank before mentioned for the purpose of heating fresh liquid and avoiding waste of heat. The sterilised liquid is finally disposed of in any suitable way.—H. T. P.

(*C.*)—DISINFECTANTS.

PATENTS.

An Improved Composition for Use as a Sanitary Reagent, Bleaching and Laundry Purposes, Coating Walls, and the like, Destroying Insects, and as a Substitute for Whiting. W. Corbould, London. Eng. Pat. 9189, June 1, 1891. 4*d*.

The improved composition consists of a mixture of camphor, whiting, and Jeyes' sanitary powder.—E. G. C.

A New Soluble Quinolene Derivative. A. Lembach and U. Schleicher, Biebrich, and C. J. Wolff, Wiesbaden, Germany. Eng. Pat. 13,693, August 14, 1891. 4*d*.

See under XX., *page* 1027.

XIX.—PAPER, PASTEBOARD, Etc.

PATENTS.

Improvements in the Manufacture of Decorative Material for Walls and other Decorative Purposes, and in the Machinery or Apparatus employed in the said Manufacture, the said Improvements being in part applicable to the Manufacture of Felt papers and Millboard. J. T. Palmer, Carshalton. Eng. Pat. 4227, September 3, 1883. (Second Edition.) *8d.*

The patent describes a method of manufacturing a decorative material for walls, &c., consisting essentially in the conveyance of the paper pulp used on to the wire cloth of a paper-making machine, a blanket or web capable of absorbing a great deal of moisture resting upon the sheet of paper pulp. The blanket travels with the pulp until it reaches the couch rolls, where it leaves it and returns over rollers by which it is squeezed, and the water expressed from it being thus restored to a condition suitable for the absorption of a fresh quantity of water from the next portion of the sheet of paper pulp. The layer of paper material then passes on to a wire cloth, or a blanket, or both, and travels between pressure rollers, by which a pattern or design is impressed upon it, the back being left plain save for the print of the wire cloth upon it, which enables the finished product to adhere readily to surfaces to which it may be applied. The blankets used, including that upon which the sheet travels between the couch rolls and the first pressing rolls, are returned by means of a suitable set of rolls by which the moisture they have absorbed from the paper pulp is expressed. A brush roller scraper or cleaner may be used to free the blanket from adhering portions of pulp, and a tray may be provided to receive the expressed water and allow of its removal through a suitably arranged pipe. The paper material may be waterproofed, parchmentised, or impregnated with any desired substance during its passage through the machine described, or at any other suitable point in its manufacture, by ordinary well-known means. Variations in the details and arrangement of the process are also claimed.—B. B.

Improvements in the Manufacture of Cellulose. E. Misch, Vienna, Austria. Eng. Pat. 16,108, October 15, 1890. *6d.*

The process consists in steaming finely-divided wood, such as wood wool, for about three hours at a temperature of 100°–120° C., whereby the resinous portion of the wood is dissolved, and the acidification of the soda-lye subsequently employed prevented. After steaming, the wood is treated at 150°–160° C. with soda-lye varying in strength from 1·005° to 1·5° sp. gr., the pressure being from 5 to 6 atmospheres. The mass, freed from excess of lye by means of a centrifugal machine, is then treated with chlorine gas. The soda lye may be re-used until it becomes viscous, when it is evaporated and subjected to fractional distillation, whereby valuable neutral hydrocarbons are obtained, the residue being ignited in presence of air, and treated for recovery of caustic soda.—E. J. B.

Improvements in the Manufacture of Electrical Insulating Materials. J. B. Thame, London. Eng. Pat. 16,747, October 24, 1890. *6d.*

See under XI., *page* 1013.

An Improved Method of Locating the Diaphragms of Strainers for Paper Pulp. H. J. Rogers, Watford. Eng. Pat. 19,576, November 28, 1890. *6d.*

The object of this invention is to reduce the number of working parts in a strainer, thereby saving original cost and reducing friction. The arrangement cannot be well understood without the drawings which accompany the specification.—E. J. B.

Improvements in Machines or Appliances used in the Manufacture of Paper. J. W. Bretherick, Darwen. Eng. Pat. 19,545, December 1, 1890. *6d.*

The inventor claims the use of brushes, the object of which is to keep clean the surface of the strainers used in the manufacture of paper.—E. J. B.

Improvements in Artificial Boards and the like. A. J. Boult, London. From M. Hamilton, New York, U.S.A. Eng. Pat. 20,324, December 12, 1890. *4d.*

Any ordinary pulp, such as straw or Manilla, is mixed with silicate of soda, alum, bicarbonate of soda, ammonia, bicarbonate of potash, and starch, and made into rolls of paper. If desirable, a colour may be added. The sheets of paper are coated with glue and then united under pressure to form boards.—E. J. B.

Improvements in the Boiling Process for Producing Cellulose by Means of Sulphurous Acid. C. Kellner, Hallein, Austria. Eng. Pat. 12,970, July 31, 1891. *6d.*

In order to obviate the inconvenience caused by the precipitation of monosulphites in the boiler when solutions of bisulphites are heated with wood as in the ordinary method of preparing wood pulp, the inventor heats the solution of bisulphite in a separate vessel, from which it is run, hot, into the boiling vessel. The monosulphite is thus precipitated outside the boiler; it is afterwards re-dissolved by the sulphurous acid evolved during the boiling operation, thus forming part of a second charge of bisulphite.

—E. J. B.

An Improved Process and Apparatus for Preparing the Wood in the Manufacture of Wood Fibre. C. Kellner, Hallein, Austria. Eng. Pat. 12,971, July 31, 1891. *6d.*

The object of this invention is to remove the knots from wood from which it is intended to prepare pulp. This has hitherto been done by the costly operation of boring. According to the present process the wood, after been cut into small pieces, is passed between two plane, conical, or cylindrical surfaces, one of which revolves and the other is stationary. The revolving disc is furnished with a number of pins or teeth which cause the wood to be further subdivided into small leaflets. The knots which resist the action of the teeth can then be separated by means of a coarse sieve.—E. J. B.

An Improvement in the Treatment of Vegetable Fibre for Pulp Manufacture. J. D. Tompkins, Brainard, U.S.A. Eng. Pat. 14,032, August 19, 1891. *8d.*

The inventor claims the "treatment of fibrous materials for their conversion into pulp by suspending them in a constantly rising current of the treating liquids and subjecting them while thus suspended to the heating, cleansing, and chemical action of the suspending liquid." The effect is produced by causing a flow of liquid upwards through the bottom of the digester.—E. J. B.

Composition of Matter for Waterproofing Pulp and other Fibrous Articles. J. C. Chapman, London. From "The United Indurated Fibre Company," Portland, U.S.A. Eng. Pat. 14,272, August 24, 1891. *4d.*

See under XIII., *page* 1017.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES AND EXTRACTS.

The Sulphonic Derivatives of Camphor. E. Marsh and H. H. Cousins. J. Chem Soc. (Trans.), 1891, 966—978.

THE substitution derivatives of camphor do not at present admit of systematic classification or prediction of the number of possible isomerides.

The sulphonic compounds have been found to rotate the planes of polarised light, a property hitherto observed in very few sulphur compounds and not at all in any sulphonic acid. Camphoric acid retains its optical activity unimpaired by the distillation of its anhydride through a red-hot tube, whereby a considerable part of it is decomposed. The recovered camphoric acid possesses, if anything, a still higher rotation now. Many of the sulphonic compounds are uncrystallisable, and being also non-volatile, are difficult to purify. Some of the salts, however, crystallise well. The α- and β- chloro- and bromocamphors, α- and β- chloro- and bromo-camphor sulphonic acids, the α-chloro-sulphonic chloride, the α-bromo-camphor sulphonic chloride, and certain of the salts of the former were prepared.

The Existence of Hyoscyamine in Lettuce. T. S. Dymond. Proc. Chem. Soc. 1891, 165—166.

LETTUCE has been used in medicine from early times as a sedative, but the active constituent has never been with certainty determined. The author's attention was drawn a few months ago to the mydriatic action of an extract of lettuce used in medicine. It had been prepared from the flowering plant of common lettuce according to the direction of the *British Pharmacopœia*. An examination showed that the mydriatic action was due to an alkaloid. Commercial specimens of the extract of wild lettuce and of the variety of the edible plant known as cos lettuce, obtained from three different sources, together with a specimen of the dried flowering plant of wild lettuce, were all found to contain this alkaloid.

The alkaloid was most easily isolated by mixing the commercial extract with water acidified with acetic acid, adding alcohol till precipitation of nearly all the constituents of the extract occurred, filtering, evaporating the filtrate to a low bulk, filtering again, washing the filtrate with ether till free from fat, then rendering it alkaline and extracting the alkaloid with ether. The impure alkaloid thus obtained was purified by conversion into the oxalate, and the precipitation of this salt by ether from its alcoholic solution. On recovering the alkaloid and crystallising it from chloroform, it was obtained in silky needles having approximately the same melting point and other properties as hyoscyamine, the poisonous mydriatic alkaloid existing in belladonna, henbane, and other plants belonging to the natural order *Solanaceæ*.

The identity of the alkaloid with hyoscyamine was proved.

The amount of hyoscyamine in the extract of common lettuce does not exceed 0·02 per cent., while in the flowering plant itself it cannot be more than 0·001 per cent. It appears that this is the first occasion on which hyoscyamine or any other alkaloid belonging to that mydriatic group has been found in a plant not a member of the natural order *Solanaceæ*, lettuce belonging to the natural order *Compositæ*.

Cryptopine. D. Rainy Brown and W. H. Perkin, jun. Proc. Chem. Soc. 1891, 166—167.

THE authors have commenced an investigation on the rare alkaloid cryptopine, which occurs in small quantity in opium, and which was first isolated by J. and H. Smith (Jahresbericht, 1867, 523), and subsequently analysed by Hesse (Annalen, Suppl. 8, 209).

Analyses of the base and of several of its salts led Hesse to assign to cryptopine the formula $C_{21}H_{23}NO_5$. The authors have prepared and analysed several samples which had been purified by conversion into the oxalate and subsequent recrystallisation from isobutyl alcohol. The results accorded with Hesse's formula, as also those of the oxalate.

The oxalate, after repeated recrystallisation from water, was obtained in the form of beautiful glistening prisms.

On oxidation with potassium permanganate, cryptopine yields among other products a crystalline acid, $C_{10}H_{10}O_6$, melting point 179°—180°, which proves to be metahemipinic acid, $C_6H_2(CH_3O)_2(COOH)_2$ [1 : 2 : 4 : 5], the acid which Goldschmidt obtained from papaverine; this result is interesting in view of the fact that metahemipinic acid, up to the present time, has only been obtained from papaverine.

Cryptopine contains only two methoxy groups, as shown by its behaviour when treated with hydrogen iodide, these two groups being situated in that part of the molecule which is converted into metahemipinic acid on oxidation.

ψ-Tropine. C. Liebermann. Ber. 1891, **24**, 2587.

ψ-TROPINE (Ber. 1891, **24**, 2344) yields tropic acid on oxidation under similar conditions to the formation of the same acid from tropine, and as in the latter reaction some ecgoninic acid is formed simultaneously.—C. A. K.

Adonin: a Glucoside contained in Adonis Amarensis. Y. Tahara. Ber. 1891, **24**, 2579—2582.

CERVELLO has given the name *Adonidin* to the active principle of *Adonis vernalis*, an amorphous glucoside, free from nitrogen, possessing a very bitter taste, and having a physiological action akin to, but more powerful than that of *digitalin*. The author has investigated the nature of the active principle of *Adonis amarensis*, a native in Japan, and which is valued as a decorative plant, and finds it to consist of an amorphous glucoside having the formula $C_{30}H_{40}O_9$. It forms a yellowish gum-like mass which yields a white powder when pulverised and is readily soluble in water and alcohol, almost insoluble in ether. The aqueous solution has a very bitter taste and becomes turbid on warming owing to the separation of the glucoside from the hot solution. This solution is precipitated by tannic acid, picric acid, gold chloride, &c., thus showing the presence of a glucoside. Concentrated nitric, sulphuric, and hydrochloric acids give indigo-blue, black red, and rose red colourations respectively. Mineral acids readily decompose the glucoside in aqueous solution, yielding 32 per cent. of sugar and 38·5 per cent. of a resinous body soluble in ether. The physiological action of the glucoside, for which the name of *Adonin* is proposed, is similar to that of Cervello's *Adonidin* except that it is physiologically very much less active, for which reason the author is of opinion that it may be successfully employed for therapeutic purposes. The yield of Adonin obtained was 1·94 per cent. on the dried roots from which it was extracted by means of 90 per cent. alcohol.—C. A. K.

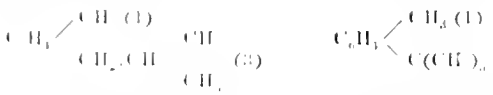
The Hygroscopicity of Camphor and of Thymol. G. Clautrian. Ber. 1891, **24**, 2612—2614.

PHYSIOLOGICAL investigations on the sensitiveness of a ferment led Errara to the conclusion that camphor is decidedly hygroscopic whilst thymol is hardly so at all. The author has confirmed this by exposing Japan camphor and thymol in weighed quantities in a moist atmosphere and ascertaining the increase in weight, the results being checked by dehydrating the products obtained over strong sulphuric acid. Special care was taken during the experiments to avoid loss of material by sublimation. Full details in regard to these precautions are given. 10 grms. of camphor were found to absorb 0·022 grm. and 0·032 grm. of water respectively in two experiments, whilst thymol does not absorb appreciable quantities of moisture. The water absorbed by the camphor is so readily removed that the absorption can only be regarded as physical; camphor saturated with moisture will even part with some to a

second portion of camphor, less rich in moisture. The author remarks that in regarding the hygroscopic qualities of bodies, two quantities must be borne in mind, viz., both the extent and the intensity of the action. For instance, camphor is only slightly hygroscopic in respect to the quantity of moisture it can absorb, but it has nevertheless a great affinity for a certain amount of moisture.—C. A. K.

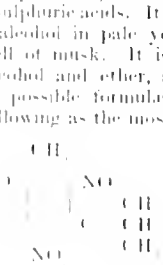
Studies on Artificial Musk. A. Baur. Ber. 1891, **24**, 2832—2843.

The author has previously shown (Ber. 1883, **16**, 2559) the essential resin contains two butyl-toluene nuclei, one a para- and the other a meta-compound. The latter is obtained synthetically by the action of isobutyl-bromide on toluene in presence of aluminium chloride, and forms the starting point for the preparation of artificial musk which is manufactured by the "Société des produits Chimiques de Thann et de Mulhouse" as "*Musc Baur*" (this Journal, 1889, 1004; 1890, 545 and 965; 1891, 655 and 574). The present paper deals with further investigations on this meta-butyl-toluene and its derivatives. The product is obtained synthetically, not only by the action of isobutyl-bromide on toluene in presence of aluminium chloride, but also when tertiary-butyl chloride is employed, the bodies obtained in the two cases being in every respect identical. Hence the hydrocarbon is to be regarded as tertiary butyl-toluene and not as isobutyl-toluene, and in its formation from isobutyl iodide, a molecular rearrangement must take place as is frequently the case in Friedel and Craft's reaction. The following formulæ represent the constitution of iso-butyl and of tertiary-butyl-toluene—



Isobutyl-toluene. Tertiary butyl-toluene.

By the action of fuming nitric acid butyl toluene yields a mono- and a dinitro compound. The former is a yellow oil, boiling without decomposition, and possessing a peculiar somewhat unpleasant smell that does not resemble that of musk. The latter is a brown oil boiling at 224—225°, and both yield the trinitro-compound on further treatment with nitric acid. This trinitro-compound is the "artificial musk," and is best prepared by treating the hydrocarbon with a mixture of nitric and sulphuric acids. It melts at 96—97° C., and separates from alcohol in pale yellow needles which have an intense smell of musk. It is insoluble in water, readily soluble in alcohol and ether, and slightly volatile with steam. Of the possible formulæ for the body, the author regards the following as the most probable:—



It forms a crystalline compound with naphthalene, melting at 89—90° C., and having the composition—

$$2\,C_6H_2.(NO_2)_3 + C_{10}H_8$$

Aniline also combines with trinitro-butyl toluene to form two crystalline compounds, $3\,C_6H_2.(NO_2)_3 + 2\,C_6H_5.NH_2$ and $C_6H_2(NO_2)_3.CH_3NH_2$, of which the latter is the more soluble. The *Mono-nitro-compound* yields the corresponding *Mono amido-compound* on reduction, $C_6H_2.NH_2$, which is identical with the body already obtained by Effront (Ber. 1884, **17**, 2322) by the action of ortho-toluidine on iso-butyl alcohol. It is a colourless oil which turns brown in the air and boils at 245° C. *Mono-amido-dinitro butyl benzene*, $C_6H_2(NO_2)_2NH_2$, is formed by the reduction of the trinitro compound by means of ammonium sulphide. This product separates from alcohol in yellow brown needles which melt at 125—126°. It is insoluble in water and forms a crystalline hydrochloride.

Homologues of artificial musk result by replacing the toluene by its homologues and nitrating the resulting hydrocarbons. In this way the trinitro compounds of butyl-meta-xylene and of butyl-ethyl benzene have been prepared. They both possess a smell of musk, but as substitutes for the natural product are inferior to the trinitro-butyl toluene.

In the preparation of the butyl toluene for making artificial musk a number of hydrocarbons other than tertiary-butyl toluene result from which the latter should be isolated by careful fractionation. Also the butyl bromide employed should be prepared from butyl alcohol that is free from amyl alcohol, otherwise amyl-toluenes result which when converted into their trinitro compounds deteriorate both the odour and the crystallising power of the "artificial musk." The investigations are being continued.—C. A. K.

Pæonol. W. N. Nagai. Ber. 1891, **15**, 2847—2853.

This substance occurs in the root of the bark of *Pæonia Montan.* According to the author the best way of obtaining it is as follows:—The finely-powdered bark is exhausted with ether, and after recovering part of this by distillation the concentrated solution is shaken with solution of sodium carbonate which removes some impurities but does not dissolve the pæonol. This may, however, be removed by agitation with sodium hydroxide, from which solution it may then again be separated by the addition of sulphuric acid and agitation with ether. After evaporating the ether an oily substance is left which, however, gradually solidifies to a crystalline mass. The compound may be purified by recrystallisation from alcohol.

Properties.—It crystallises in colourless glittering needles which fuse at 50° C. It volatilises in a current of steam, has an aromatic odour, a burning taste, is sparingly soluble in cold, more so in hot water, and freely soluble in alcohol, ether, benzene, chloroform, and carbon disulphide. Ferric chloride gives a reddish-violet colour, when added to its aqueous or alcoholic solution. Strong sulphuric acid dissolves the substance without change of colour. The compound acts as a weak acid, being dissolved by the caustic alkalis, but not by their carbonates or even by ammonia.

Its formula, according to the author, is $C_9H_{10}O_3$

Derivates.—When fused in a silver dish with four parts of potassium hydroxide and a little water it turns red, finally brown. If the mass is dissolved in water and acidified with sulphuric acid, white crystalline needles are obtained, which after recrystallisation from hot water, prove to be Nencki's and Sieber's resacetophenone (dioxyacetophenone)—

$$C_6H_3.(COCH_3)(OH)(OH)$$

If after this substance has separated, the mother-liquor is shaken out with ether a substance is obtained which after purification with sodium hydroxide and re-extraction with ether proves to be α-resorcylic acid $C_6H_3CO_2H(OH)(OH)$.

Resorcinol, $C_6H_3(OH)(OH)$, is also formed in small quantity.

Action of hydriodic acid. By heating pæonol for five hours in a sealed tube at 150° C., it is quantitatively decomposed into methyl iodide and resacetophenone.

According to the author's views, Pæonol is a methoxylated, hydroxylated acetophenone, or rather a methylated resacetophenone. Although a phenol-ketone, it does not combine with sodium-hydrogen sulphite, and in this respect it behaves like acetophenone.—L. de K.

The Behaviour of Azoimide with Living Organisms. O. Loew. Ber. 1891, **15**, 2947—2953.

Azoimide ($N_3.NH$) seems to have a great future as a probable strong disinfectant, antiseptic, or germ destroyer. This fact the experiments described with various lower vegetable and animal organisms fully proves. The substance is, however, an active poison, and so could not be used to preserve articles of food.—L. de K.

Some of the Constituents of Paracoto Bark. G. Ciamician and P. Silber. Ber. 1891, **24**, 2977—2990.

In a previous communication (this Journal, 1891, 383) on "Hydrocotëine" the authors regarded that body as a derivative of benzo-phenone, of the formula—

$$C_6H_2.OH.(OCH_3)_2.CO.C_6H_5$$

They are, however, as yet unable to positively confirm that formula, owing to the indefinite nature of the products obtained by the action of most reagents on hydrocotëine. Nor did the authors succeed in preparing its oxime or hydrazone. Phosphorus pentachloride acts readily on hydrocotëine. The resulting product contains benzoyl chloride, benzyltrichloride, a new body of the formula, $C_8H_7Cl_3O_2$, and a considerable amount of resinous matter. The new compound is volatile with great difficulty in steam, and crystallises from alcohol in long colourless needles, melting at 174° C. Assuming the authors' formula for hydrocotëine to be correct, the new substance is probably the dimethyl ether of a trichlorophenol, $C_6HCl_3(OCH_3)_2$. Methyl hydrocotëine, when treated with phosphorus pentachloride, yields the corresponding trimethyl ether, $C_6Cl_3(OCH_3)_3$, which forms fine white needles, melting at 130°—131° C. Besides this substance a small quantity of diehloromethylhydrocotëine, $C_6H_5.CO.C_6Cl_2(OCH_3)_3$, is produced. It crystallises in colourless prisms, melting at 81°—82° C.

Protocotëine is the name the authors give to a body occurring in crude hydrocotëine. It may be separated from the latter by repeated fractional crystallisation from alcohol in which it is less soluble than hydrocotëine.

Protocotëine, $C_{16}H_{14}O_6$.—Pale yellowish monoclinic prisms melting at 141°—142° C. It is soluble in alcohol, ether, glacial acetic acid, benzene, and chloroform; insoluble in water. A solution of protocotëine in weak alcohol is coloured reddish-brown by ferric chloride. With nitric acid (1·4) it gives in the cold a blue-green colour, which on warming changes to a dirty reddish-brown tint. Protocotëine dissolves in alkalis, forming a yellow solution from which it is reprecipitated by carbonic acid. It contains two methoxyl groups, like hydrocotëine.

Mono-acetylprotocotëine, $C_{14}H_2O_3(OCH_3)_2(C_2H_3O_2)$, forms colourless crystals melting at 103° C. It is insoluble in water, soluble in ether, hot alcohol, chloroform, and acetic ether.

Methyl-protocotëine crystallises in colourless prisms, which melt at 134°—135° C. It is insoluble in water and alkalis.

The presence of the group CO in protocotëine is proved by the fact that it readily forms a phenylhydrazone. It separates from water in small colourless prisms, melting at 211° C.

Dibromprotocotëine, $C_{16}H_{12}Br_2O_6$, crystallises in silky scales, which melt at 170° C. It is soluble in ether, alcohol, glacial acetic acid, and insoluble in water.

Acetylbromprotocotëine, $C_{16}H_{12}BrO_3(C_2H_3O_2)$, is obtained in fine white needles. It melts at 175° C. and is insoluble in water and alkalis.

By fusion with potash, or heating with hydrochloric acid to 140° C. protocotëine yields protocatechuic acid, hence the name "protocotëine." Under the same circumstances hydrocotëine gives benzoic acid. Protocotëine and methylprotocotëine on treatment with phosphorus pentachloride yield, amongst other products, two bodies, melting respectively at 174° C. and 130°—131° C., which are identical with those similarly obtained from hydrocotëine and methylhydrocotëine. These results agree with the assumption that protocotëine differs from hydrocotëine in the manner exemplified in the following formulæ:—

$$HO.C_6H_2(OCH_3)_2CO.C_6H_5$$

Hydrocotëine, or, as the authors now prefer to call it, *Benzocotëine.*

$$HO.C_6H_2(OCH_3)_2CO.C_6H_3\begin{matrix}O\\ \diagup\\ \diagdown\\ O\end{matrix}>CH_2\ [O:O=3:4]$$

Protocotëine.

Alkaline potassium permanganate converts protocotëine into an acid, which has not been further examined; and a neutral volatile body identical with *paracumarhydrin,* which was first obtained by Jobst and Hesse (Annalen, **199**, 17) from paracotëine by boiling with potash.

It forms a hydrazone $C_{13}H_8O_3(N_2HC_6H_5)$ crystallising in scales which melt at 114° C.—H. T. P.

Investigations on the Terpenes and their Derivatives. J. W. Brühl. Ber. 1891, **24**, 3374—3416. (Third Communication.)

Part I.

The Camphors.—Research assisted by H. Biltz and A. Cantzler.—The author will investigate the constitution and chemical and physical properties of the camphor and allied bodies, and proposes dividing his experiments into two classes. In this paper he deals with the chemical series of research alone, devoting himself to the camphor bodies, ether, and acid derivatives; also a few salts.

Menthol, $C_{10}H_{20}O$.—This substance behaves as a derivative of hexahydrocymene, and as a secondary alcohol of this aromatic body. Among other results, he finds menthol gives no addition products with hydrogen, halogen, or halogen acids. It has also been proved that menthol can be oxidised by dry methods into cymene. For this purpose anhydrous copper sulphate was used, heated under pressure in tubes to 250—280°. The oil produced was dried and distilled over nitrogen, and fractionated. It proved to be cymene.

By this result it is shown that menthol may be easily converted into cymene by certain oxidising agents, the reaction following the equation—

$$C_{10}H_{20}O + O_2 = C_{10}H_{14} + 3\,H_2O$$

Menthylethylether, $C_{10}H_{19}O.C_2H_5$.—The author refers to the preparation of this body. 30 grms. of anhydrous toluene were dissolved in 30 grms. of menthol, 8 grms. of sodium added, and the whole heated to the boiling point in an oil-bath. The product was treated with ethyl-iodide, and heated till alkalinity was destroyed. The sodium iodide was dissolved out by water, the unaltered toluene and ethyliodide distilled off. The product was heated with sodium, and distilled over sodium in an atmosphere of nitrogen. A substance was thus obtained as a colourless mobile liquid with a slight odour of menthol, and is the ether sought. It boiled at 211·5°—212°.

(2.) *Borneol,* $C_{10}H_{18}O$.—Consists of common or Japan camphor with the addition of two hydrogen atoms. The camphor being a ketone, the constitution of borneol answers to the corresponding secondary alcohol. The author discusses the preparation of borneol obtained from various sources, arriving at the conclusion that the purest and cleanest product is to be obtained from borneol-carboxylic acid. Its melting point is 206°—207° C. The product obtained from crude borneol and Baubigny's method, and two distillations with steam, is a crystalline white product, which after pressing and drying melts at 202° to 203°.

Bornylethylether, $C_{10}H_{17}O.C_2H_5$.—As solvent for the preparation of this compound from borneol, xylene was used, the action with sodium not taking place till after the metal had fused. The preparation was carried on in a manner similar to the production of the menthyl ether already described. This ether is a colourless, viscous, and dense liquid, with a very mild odour. It boils at 204°—204·5°.

Bornylmethylene-ether $(C_{10}H_{17}O)_2CH_2$.—Prepared by methods similar to those by which the previously described ethers were formed. It yields a crystalline mass of fine white, rhombic prisms, melting at 167°—168°. In the fused state it shows a beautiful bluish-yellow fluorescence.

Bornylmethylether, $C_{10}H_{17}.OCH_3$.—This derivative was also prepared.

(3.) *Action of Sodium on Camphor.*—This reaction carried on in a neutral solution yields besides sodium-camphor also sodium-borneol: for as the formation of the

first-named body proceeds, the hydrogen set free reduces a further portion of camphor.

Ethyl Camphor.—This is prepared by Bauhigny's method by means of ethyl-iodide on camphor. By distillation in vacuo and many fractionations, a colourless liquid boiling at 131°—136° was obtained.

Camphocarboxylic Acid and Derivatives.—This acid was prepared by Bauhigny's method (Ann. Chem. Phys. (4), **19**, 221, 1870), the reaction proceeding as follows:—

(*a.*) $2\,C_{10}H_{16}O + 2\,Na + C_{10}H_{18}NaO = C_{10}H_{17}ONa + H$

Sodium camphor. Sodium borneol.

(*b.*) $C_{10}H_{17}NaO + C_{10}H_{18}ONa + 2\,CO_2 =$

$C_{10}H_{16}(CO_2Na)O + C_{10}H_{17}O.CO_2Na$

Sodium camphocarboxylate. Sodium borneolcarboxylate.

The author deals in extenso with the various probable formulæ, and action of sodium and CO_2 on camphor, and further the action on these derivatives of water.

Salts and ethers of campho-carboxylic acid were prepared by the author.

Sodium Salt.—Crystalline powder, slightly soluble in water, alcohol, methyl alcohol, and chloroform, insoluble in acetone, ether, and carbon bisulphide.

The Calcium Salt is with difficulty soluble in water and alcohol, and crystallises in needles.

The Potassium, Lithium, and Ammonium Salts were also prepared.

Camphocarboxylicethylether, $C_{15}H_{24}O_4$, is a colourless liquid of powerful odour, and of the consistency of glycerol.

As a result of the action of phenylhydrazine on campho-carboxylic acid a snow-white crystalline powder is obtained, melting at 131°—132°, and having the formula—

$$C_{17}H_{20}N_2O + H_2O$$

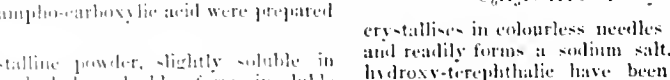
It is very easily soluble in benzene and chloroform, less so in ether and alcohol. This body has been called *Camphopyrazolone*, and has been provisionally patented.

On a variety of theoretical grounds the author believes the constitution formula of camphor to be most correctly represented by—

—E. F. H.

A New Method for the Preparation of Phenolhydcarboxylic Acids. H. Hilde. J. Prakt. Chem. 1891, **44**, 5—14.

Ost has shown that Kolbe's method for the preparation of hydroxycarboxylic acids of the aromatic series applies also to the production of hydroxydicarboxylic acids, and he has prepared both hydroxyisophthalic acid and hydroxytrimesinic acid by the action of carbon dioxide on basic sodium salicylate at 200°—400° C. (J. Prakt. Chem. **14**, 93, and **15**, 401). The acids that result in this way are unsymmetric and no adjacent hydroxydicarboxylic acids could be obtained thus. The author finds, however, that if the sodium salt of the methyl ester of salicylic acid be treated with carbon dioxide under increased pressure, on the lines of Schmitt's method for the preparation of salicylic acid (this Journal, 1885, 688) adjacent hydroxydicarboxylic acids result, and in this way such acids derived from ortho-, meta-, and parahydroxy benzoic acid have been prepared. The sodium salt of gaultheria oil, when heated with an excess of carbon dioxide in an autoclave for about 24 hours to 150°, yields the methyl ester of the adjacent hydroxyphthalic acid, $C_6H_3(OH)(OCH_3)(COOH)_2$ 1.2.3. The ethyl ester of salicylic acid behaves similarly when treated with carbon dioxide under pressure, but the phenyl ester (salol) does not react. The diphenyl ester of the adjacent isophthalic acid results by treating the acid with phenol and phosphorus oxychloride at 170°—180°. It crystallises from alcohol in colourless prisms melting at 99° C., and differs from salol in forming a fairly stable sodium salt, $C_6H_3O.Na(CO.OC_6H_5)_2$. The sodium salts of the ethyl esters of both meta- and para-hydroxybenzoic acid react readily with carbon dioxide at 170° C. to form the methyl esters of the adjacent hydroxycarboxylic acids. The free acids have the formulæ—



Hydroxy-terephthalic acid. Hydroxy-isophthalic acid.

The ethyl ester of the latter forms monoclinic plates which melt at 191°—195° C. The sodium salt of the ester crystallises with 4 molecules of water; the silver salt —is soluble in hot water. The phenyl ester—

$$C_6H_3.OH.CO.OC_2H_5.CO.OC_6H_5$$

crystallises in colourless needles which melt at 64°—65° C. and readily forms a sodium salt. The free acid and the hydroxy-terephthalic have been previously prepared by other means. The methods are patented—C. A. K.

Preparation of Oxygen and its Application to Illuminating Purposes. G. Kassner. J. für Gasbeleuchtung, 1891, **34**, 351—353.

See under II., *page* 991.

Glycerin. J. Schenkel. Zeits. f. angew. Chem. 1891, 505—508.

See under XII., *page* 1013.

PATENTS.

A New Soluble Quinoline Derivative. A. Lembach and F. Schleicher, Biebrich, and C. J. Wolff, Wiesbaden, Germany. Eng. Pat. 13,693, August 14, 1891. 4*d*.

The object of the invention is to prepare a soluble quinoline derivative to be used for antiseptic and other purposes. The derivative prepared is quinolinequinophenol sulphate, which may be obtained either by treating orthohydroxyquinoline sulphate with quinoline, or by treating quinoline sulphate with orthohydroxyquinoline. The mixtures are boiled with water until the product is insoluble in ether. The compound formed consists of a yellow solid resembling fused ferric chloride in appearance, and like this body it is very hygroscopic. The quantities required for the preparation are given.—C. A. K.

A Process for the Preparation of Phenylestersalicylic Acid or Salol from Salicylic Acid. Paul Ernert, Ludwigshafen, Germany. Eng. Pat. 14,224, August 22, 1891. 4*d*.

It is generally stated that salicylic acid sublimes undecomposed when carefully heated, but that it is partially decomposed when rapidly distilled into carbonic acid and phenol. The author has found that the extent of the decomposition depends upon the temperature, and that at a high temperature the acid separates water and carbon dioxide with the formation of salol if the water formed during the heating be distilled off and the access of air carefully avoided. To prepare salol by this means pure or crude salicylic acid is heated in a flask to 220°—230° C. The flask is provided with a narrow neck which projects so far out of the bath that the steam evolved in the reaction does not condense and run back into the flask

but passes on to a small bulb connected with the neck. The flask is filled with carbonic acid before heating and a gentle current of the gas passes through in the opposite direction to the issuing vapours, during the operation. The resulting salol is washed with water or, if necessary, with soda and purified by recrystallisation from alcohol or other suitable solvent.

The author is of opinion that the formation of the salol most probably takes place with the intermediate formation of an anhydride of salicylic acid according to the following equations:—

(i.) $C_6H_4\begin{cases}CO.OH\\OH\end{cases} + C_6H_4\begin{cases}OH\\CO.OH\end{cases} = C_6H_4\begin{cases}CO.OH\\O\\C_6H_4\end{cases}\begin{matrix}\\\\CO.OH\end{matrix} + H_2O$

(ii.) $C_6H_4\begin{cases}CO.OH\\O\\C_6H_4\end{cases}\begin{matrix}\\\\CO.OH\end{matrix} = CO_2 + C_6H_4\begin{cases}OH\\CO.OC_6H_5\end{cases}$

This idea is favoured by the fact that the addition of phenol does not increase the yield of salol, which amounts to the theoretical quantity, 2 kilos. of salicylic acid giving 1·4—1·5 kilos. of salol.—C. A. K.

Production of a Novel Pyrazolon. O. Imray, London. From the "Farbwerke vormals Meister, Lucius und Brüning," Hoechst-on-the-Maine, Germany. Eng. Pat. 18,024, November 8, 1890. 4*d*

Knorr has shown that pyrazol derivatives result by the action of phenylhydrazine on unsaturated ketones and also that a pyrazolone derivative is formed by the action of phenylhydrazine on cinnamic acid (Ber. 1887, **20**, 1107). The new derivative is obtained by the action of phenylhydrazine on crotonic acid at 130°—150° C., when a yellow-red melt results, which is extracted with methyl alcohol. When purified by recrystallisation from methyl alcohol it forms white crystals melting at 84°—85° C. It is only sparingly soluble in hot water, and when treated with oxidising agents, such as ferric chloride, it gives a flocculent blue precipitate, soluble in chloroform, with an intense blue colour—a general reaction for the pyrazolones.—C. A. K.

Production of Sodium-formylphenylhydrazine, and of Symmetric Alkylphenylhydrazine and of Analogous Compounds. O. Imray, London. From the "Farbwerke vormals Meister, Lucius und Brüning," Hoechst-on-the-Maine, Germany. Eng. Pat. 18,025, November 8, 1890. 6*d*.

In order to prepare secondary phenylhydrazines, phenylhydrazine has been treated with sodium and the sodium compound acted upon by alkyl haloids. In this way it is only the hydrogen of the imido group in the hydrazine that is thus replaced and the resulting compounds are the unsymmetrical alkyl phenylhydrazines, the methyl compound, for instance, having the formula $C_6H_5.N.(CH_3)NH_2$. If, however, formyl phenylhydrazine, obtained by boiling phenylhydrazine with formic acid, be boiled in xylene solution with sodium and the solution then treated with an alkyl iodide a symmetric alkyl phenylhydrazine results according to the equation—

$$C_6H_5.NH.N\begin{cases}CHO\\Na\end{cases} + CH_3I = C_6H_5.NHN\begin{cases}CHO\\CH_3\end{cases} + NaI$$

The sodium compound is very explosive when dry, and cannot therefore be isolated, so that, in order to prepare the alkylhydrazine, the above xylene solution of the sodium compound is treated direct with the alkyl haloid. When the reaction is completed the solution is filtered, the xylene distilled off, and the formyl compound left behind saponified by means of alkali or of acid. The alkylphenylhydrazine is then extracted with ether and finally distilled in vacuo. The methyl compound is a yellowish oil boiling at 220°—230° C. When oxidised with mercuric oxide "azophenylmethyl" results. The ethyl compound is similarly prepared and is identical with that got by other means.—C. A. K.

Improvements in the Manufacture and Production of Medicinal Compounds from Ethereal Oils. J. Y. Johnson, London. From F. von Heyden (Nachfolger), Radebeul, Germany. Eng. Pat. 19,074, November 24, 1890. 6*d*.

The medicinal application of the odoriferous constituents of the ethereal oils, such as menthol, borneol, geraniol, thymol, carvacrol, eugenol, and gaultheria oil which possess peculiar physiological and antiseptic properties, has been greatly restricted, owing to their strong taste and smell and their corrosive action on the mucous membrane. The patentee prepares odourless, tasteless, neutral products from these hydroxy compounds, or from the oils containing them, by converting them into carbonates, carbamates, or alkylcarbonates, which products are without action on the mucous membrane. The *carbonates* are produced either by the action of one molecule of carbonyl chloride in benzene solution on two molecules of the hydroxy compound at 150° in a vessel capable of withstanding pressure, or by treating two molecules of the latter dissolved in caustic soda with phosgene gas. The following equations represent the changes that occur:—

(i.) $2\,R.OH + COCl_2 = \begin{cases}R.O\\R.O\end{cases}CO + 2HCl$

(ii.) $2\,R.ONa + COCl_2 = \begin{cases}R.O\\R.O\end{cases}CO + 2\,NaCl$

The *carbamates* are prepared by substituting phosgene amide for phosgene—

$$CO\begin{cases}Cl\\NH_2\end{cases}$$

in the above reactions or by treating the ethereal oil first with carbonyl chloride and subsequently with ammonia.

These carbonates and carbamates are, with the exception of carvacrol carbonate, crystalline bodies. The menthol carbonate has the composition $CO(O.C_{10}H_{19})_2$, and melts at 160° C; the carbamate—

$$CO\begin{cases}NH_2\\O.C_{10}H_{19}\end{cases}$$

melts at 161° C. The melting points of the corresponding compounds of dextro- and levo-borneol, guaiacol, creosol, eugenol, carvacrol, thymol, and gaultheria oil are given, together with details of typical methods of preparation. Ethyl salicylate, iso-eugenol, and also creosote can be converted into similar derivatives, the last yielding a mixture of carbonates or carbamates of phenols. Alkyl carbonates can be similarly obtained, such as eugenol methyl carbonate—

$$C_6H_3\begin{cases}C_3H_5\\OCH_3\\O.CO.OCH_3\end{cases}$$

which results by the action of chloroformic ester on eugenol or its sodium compound. Several methyl and ethyl compounds of the various ethereal oils have been thus prepared, all of which are liquids (except ethyl eugenol carbonate, melting point 26°—27°) and are on this account specially suitable for injections.

These preparations are split up into carbonic acid or ammonia and the active hydroxyl compound in the system.—C. A. K.

Manufacture of a Compound of Antipyrine and Iodine. O. Imray, London. From the "Farbwerke vormals Meister, Lucius, und Brüning," Hoechst-on-the-Maine, Germany. Eng. Pat. 19,576, December 1, 1890. 4*d*.

Two parts by weight of antipyrine are dissolved in 20 parts by weight of water, and the solution heated to boiling. Three parts by weight of potassium carbonate and 2·8 parts by weight of iodine are alternately added in small quantities at a time to the solution. A yellow-brown powder separates after the completion of the reaction which is washed with water and crystallised from dilute alcohol. When pure the product forms white prismatic needles melting at 158—160° C. It is nearly insoluble in water, but readily soluble in hot alcohol. "For the potassium carbonate soda or free alkali or an alkaline earth may be substituted."—C. A. K.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

PATENTS.

An Improved Apparatus for keeping Dishes containing Liquids in Regular Motion, specially for Use in the Practice of Photography. J. W. Hunter, London. Eng. Pat. 18,731, November 19, 1890. 8*d*.

A LEVEL table or platform, on which the dish is placed, is fixed to a vertical stem capable of oscillating on its own axis. The motion is imparted to the stem by a fork actuated by a running-down motion controlled by a fan or heavy wheel.—C. H. B.

Improved Apparatus for Use in Photographic Printing. L. J. Sellier, Coruña, Spain. Eng. Pat. 18,967, November 22, 1890. 8*d*.

FRAMES containing prints to be vignetted, cracked negatives, &c. are placed on small level platforms or supports, attached to vertical stems that are caused to rotate slowly by means of any convenient motive power.—C. H. B.

Improvements in Photographic Dishes. E. S. Norcombe, Birmingham. Eng. Pat. 19,358, November 28, 1890. 6*d*.

THE dishes are made of transparent glass and have, near the bottom and parallel with it, on two or more sides, a deep groove, into which the plate slips and is thus prevented from falling out when the dish is inclined. A similar result is obtained by means of a row of projections or nipples. The developer or other solution can thus be poured out of the dish and the plate examined by holding the bottom of the dish near the light. When films are used an open glass frame with an outer flange on the lower edge, is placed on the top of the film as it lies in one of the dishes just described, and the flange slips into the groove or under the nipples and keeps the film in its place.—C. H. B.

Improvements in the Means for Washing Photographic Negatives and Prints. A. Palmer, Nottingham. Eng. Pat. 20,199, December 11, 1890. 8*d*.

A WOOD trough is used with sliding adjustable racks capable of supporting negatives in either a vertical or horizontal position. When the trough is used for prints the racks are removed. The water enters at one of the bottom corners by means of a pipe running along the whole length of the bottom and terminating at the other end in a funnel somewhat above the level of the tank. The waste water escapes at the top through an overflow-pipe at the corner, diagonally opposite to that at which the water enters.—C. H. B.

Improvements in and relating to Photochromographs. L. Meyer, Berlin, Germany. Eng. Pat. 14,943, September 4, 1891. 4*d*.

A PHOTOLITHOGRAPH is illuminated with oil colours, the outlines and chiaroscuro being produced by the lithograph. When thoroughly dry the print is transferred to artists' canvas or other suitable foundation and the paper is stripped off. There is then on the canvas a coloured picture, with the shading of the photolithograph on its surface.—C. H. B.

A New or Improved Process for Producing Photographic Pictures having Colours resembling those of the Objects from which they are obtained. V. Mathieu, London. Eng. Pat. 16,091, September 22, 1891. 4*d*.

AN ordinary photographic print, preferably of a black colour, is made transparent by repeated treatment with a mixture of alcohol and Venice turpentine, followed by baking in a hot-air oven, and oil colours are applied to the back of the transparent print.—C. H. B.

XXII.—EXPLOSIVES, MATCHES, Etc.

Glycerin. J. Schenkel. Zeits. f. angew. Chem. 1891, 505—508.

See under XII., *page* 1013.

On the Explosive Properties of Trinitrotoluene. C. Häussermann. Zeits. f. angew. Chem. 1891, 508—511.

THE author has made various experiments to test the safety and suitability of trinitrotoluene as an explosive, and states that there are no difficulties or dangers in its manufacture which could hinder it from entering the field with other explosives. In order to test its stability when kept for some time he exposed portions of this body in the air for several months to varying temperatures (−10°—+50°), and found that when the trinitrotoluene had been crystallised from alcohol only a slight surface yellow colour was noticed, and no change could be detected in any of its other properties, but when the body had only been freed from acid by washing with water and dilute soda and allowed to stand a short time, traces of acid vapours were frequently detected by the "heat test." Some of the trinitrotoluene was rubbed in an iron mortar, alone and mixed with sand, and no change was observed. On striking it on an anvil, only a very slight decomposition accompanied by evolution of smoke took place. On being wrapped in tin-foil and struck on the anvil, only the slightest decomposition could be detected, and this did not give rise to a report or any appearance of fire. Further experiments showed that trinitrotoluene could not be exploded by flame or by heating in an open vessel in the air. Heated on platinum foil it first melts, then evaporates and catches fire, burning quietly with a very sooty flame. Projected on to a red-hot iron plate it simply burns rapidly. When heated in a test-tube it boils at 300°, and if the heat be continued it froths up and catches fire, leaving a large porous carbonaceous residue. Only when a large mass is rapidly heated in a covered vessel does feeble detonation take place, and this produces very slight effects. Seventy grms. of the powdered substance were placed in a closed cubical zinc case, the sides of which measured 4 cm. This case was placed on a cast-iron plate 2 cm. in thickness, and was fired by a fulminate detonator 35 mm. in length. The explosion was accompanied by a loud report, and a distinct, although faint, cloud of smoke. The iron plate was quite destroyed, and pieces of it scattered widely. Further experiments showed that it belongs to the class of shattering explosives. A mixture was also made of 1 part of trinitrotoluene and 3½ parts of ammonium nitrate. Comparative experiments showed that

this mixture did less mechanical work on explosion than the trinitrotoluene alone, but more than a corresponding mixture of dinitrobenzene and ammonium nitrate. It is pointed out that the manufacture of an explosive by mixing trinitrotoluene and ammonium nitrate does not give rise to injurious fumes, as in the case of dinitrobenzene.—W. M.

PATENTS.

Improvements in Cartridge Cases. J. C. Butterfield and T. C. Batchelor, London. Eng. Pat. 19,659, December 2, 1890. 8*d*.

This invention consists in making metallic cartridge cases in two parts or shells, which after being filled with the explosive are united in the centre and screwed together or closed in any suitable manner.—W. M.

A Novel Explosive Compound. W. C. Gedge, London. From "The California Explosive Company," San Francisco, California. Eng. Pat. 11,326A, July 3, 1891. 4*d*.

This is a mixture of methyl and ethyl nitrates, nitrobenzene, methyl alcohol, pyroxyline, and nitroglycerin which has been specially purified by treatment with ethyl alcohol. —W. M.

A Centrifugal Machine for Separating Acid from Nitrocellulose or for other like Purposes. R. Kron, Golgern, Germany. Eng. Pat. 13,612, August 12, 1891. 6*d*.

The centrifugal machine is provided with a perforated vessel or basket adapted to be tipped, in combination with a surrounding cylinder or guard which can be raised clear of the basket when the latter is being tipped.—W. M.

XXIII.—ANALYTICAL CHEMISTRY.

APPARATUS.

Chemical Manipulation. H. N. Warren. Chem. Zeit. 1891, 64, 146—147.

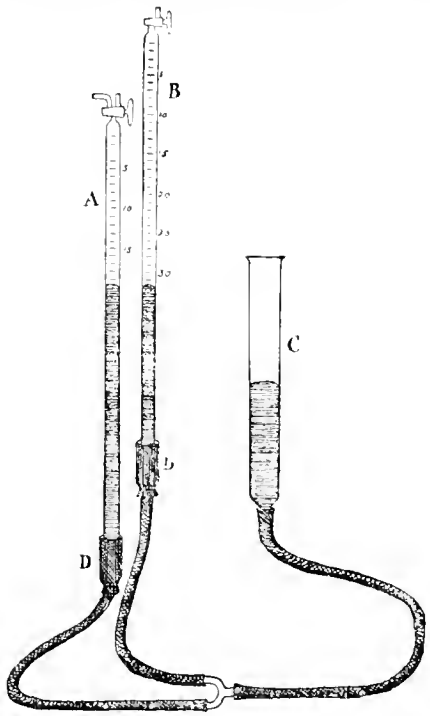
An efficient platinum crucible is prepared by folding a circular piece of platinum foil twice like a filter-paper. To make gold and silver crucibles a porcelain crucible is first covered externally with an ethereal solution of pyroxylin, when the ether has volatilised, a solution of gold chloride or silver nitrate is applied to dry pyroxylin, and while still moist is exposed to sulphurous acid fumes. The metallic coating thus produced can be increased electrically to any desired thickness by the use of the ordinary solutions. In this way a compact metallic crucible is obtained, which may be detached from the porcelain crucible by heating, and so destroying the intervening film of pyroxylin.

A good surface for coating with copper is a deposit of metallic antimony, obtained by exposing the flask or other cold objects to a flame of hydrogen antimonide.—D. A. L.

The Gravicolumeter, an Instrument by Means of which the Observed Volume of a Single Gas gives directly the Weight of the Gas. F. R. Japp. J. Chem. Soc. Trans. 1891, 894—903.

This apparatus is so constructed that, with an ordinary graduation in cubic centimetres, any desired single gas may, without observation of temperature or pressure, and without calculation, be measured under such conditions that each cubic centimetre represents a milligramme of the gas. The form of the apparatus is, with slight modifications, that of Lunge's gas volumeter (this Journal, 1890, 547); the method of employing the regulator is, however, different.

The apparatus, which is represented in the annexed drawing, consists of two gas burettes, of 50 cc. capacity



each, both furnished with obliquely bored taps. One of these burettes, A, which has a three-way tap, is the gas-measuring tube; the other, B, which need only have a single tap, performs the function of the regulator in Lunge's gas volumeter, and is termed the "regulator tube." As in Lunge's instrument, both tubes are moistened internally with a drop of water, in order that the gases they contain may be saturated with aqueous vapour, and both are connected by means of stout flexible tubing and a T-piece, with the same moveable reservoir of mercury, C. And since, in certain determinations, the level of the mercury reservoir is considerably below the lower end of the two burettes, and an inward leakage of air might thus occur at the junctions of the burettes with the india-rubber tubing, these junctions are surrounded with wider pieces of india-rubber tubing, D D, tied round the bottom and open at the top, and filled with water, so as to form a water-joint.

The 25 cc. division of the regulator tube is taken as the starting point in calculating what the author terms the "gravivolumetric values" of the different gases to be measured. Thus, in the case of nitrogen, he calculates to what volume 25 cc. of "standard-dry" nitrogen must be brought in order that 1 cc. would correspond with 1 mgrm. of the gas; that is to say, 25 cc. of standard-dry nitrogen weigh $0{\cdot}001256 \times 25 = 0{\cdot}0314$ grm.; and, therefore, these 31·4 mgrms. of nitrogen must be brought to the volume of 31·4 cc. The division 31·4 on the *regulator* tube is marked N_2. Corresponding points are in like manner determined for the various other gases which it is desired to measure, and these points are similarly marked O_2, CO_2, &c., as the case may be, on the regulator tube. Finally, the thermometer and barometer are read (a process which is only necessary once for all in setting the regulator); the volume which 25 cc. of standard-dry air would occupy if measured moist at the observed temperature and pressure is calculated; and this calculated volume of air is admitted into the regulator tube and the tap closed. The instrument is now ready for use.

Suppose it is desired to ascertain the weight of a quantity of nitrogen contained in the measuring tube. The mercury

reservoir is lowered until the mercury in the regulator tube stands at the nitrogen mark, 31·4, at the same time adjusting the regulator tube itself, by raising or lowering it bodily, so that the mercury level in the measuring tube and the regulator tube may be the same. *Under these circumstances each cubic centimetre of gas in the measuring tube represents a milligramme of nitrogen.* For, since in the regulator tube 25 cc. of standard-dry air have been made to occupy the volume of 31·4 cc., and as the gases in the two tubes are under the same conditions as regards temperature, pressure, and saturation with aqueous vapour, therefore, in the measuring tube, every 25 cc. of standard-dry nitrogen has also been made to occupy the volume of 31·4 cc. But 25 cc. of standard-dry nitrogen weigh, as just stated, 31·4 mgrms.; so that the problem is solved, and the cubic centimetres and tenths of cubic centimetres give directly the weight of the gas in milligrammes and tenths of milligrammes.

The various other single (*i.e.*, unmixed) gases may be weighed in like manner by bringing the mercury in the regulator tube to the "gravivolumetric mark" of the gas in question, and adjusting the levels as before. An exception would be made in the case of hydrogen, which would be brought to such a volume that each cubic centimetre would contain a *tenth* of a milligramme.

Mixtures of gases may also be weighed, provided that the density of the mixture is known. Thus, in the case of air, the gravivolumetric value would be 32·35.

Lastly, if the mercury in the regulator tube be brought to to the mark 25, a gas or mixture of gases in the measuring tube will have the volume which it would occupy in the standard-dry state. In this form the instrument is merely a gas volumeter, as described by Lunge, and may be employed for ordinary gas analyses.

From a number of experiments which the author has made, he concludes that the maximum error of the instrument is identical with the error of reading a 50 cc. gas burette with the eye alone, *i.e.*, 0·05 cc., corresponding to one-twentieth of a milligramme in weight.

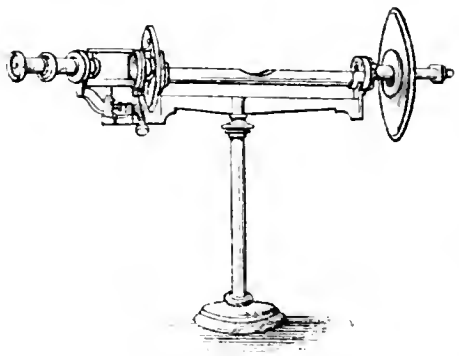
The gravivolumeter is designed to fulfil a variety of purposes for which Lunge employs a number of gas volumeters, with a special graduation for each gas, and the author concludes, from his experimental results, that it will fulfil these purposes equally well. Unlike Lunge's specially graduated gas volumeters, it makes no claim upon the skill of the instrument maker beyond that of carrying out the ordinary graduation in cubic centimetres with which he is familiar.

In analytical processes in which the weight of the gas evolved from a weighed quantity of substance has to be determined, the instrument ought to be of service. It is sufficiently accurate for technical purposes, and even for some scientific purposes, such as the absolute determination of nitrogen in organic substances, and the determination of the weight of displaced air in Victor Meyer's vapour density method, purposes for which Lunge has employed his gas volumeter.—F. B. J.

A Spectro-Saccharimeter. P. Glan. Neue Zeits. Rübenzucker Ind. 1891, **26**, 138—141.

The apparatus Fig. 1 serves to determine the rotatory power, for any desired ray of the spectrum, of all substances which rotate the plane of polarised light. The source of light is a petroleum or gas lamp, or the electric light. The instrument admits of greater exactitude than those which employ sodium, or non-homogeneous light, inasmuch as the rotatory power can be determined for the green or blue rays which are rotated through greater angles than is the yellow ray; it is, moreover, independent of the colour of the substance experimented with, so that with sugar solutions decolourisation is unnecessary. Its construction is shown in Fig. 2. The slit s_1 is placed in the focus of the achromatic lens l_1, and the light, which is concentrated upon s_1 by a short-focus lens, emerges parallel from it, passing through a Glan's polarising prism p_1, and then through a diaphragm q, the half of which is covered with a thin quartz plate cut perpendicular to its axis; this rotates the plane of polarisation a few degrees, differing according to the ray. The light now passes through the tube containing the solution under examination, and then through the polarising prism p_2 (analyser), which latter is capable of being rotated, the rotation being measured to the hundredth of a degree by a vernier on a divided circle. After passing through the flint-glass prism

Fig. 1.



A Spectro-Saccharimeter.

Fig. 2.

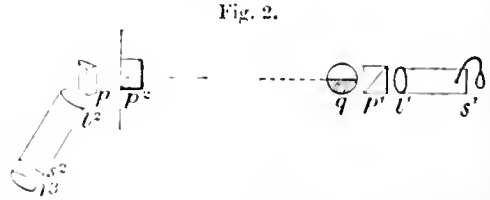


Diagram showing Principle of Spectro-Saccharimeter.

p, a spectrum is produced, of which the achromatic lens l_2 projects a minified image on the slit s_2. This image can then be observed by the short-focus lens l_3. The lens l_2 also projects an image of q which can be observed by drawing out l_3 and thus bringing it into focus. As the planes of polarisation of the light, after passing through the diaphragm q, are inclined to one another at a certain angle which differs according to the ray, the two halves of q will only appear equally bright when the light passes the polarising prism p_2 so that its plane of polarisation exactly bisects this angle, or is perpendicular to the line which bisects it. The latter position is that from which the smallest deviation causes the maximum difference in the brightness of the two halves; it is therefore that at which p_2 is placed in the measurement. If the angle at which the planes of polarisation of the light after passing through q be represented by α, then when p_2 is turned from the position at which it exactly bisects this angle through a very small angle γ, the relative brightness of both halves will be $1 + 4 \tan \frac{\alpha}{2} \sin \gamma$; on the other hand, when p_2 is turned from the position at which its plane of polorisation is perpendicular to the line bisecting the angle α, through the same angle γ, the relative brightness is $1 - 4 \cot \frac{\alpha}{2} \sin \gamma$. The alteration is greater in the latter case because α only amounts to a few degrees.

The slit s_1 is first illuminated with sodium light, and the slit s_2 placed at 6 cm. from the lens l_2, this being the focus of the latter; the lens l_3 is then drawn out until s_2 is discernible. s_1 is now brought within such a distance of l_2 that its image is clearly seen through s_2; s_1 is generally adjusted to a width of $\frac{1}{2}$ mm., and s_2 made wide enough to admit its image. The latter completely fills s_2 when the small Keppler telescope is brought to the requisite position by rotating it round the axis of the cylinder containing the flint-glass prism p. Both the tube containing the slit and the telescope can be adjusted by screws so that the image of s_1 occupies the centre of the field of vision, and the light

passes axial through p_2. By rotating p_2 the image of s_1 may be completely extinguished, and if the lens l_1 be now drawn out till q appears, it is easy to find, by rotating p_2, that position at which the two halves of the field are equally bright, and a movement of a few hundredths of a degree from this is sufficient to render one half darker than the other. The slit s_1 is next illuminated with white light, and after adjusting the slits, l_3 is drawn out until q is in focus, when it appears in that colour corresponding with the portion of the spectrum which falls upon s_2. To characterise the colour l_3 is pushed in, and s_1 illuminated with lithium, sodium, thallium, strontium, and rubidium light, and when the image of s_2 appears, the position of the Keppler telescope, as indicated by the vernier attached to the edge of the cylinder, is noted for each of these lights. Another method is to make s_1 narrow, and illuminate it with sunlight until the Fraunhofer lines are seen in s_2, the positions of the telescope for these being then noted as just described. A sufficient number of fixed positions of the telescope is thus obtained at which homogeneous colours pass through s_2, and rotatory powers may then be determined for these with the instrument.

The spectro-saccharimeter requires a bright light, and the author employs a petroleum lamp of 36-candle power provided with a condenser; this concentrates the light from the round flame on a small circular opening of 2 cm. diameter, which is placed as near as possible to the slit s_1 of the instrument. The condenser is constructed of sheet iron, having conical projections at the back and front, the widest portions of the cone being 10 cm.; the posterior cone is closed, and both are lined with German silver. The lower portion of the condenser has a neck perforated to admit air, and the upper portion has a short chimney.

Determinations show that the precision of the instrument is as great with or without the tube filled with liquid, but care must be taken that the two ends of the tube are parallel, as when they are not the tube filled with liquid acts as a prism, and shifts the spectrum so that the colour passing through s_2 is altered. The tubes are tested as follows:—s_1 is illuminated with sodium light, and its image rendered visible by pushing in l_3; on now interposing the tube filled with liquid and rotating p_2 to the requisite amount, the image of s_1 should not have shifted, if the ends of the tube be parallel.

For analytical purposes the author advises the use of green light, which is very pleasant to the eyes, the instrument being put into adjustment with thallium light as above described. The spectro-saccharimeter may also be found of service in general investigations of rotatory dispersion and in all the applications of optical rotation to quantitative analysis.—A. R. L.

The most Convenient Form of the Gas Volumeter. G. Lunge. Zeits. f. angew. Chem. 1891, 410—412. (See this Journal, 1890, 547.)

This apparatus having been constructed in a great variety of forms, this is a discussion as the most convenient one for general use. The author concludes that except in the case of technical laboratories, where only one substance is examined and where the measuring tube should be graduated so as to give direct percentages, it is best to have two of these apparatus, one with a 150 cc. bulb tube with a wet "reduction tube" and the other with a straight 50 cc. measuring tube with a dry "reduction tube." It is to be noticed that dry gases can be measured in a gas volumeter provided with a "wet" reduction tube by fixing the 100 cc. mark of the latter as many millimetres *lower* than the mercury in the measuring tube as corresponds to the tension of aqueous vapour at the working temperature, and *vice versâ*.—F. H. L.

Colour-Photometry. Captain Abney. Proc. Chem. Soc. November 19, 1891.

According to the author, *the colour of a body, when viewed in a light of standard quality, is known when (a) its luminosity, (b) its hue and (c) its purity, or the extent to which it is freed from admixture with white light, are known and expressed by numbers.*

The luminosity of a colour can be given in absolute number by referring it to the standard of white. Thus, if white light fall on a coloured surface and on a surface of some standard white, the luminosity of the former may be expressed in terms of that of the light. The comparison is easily accomplished by causing the light falling on the white surface to be rapidly alternately made brighter and darker than that falling on the coloured surface. This can be done by interposing in the beam falling on the white surface rotating sectors with apertures which open and close *at will* during rotation. The point of equal luminosity can be found by this plan within 1 per cent. The author uses a zinc oxide surface as standard white. By sending the beams through a trough containing water in which mucin is suspended in minute particles, it can be shown that the relation only holds good for the particular light in which it is measured. Hence the necessity for using a standard light.

The luminosity of the light transmitted through coloured translucent bodies can be also measured.

The standard light recommended is that from the crater of the positive pole of the electric light when a high illumination is required, or from a petroleum lamp when the illumination need not be so intense.

For measuring the luminosity of *light coming through translucent bodies*, a white oblong of paper is placed on a blackened card, a square which occupies half this oblong being pierced in the card, and thus half can be illuminated from the back of the card, and the other half by light from the front by placing a rod in the path of the beam to cast a shadow on the first half. The translucent substance is placed close behind the aperture in the card, and the light illuminating the paper, after passage through the translucent medium, measured by altering the illumination of the other half lighted from the front.

The luminosity of the pure spectrum colours may be measured by what the author calls the colour patch apparatus, which is described in the *Phil. Trans.* 1886, and in his work on "Colour Measurement and Mixture." It essentially consists of a collimator, two prisms, a lens, and a camera on the screen of which a spectrum is brought to a focus. This screen is removed for experiments, and a collecting lens used to recombine the spectrum, and to form an image of the last surface of the second prism on a screen some 4 ft. off. A slide with a split passed through the spectrum causes the white patch to become a colour patch of monochromatic light due to the particular ray traversing the spectrum slit. The white light with which the colour is compared is obtained from the light coming through the collimator and reflected from the first surface of the first prism; by means of a mirror and lens, it forms a patch equal in size to, and which can be caused to overlap, the coloured patch, or to lie alongside of it. In the first case, a rod placed in the path casts two shadows, one of which is illuminated by the colour and the other by the white light; rotating sectors in the path of the latter allow the luminosity to be compared. The light used is the electric light, an image of the crater of the positive pole being formed on the slit of the collimator.

The luminosity of a colour is not the same when viewed from all parts of the eye. The centre of the eye is that with which observations are usually made; hence the luminosity should be measured with that part of the retina, and it is advisable that no more than 6° of angular measure from the eye should be compared.

The action of the yellow spot was then alluded to.

The luminosity of any pigment on paper can be found by rotating it with two of the three colours: red, emerald-green and ultramarine.

These three make a grey which matches a grey formed of black and white. If the luminosity of the three have been accurately determined, by substituting the pigment whose luminosity is required for one of them, another grey can be formed to match a grey consisting of black and white. After measuring the angular aperture of the sectors, the luminosity is determined by calculation; the result is found

to agree with the measurement made by the direct method. This is one of the many proofs that the measure of luminosity obtained in the manner described is correct, and not a mere accident (compare this Journal, 1890, 10—15).

The colour of a pigment can be referred to the spectrum colours by measuring the absorption. In the case of transparent bodies, this is best done by using a double-image prism at the end of the collimator so as to form two spectra on the camera screen. By adjustment, these may be caused to be so exactly one over the other, that the same colour will pass through a slit in them. After emergence from the slit, the rays from the top spectrum are diverted by a right-angle prism, and caught by another which sends them through a lens on to the screen, forming a patch. Another patch as usual is formed by the rays from the bottom spectrum. By placing the transparent body in the path of one of these rays, the absorption can be measured by equalising the brightness of the patches by the sectors and noting the apertures.

To measure the absorption of pigments an easy plan is to rotate black and white sectors together with variations in the amount of white, and to cause the colour patch to fall partly on the film and partly on the pigment. The colour is varied till it is seen that the grey disc and the pigment reflect the same amount of light.

By both these plans templates can be cut out, which, when rotated in the spectrum, give the exact colour of the pigment on the screen; hence this is a reduction of the true colour to absolute numbers, since the colour can be reproduced from a reference to a note book. It is to be remarked that the measures are unaffected by any defect in the eye of the observer or by the kind of light in which they were effected.

The mixture in varying proportions of red, green, and violet of the spectrum makes white. This can be shown by placing three slits in standard positions in the spectrum, and altering their apertures till a match be made with a patch of white light alongside.

Any other colour can be matched by the mixture of the same three colours (compare this Journal, 1890, 11).

Since three colours will make white, and the same three colours will make a match with an impure colour, every colour in nature can evidently be matched by mixing not more than two of these colours with a certain proportion of white light; and if these colours be red and green, or green and violet, the colour can be matched by one spectrum colour and white light, since there is some intermediate colour which has the same hue as the mixture of these two colours. Hence any colour, except purple, can be referred to some spectrum colour, together with a certain proportion of white light. In the case of purple the colour may be expressed as white light, from which the complementary colour is eliminated. *Hence any colour whatever may be expressed in terms of white light and one spectrum colour, the latter in wave lengths, and the former in percentage of luminosity.*

Light coming through properly picked specimens of red, blue, and green glass, and overlapping, may also be made to match a colour.

If the dominant wave lengths of the colour of these three glasses be known, and also the amount of white light mixed with it, these measures can be noted in terms of these three glasses; and, further, it is possible, by mixing the light coming through the three glasses in various proportions, to obtain a spectrum colour mixed with white light for each such mixture. Hence this is a substitute for the spectrum itself.

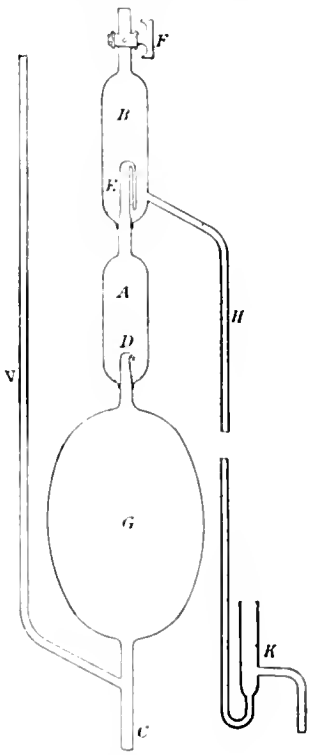
Any colour can be reproduced with three rotating sectors of red, green, and blue when certain proportions of white or black, or both, are mixed with one or other. If the dominant wave lengths and the proportion of white light mixed are known of each such colour, the pigment whose colour is to be determined can be expressed in numbers as before, and in terms of spectrum colours if desired.

In conclusion, the author claims to have demonstrated that the reference of colour to numbers is not only possible but easy, and that, to chemists especially, the application is one of almost capital importance.—O. H.

PATENTS.

An Improvement in Mercury Vacuum Pumps. E. C. C. Baly, London. Eng. Pat. 20,309, December 12, 1890. 6*d*.

In this invention two small subsidiary chambers are connected with each other by the short neck of a syphon dipping into mercury. The lower chamber is similarly connected with the vacuum chamber, and the upper chamber is in communication with a mechanical air pump. By this improvement the use of valves and taps, which are difficult of construction and so liable to leak, are avoided.



The pump is worked as follows: A preliminary exhaustion through F having been obtained by mechanical means the mercury is driven into the top chamber B. On lowering the mercury the reduced pressure in B will not be sufficient to drive any mercury back over the syphon E. Thus a Torricellian vacuum will be formed in the middle chamber A. Similarly a second vacuum will be formed in the large chamber G separated from that in A by the intermediate syphon D, and any air which is drawn into G is discharged by the rising mercury into the Torricellian vacuum in A, thus suffering the least possible compression in the chamber G. The mercury reservoir is suitably connected to C and the vessel to be exhausted to tube V. The tubes H, K, simply act as an overflow from B.—O. H.

Improvements in Ore-Sampling Machines. H. Le Roy, Bridgman, Blue Island, U.S.A. Eng. Pat. 13,198, August 1, 1891. 8*d*.

See under I., *page* 990.

INORGANIC CHEMISTRY.—QUALITATIVE.

Detection of Nitrates and Chlorates. M. Forbes. Chem. News, 1891, **64**, 105.

To deteet nitrates wnen mixed with chlorates, the mixture, placed in a test tube along with dilute sulphuric acid and copper foil, is heated in a bath of boiling saturated salt solution; the chlorate is first decomposed, attacking the copper and evolving greenish chlorous gas, subsequently the nitrate is decomposed, also attacking the copper, but evolving red nitrous fumes. In the absence of chlorates, bnt in the presence of bromides or iodides, nitrates may be detected by heating with lead foil and strong hydrochlorie aeid, the nitrate decomposes, forms lead nitrate, the presence of which is indicated by the precipitation of lead chloride.

—D. A. L.

INORGANIC CHEMISTRY.—QUANTITATIVE.

The Volumetric Estimation of Carbon in Iron and Steel, and the Determination of Carbonic Acid in Aqueous Solution. G. Lunge and L. Marchlewski. Zeits. f. angew. Chem. 1891, 412—414.

The apparatus devised by the authors and described in this Journal, 1891, 658, is employed for this purpose, by the substitution for the decomposition flask A (p. 658) of a flask holding 200 ee., into the side of which a funnel provided with a stop-eock and holding about the same amonnt is fused, the tube from which reaches to the bottom of the flask and is drawn out to a fine point; to the neck of the flask, the inner tube of an inverted condenser is ground, the other end of which is connected by another ground joint with the tube *d* (*loc. cit.*). Into the flask is weighed out from 0·5 to 5 grms. of the iron or steel and 10 times the amount (in ec.) of a saturated solution of copper snlphate added; at the end of the action the flask is connected up with the cooler and the gas volumeter, and the whole exhausted in the manner previously described. 5 to 50 ec. of a solution of ehromic acid (1:1) is added through the funnel, and then 130 ec. of sulphuric acid, sp. gr. 1·65, saturated with ehromic acid, or in the case of samples containing small amounts of carbon only, 70—75 ee. of an acid of sp. gr. 1·71. The funnel is rinsed out with 5—30 ec. of weak acid (sp. gr. 1·10), and the cock betweeu it and the flask closed. The cock on the volumeter is then opened and the flask warmed slightly. When all the carbon is oxidised, 1 or 2 ec. of hydrogen peroxide are added through the funnel to drive out the last traces of carbonic anhydride, and finally the flask and tubes are filled up with warm water. The total amount of gas in the measuring tube is noted, the carbonic acid absorbed in the Orsat's tube and the residue measured as before described. Should it be feared that there will not be suffieient gas left to reach below the bulb, some air free from CO_2 should be introduced into the tube B before the absorption takes place. Results given in the original paper show very close agreement with others obtained by the gravimetric method.

For the estimation of earbonic acid dissolved in water the sample is introduced into the flask with a small quantity of pure aluminium or iron wire, and after exhaustion the aeid run in through the funnel; this method giving the total amount of earbonic anhydride present. As previously explained the apparatus once set acts as its own barometer, and hence 1 ec. of gas corresponds to 0·000536 grm. of carbon, no correction for temperature or pressure being necessary.—F. H. L.

Estimation of Bromine and Iodine in Presence of Chlorine. E. Nihoul. Zeits. f. angew. Chem. 1891, 441.

The usual proceeding is to precipitate as chloride, bromide and iodide of silver and weigh as such, and then subsequently to eonvert the whole into chloride by the aid of chlorine and weigh again. As chlorine is unpleasant and its use at times difficult, the author has examined the question of the possibility of substituting hydrochlorie aeid gas therefor. He finds that silver bromide is completely transformed into chloride by hydrochloric acid gas, but that for quantities of from 0·1 grm. to 0·4 grm. of silver bromide it is necessary to pass the gas for an hour. The iodide is not completely transformed by hydrochloric acid gas. Now, considering that the whole operation for conversion of bromide into chloride by chlorine lasts only five minutes, and that for the conversion of iodide into chloride only ten minutes, it is evident that substitution of hydrochloric acid gas is not to be thought of here as a substitute for chlorine.

—T. L. B.

Valuation of Aluminium and its Alloys, F. Regelsberger. Zeits. f. angew Chem. 1891, 442—446 and 473—478. (See also this Journal, 1891, 387.)

The author gives the following as his complete method of determining the silicon:—4 grms. of clippings are weighed into a deep porcelain dish, covered with a clock glass; 80 ec. of *aqua regia* (30 ec. of nitric acid of sp. gr. 1·35 to 70 ec. of hydrochloric acid of sp. gr. 1·16) are gradually added with care and the whole is warmed. Then with continued boiling about 30 ec. of strong sulphuric aeid are added. When acid vapours cease to be evolved, 150—200 ec. of water are carefully added, the clock-glass still being kept on, and finally the precipitate is filtered and well washed. The precipitate is ignited in a platinum crucible direct and weighed. Evaporation with pure hydrofluoric acid is now performed, loss being taken as SiO_2. If now the residue is not of a pure red, it is warmed with a mixture of hydrofluoric acid and a little concentrated nitric acid, and then once more ignited and weighed; the difference between the weight now and the previous weighing is due to silicon. The introduction of sulphuric acid in the foregoing operation is necessary in order to get a precipitate which is sufficiently well matted to filter well.

Valuation of Ferro-Aluminium.

(*a.*) *Estimation of the Aluminium.*—5 grms. of the material are dissolved in dilute sulphuric acid in a porcelain dish covered with clock-glass and heated on asbestos until acid vapours are evolved; water is then added. Should it be desired to determine the silicon, the solution is made up to 300 ec. and filtered into a dry flask; 100 ec. of this are reduced with bisulphite or with iron wire and nearly neutralised with sodium carbonate solution and then poured into a boiling mixture of 50 ec. of pure caustic potash solution (= 10 grms. of caustic potash) and 40 ec. of pure cyanide of potassium (= 8 grms. of potassium cyanide). If iron has been used for reduction more cyanide is required. Here it is to be noted that a small quantity of iron and manganese (if present) are precipitated. The solution is made up to 500 ec. and filtered. To 300 ec. (equivalent to 1 grm. of the original material) a concentrated solution of ammonium nitrate is carefully added, after which the whole is boiled for about half an hour until the alkalinity has almost disappeared. A drop of ammonium hydrate is now added and the precipitate is filtered off and washed until the washings show no further blue with ferric chloride. The precipitate is ignited in a platinum crucible and weighed as Al_2O_3. Should the precipitate be slightly greenish then iron is present, due to decomposition of the potassium ferrocyanide by continued boiling of the ammoniacal solution. In this case the finely-powdered aluminium oxide is again ignited and then treated in a covered beaker with concentrated hydrochloric acid and titrated, without filtering, with stannous chloride. In the brown precipitate obtained above on boiling with caustic potash and potassium cyanide, the manganese may be determined by igniting and weighing and then titrating the iron (the amount of manganese thus being got by difference).

(*b.*) *For the Estimation of the Iron.*—In ferro-aluminium the sulphuric acid solution may be reduced with zinc and titrated with permanganate (or the solution used for the aluminium determination may also be taken.

(*c.*) *Estimation of Manganese.*—This may be performed in a separate solution according to the method of Volhard or of Hampe, or it may be estimated as already indicated under (*a*).

(*d.*) *Estimation of Silicon.*—The first residue obtained under (*a*) consists of a mixture of silicon, silica, and ferric oxide. This may be purified whilst still moist by boiling with caustic potash.

(*e.*) *Estimation of Carbon.*—This is carried out by oxidising 5 to 10 grms. of the material with chromic and sulphuric acids and weighing the carbon dioxide formed.

(*f.*) *Estimation of Sulphur.*—In the usual way after solution in *aqua regia*.

(*g.*) *Estimation of Phosphorus, Titanium, &c.*—These are performed as in the case of pig iron.

Approximate Valuation by aid of Specific Gravity.—When the same materials are used and so long as the conditions of the manufacture remain the same, the specific gravity of the masses of ferro-aluminium made bears a definite relation to the quantity of aluminium contained, the specific gravity is inversely proportional to the amount of aluminium contained. As the raw products vary but slightly in the same class of goods, differences of physical condition need only be taken into consideration, and these are rendered evident in the external appearance of the products, such, for instance, as separation of graphite. According to the process of manufacture of ferro-aluminium the graphite separates from the mass and may be mechanically removed, or it remains evenly distributed in the mass; in the former case, a product is obtained free from graphite, and in the latter a product containing graphite, and so grey to blackish in fracture instead of white. The product free of graphite has, for the same amount of aluminium, a higher specific gravity than the other. In the compilation of empirical tables of the specific gravity and amount of aluminium, these points must be carefully noted.

Estimation of Small Quantities of Aluminium in Iron and Steel the author considers may be most easily and most quickly performed by the potassium cyanide method. The large quantities of reagents required, however, are apt to contain sufficient alumina to introduce considerable errors.

Alloys of Aluminium and Copper.

These may be classed under three heads: (*a*) "aluminium bronzes," consisting for the most part of only aluminium and copper; (*b*) "aluminium brass," containing a third considerable constituent, zinc; (*c*) other combinations in company with copper. The most useful aluminium bronzes contain from 5 to 12 per cent. of aluminium, not more; if more than 12 per cent. be present, the alloy becomes brittle and unworkable. Silicon is often purposely added, as it increases the tensile strength; maximum is 2·5 per cent. A good idea as to the character of the alloy may be obtained from its outward appearance and physical properties. An alloy containing less than 3 per cent. of aluminium has almost the colour of copper; with from 3 to 4 per cent. it has the colour of a reddish sample of gold; with 5 per cent. the colour is gold yellow, and with increasing percentage of aluminium the alloy becomes yellower, whilst with 15 per cent. of aluminium the colour is white with merely a tinge of red. Fracture gives also characteristic indications. Aluminium brass contains up to 3·5 per cent. of aluminium. Even 0·25 per cent. of aluminium has a very considerable influence on brass, raising the tensile strength. An alloy with 40 per cent. of zinc and 2 per cent. of aluminium has a high tensile strength, whilst with 40 per cent. of zinc and 3 per cent. of aluminium the alloy is brittle, but a great improvement is again noticed if the zinc be reduced to 33 or 34 per cent. For rapid valuation of these alloys, a specific gravity determination made in conjunction with a qualitative examination may be made to tell whether aluminium bronze or aluminium brass is present, and, if the former, what amount of aluminium and silicon it may be expected to contain. These points are illustrated in the original article by a diagram.

The author makes the following observations regarding quantitative estimations:—*Silicon* (*a.*) 3—5 grms. of material are dissolved in *aqua regia*, the solution is taken to dryness, and the residue is taken up with hydrochloric acid or evaporated with sulphuric acid. Should the residue be not perfectly white, it is fused with a mixture of sodium and potassium carbonates. (*b.*) Should tin or lead be present, nitric acid alone is used instead of *aqua regia*, evaporation being subsequently performed with sulphuric acid. The precipitate obtained in this way contains the silicon, the tin, and the lead. It is fused with sodium and potassium carbonates, and then evaporated with nitric acid. SiO_2 and SnO_2 form the new precipitate. The silica may subsequently be determined by evaporation with hydrofluoric and sulphuric acids.

Iron and Aluminium.—(*a.*) Zinc absent. From the original solution in *aqua regia* the copper is precipitated by sulphuretted hydrogen or sodium thiosulphate, and then the iron and aluminium are separated in the filtrate by pouring the same into boiling caustic potash (after removal of sulphuretted hydrogen, &c.). The cyanide method may also be used, but in this case the alumina precipitate generally contains a little copper. This may be removed, however, by boiling with dilute nitric acid, neutralising with ammonia, and filtering the pure hydrate precipitated. The iron determination here must be made in a special portion of the solution by precipitating with ammonium hydrate, dissolving the precipitate in dilute acid, and titrating with stannous chloride, or after reduction with zinc titration may be performed with permanganate. (*b.*) Zinc present. The iron and aluminium are first precipitated together by sodium acetate or ammonium hydrate, and then separated as above in (*a*).

Copper. — Best done by electrolysis. 3—5 grms. of material are dissolved in nitric acid, a little sulphuric acid is added, and the whole is evaporated to a syrup. An aliquot portion (= about a grm.), diluted, is then electrolysed. Before electrolysing it is well to neutralise with ammonia and add 10 cc. of dilute nitric acid for 200 cc. of liquid. By taking this precaution complete precipitation is effected.

Zinc. — Most conveniently estimated electrolytically. Precipitation as phosphate is quick (Lösekann and Meyer, Chem. Zeit. 1886, 729 and 1605; also 1891, 81). Determination with potassium ferrocyanide is also very quick, and is sufficiently exact.

Manganese occasionally finds its way into bronzes. It is obtained in company with the iron in separation of iron and alumina by caustic potash.—T. L. B.

New Method for the Quantitative Separation of Iron, Aluminium, and Chromium. C. Marchal and J. Wiernick. Zeits. f. angew. Chem. 1891, 511—513.

The authors propose this method as being greatly superior in delicacy and feasibility to those hitherto in use, which is based on the employment as reagent of freshly precipitated manganese peroxide, prepared by the double decomposition of equivalent quantities of manganese sulphate and potassium permanganate.

The oxides are best dissolved in sulphuric acid, and the excess of acid is neutralised by adding sodium carbonate until a slight permanent precipitate is formed, which is re-dissolved by addition of a drop of acid. The hydrated manganese is then added, and the whole is boiled for 10 minutes. After allowing the precipitate to subside a drop of the clear solution is tested with ferrocyanide, and if it be found free from iron, enough manganese peroxide has been used; otherwise more must be added and the boiling and testing repeated. The precipitate now contains all the iron, and the solution all the alumina and chromium, from which the alumina is precipitated by heating with ammonia. The chromic acid in this filtrate is reduced to chromic oxide and then precipitated with ammonia.

The precipitates containing the ferric oxide and alumina are separated from accompanying manganese oxides by solution in hydrochloric acid and precipitation with sodium acetate in the ordinary way.

The following results show the accuracy of the separation:—

	Employed.	Found.
	Grms.	Grms.
1. Fe_2O_3	0·042	0·046
Al_2O_3	0·099	0·095
Cr_2O_3	0·100	0·104
2. Fe_2O_3	0·180	0·182
Al_2O_3	0·0582	0·0584
Cr_2O_3	0·1714	0·1708
3. Fe_2O_3	0·072	0·072
Al_2O_3	0·29	0·293
Cr_2O_3	0·070	0·0708

—W. M.

Antimony Pentasulphide. T. Wilm. Zeits. Anal. Chem. 1891, **30**, 428—446.

It is a well-known fact that different samples of the "golden sulphide of antimony" used in vulcanising rubber often produce widely different results, some being indeed useless for this purpose, owing to the dark colour of the product. These differences have usually been explained by considering that some varieties of the commercial sulphide consist almost entirely of the compound Sb_2S_5, while others, the inferior ones, are varying mixtures of trisulphide, pentasulphide, and free sulphur in such proportions as to yield on analysis figures corresponding to the true pentasulphide. For this reason the usual process employed in examining the commercial substance has been to estimate the amount of sulphur soluble in carbon bisulphide. The author's experiments, however, show that this process is absolutely unreliable, seeing that samples of pure pentasulphide prepared by different methods yield on extraction different amounts of sulphur to the solvent.

Two samples of the golden sulphide, (*a*) and (*b*), were examined; (*b*) behaved towards carbon bisulphide exactly as a pentasulphide prepared from pure crystallised Schlippe's salt ($Na_3SbS_4 + 9\,H_2O$), yet was useless for vulcanisation. (*a*) contained more free sulphur, and might be considered a mixture of trisulphide and sulphur, and yielded vulcanised products of very superior quality. On treatment with water, (*a*) was found to be much more readily miscible than (*b*), and examined under the microscope appeared to contain some semi-transparent crusts resembling sulphur, while (*b*) was perfectly homogeneous. The aqueous solutions, which in both cases were neutral to test papers, after acidifying with nitric acid, gave with barium chloride, (*a*) a faint cloudiness, and (*b*) a yellow colouration, and afterwards a brownish-black flocculent precipitate; with silver nitrate, (*a*) a strongly-marked cloudiness, and (*b*) no reaction. Extracted with tartaric acid solution, (*a*) gave on treatment with sulphuretted hydrogen an immediate yellow colour, and on heating a considerable precipitate of sulphide, (*b*) containing only traces of dissolved antimony. On shaking for some time with concentrated ammonia at ordinary temperatures, both yielded a yellow liquid with much free sulphur and a whitish insoluble residue, but while this, in the case of (*a*), contained, even after 14 days, much undecomposed red antimony sulphide, no trace of any red substance was found in the residue from (*b*) after two days. Heated in air both samples behaved alike, the first appearance of decomposition being at about 180°, no darkening in colour occurring at 110°, as stated by Classen (Ber. **16**, 1071).

For the quantitative estimation of the total amount of sulphur present, the best method is that of Carius, which consists in heating the substance with fuming nitric acid under pressure. From 0·2—0·4 grm. of the pentasulphide is weighed out into the tube to be sealed up, and about 1 cc. of fuming nitric acid introduced into a smaller tube made of very thin glass and drawn out at one end to a very fine opening. This latter is then dropped into the larger tube, which is sealed up and the acid set free by breaking the inner tube by a blow. After the action is over, the tube is heated to about 130° for two or three hours; the end is then broken off and a small quantity of water introduced with care, a considerable amount of gas being set free. It is next filled up with strong hydrochloric acid and heated on the water-bath till the white residue is dissolved. The tube is washed out into a porcelain basin, evaporated down, to remove the nitric acid, a little more hydrochloric acid added, and then tartaric acid solution. If successful a perfectly clear liquid should result which is not rendered turbid by the addition of water. This being the case, the sulphuric acid is precipitated with barium chloride in the ordinary way.

If sufficient material be at hand, the extraction of the free sulphur may take place in a Soxhlet's apparatus, about 5 grms. being treated for two or three hours; otherwise 0·5 to 1·0 grm. of the substance should be treated in a small Erlenmeyer's flask two or three times with 10—15 cc. of carbon bisulphide, the flask being tightly corked and heated on the water-bath with constant shaking, the liquid being filtered through a tared paper dried at 110°. The flask must finally be rinsed out with alcohol, the finer particles sticking tightly to the walls, for which reason it is impossible to conduct the operation by boiling with an inverted condenser, owing to the bumping of the liquid. After the residue is washed with alcohol, it is dried at 100°—110° and weighed.

To prepare pure antimony pentasulphide, some freshly-crystallised Schlippe's salt was dissolved in water, and poured in a thin stream into so much dilute sulphuric acid that the mixture had a faintly acid reaction. To avoid as much as possible the presence of free sulphur from the decomposition of the sulphuretted hydrogen, the latter was removed from the liquid as fast as it was formed by passing through it a current of pure carbonic acid gas: this precaution, however, was afterwards found to be unnecessary when acid liquids were employed. The voluminous precipitate settled well, and was washed by decantation; towards the end of the process a colloidal modification was formed, and could only be removed from the wash-waters by the addition of a small quantity of hydrochloric acid. The substance was finally brought on to a filter-pump, washed with alcohol, and dried over sulphuric acid. This product in common with all the others prepared by the action of acids on alkaline liquids was found to shrink very much in drying, yielding a dark brown brittle substance resembling ferric hydrate. Samples of pentasulphides were also prepared in different ways from the substance known as *Kalium stibicum*, by the addition to the filtered aqueous solution of sulphuretted hydrogen either alone or in the presence of tartaric and hydrochloric acids, a second precipitate (see table) being obtainable from the first decanted liquor by the addition of more sulphuretted hydrogen while warm. From the commercial *liq. stibii chlorati*, by saturation with chlorine, addition of tartaric acid, followed by sulphuretted hydrogen, another variety was obtained, and lastly the commercial antimony pentachloride (*stib. perchlorat.*) was employed. The characteristics of these different substances are shown in the Table (I.). on following page.

It is probable that a partial explanation of the irregularities noticeable in the last column may be found in the not generally known volatility of antimony pentasulphide at temperatures only slightly above 100°. On heating in an air-bath to about 110°, not only does this substance volatilise as such, as may be seen by placing a watch-glass over one of the openings of the bath, and examining the sublimate under the microscope, but at the same time, a partial oxidation takes place, the bath becoming filled with a dense white fume, consisting of an oxide. The sample referred to in Table I. as "first precipitate" lost in 28—30 hours at temperatures varying from 100° to 120°, 8·4 per cent. of its weight; that from Schlippe's salt lost 4·6 per cent. in 9—10 hours at 100°—110°, and the commercial sample (*b*), 1·7 per cent. in four hours at 105°—110°. After exposure to heat in this manner, free oxide was found on extraction with tartaric acid, whereas previously, the sample prepared from Schlippe's salt contained nothing

soluble. Antimony trisulphide heated under similar conditions to 120° suffered no loss of weight.

TABLE I.

Source of Sample.	Total S	S soluble in CS_2	S in Residue (by diff.)
	Per Cent.	Per Cent.	Per Cent.
Commercial sulphide (*a*)	41·30	13·21 13·29	28·60
" " (*b*)	40·30	9·08 9·17	31·60
	..	8·40	..
Pentasulphide from pure crystallised Schlippe's salt	40·50	7·88	32·80
	40·85	7·90	
From *kal. stibicum* without tartaric acid	37·92	13·82	24·22
	38·32	14·00	
From *kal. stibicum* with tartaric acid	39·00	11·71	27·29
From *kal. stibicum* with tartaric acid and hydrochloric acid, 1st precipitate	39·83	12·29	27·60
		12·18	
From *kal. stibicum* with tartaric acid and hydrochloric acid, 2nd precipitate	36·75	8·15	28·94
	37·11		
From *kal. stibicum*, using much HCl	39·35	8·35	31·00
From *liq. stib. chlorat.* ..	41·04	6·37	34·40
	41·18		
From com. $SbCl_3$	38·53	13·80	24·80
	38·74		
Calculated for Sb_2S_3	39·58	..	..
" " Sb_2S_4	34·39	..	..
" " Sb_2S_5	28·23	..	..

These results show that Bunsen's process (Annalen, **192**, 305) for the estimation of antimony in presence of arsenic, which consists in the precipitation of the former by sulphuretted hydrogen in the oxidised solutions and the washing of the precipitate in water, alcohol, four amounts of carbon bisulphide, and finally alcohol, and then drying at 110° and weighing as Sb_2S_5,—yields faulty results; and to see whether this could be avoided by drying over sulphuric acid, some pentasulphide was prepared in the way given by him for the analysis, and also two fresh samples from Schlippe's salt ((*a*) and (*b*)), the first exactly as previously described, but without the use of alcohol in the washing, (*b*), without the carbonic acid but with alcohol. These three samples before drying were extracted with cold CS_2 and in each case *yielded a considerable amount of free sulphur*, and on further treatment with the hot solvent still more free sulphur was obtained. Dried as described above, their analyses are given in Table II.

TABLE II.

Sample.	Total S	S soluble in CS_2	S in Residue (by diff.)
	Per Cent.	Per Cent.	Per Cent.
Sb_2S_5 from Schlippe's salt (*a*)	41·25	5·93	35·22
	41·27	5·86	
		6·22	
Sb_2S_5 from Schlippe's salt (*b*)	40·62	7·59	33·03
Bunsen's sulphide	39·96	3·59	36·37

—F. H. L.

Electrolytic Determination of Metals as Amalgams. G. Vortmann. Ber. 1891, **24**, 2749—2765.

IN the electrolytic estimation of metals it is necessary that the metal form a well-adhering film on the platinum dish, which is used as electrode.

This film must be sufficiently adherent to admit of its being washed. Some of the metals determinable by this method adhere well only when present in small quantities; such metals are antimony, bismuth, cadmium, lead and manganese. For the purpose of improving the character of the film it was proposed by Luckow (Chem. Zeit. 1885, 338; see also Zeits. f. Anal. Chem. 1880, 15) to add a quantity of mercury so that an amalgam might be deposited. Wolcott Gibbs (Chem. News, **42**, 291) employed mercury as negative electrode, dispensing with a platinum dish, and using a glass beaker. It is known that mercury may be deposited satisfactorily from acid solutions, from solutions in cyanide of potassium, and from ammoniacal solutions of the sodium pyrophosphate double salt; the author shows also that it may be perfectly well deposited from the ammonium oxalate double salt, and from solutions of its salts in potassium iodide, in sodium sulphide, and in ammonia in presence of tartaric acid.

Determination of Zinc.—Luckow recommended that the depositing of zinc as amalgam should be performed in a solution slightly acidified with sulphuric acid. The correctness of this method the author confirms, but he furthermore points out that a large excess of free acid is capable of preventing deposition altogether. In ammonium oxalate solution, and in ammoniacal solution in presence of tartaric acid the amalgam deposits well; in the former case not more than 3 parts of mercury must be present to 1 part of zinc, otherwise the deposit is not fixed: in the case of the ammoniacal solution at least three times as much mercury as zinc should be present—excess of mercury not being detrimental. Unfortunately the platinum dish is apt to be very considerably attacked in this method of zinc deposition, and it seems better to adopt the method, hitherto used, in which the platinum dish is previously coated with copper or silver.

Determination of Cadmium.—The ammonium oxalate method is only adapted to the determination of small quantities of cadmium, as the cadmium ammonium oxalate is less soluble in water than the corresponding zinc salt. For cases where the cadmium to be deposited exceeds 0·3 grm., the following method is recommended:—The solution of the cadmium and mercury salts is mixed with about 3 grms. of tartaric acid, and then ammonia is added until the solution smells strongly of the same; the whole is diluted with water and deposition carried out.

Determination of Lead.—In acid solutions this may be carried out as follows:—The lead salt and mercuric chloride are dissolved in water, 3 to 5 grms. of sodium acetate are added, and a few cc. of a strong solution of potassium nitrite; the precipitate formed is dissolved in acetic acid and deposition proceeded with. The great difficulty in lead estimations is the liability to formation of peroxide of lead on the positive pole; presence of nitrous acid, as provided in the foregoing method, is instrumental in preventing this. Deposition of the lead amalgam may also be performed from a dilute nitric acid solution, to which potassium nitrite is continually being added slowly; the acetic acid method is, however, much more convenient. Lead may also be determined in alkaline solution obtained by dissolving the lead salt and mercuric chloride in water, adding tartaric acid, and then caustic soda in excess; the brown precipitate formed is easily dissolved in potassium iodide. During deposition no peroxide separates (as is the case if an ammoniacal solution be used). As the amalgam obtained is easily oxidisable in moist condition, the results given are high and consequently the method is made to serve rather as a separation of lead from other metals, such as tin and arsenic, than as a means of direct estimation.

Determination of Bismuth.—This is best performed in acid solution, since bismuth oxalate is insufficiently soluble in ammonium oxalate solution. Excess of acid must be present during deposition so as to prevent precipitation of basic salts, and yet too large an excess is not desirable;

hence the author, instead of a large excess of hydrochloric acid, uses potassium iodide, since bismuth iodide dissolves in excess of potassium iodide and no basic salt separates on dilution.

Determination of Antimony. — This estimation has hitherto been difficult to perform by electrolytic method, and its estimation at all has been limited to small quantities; the amalgam method of deposition, however, renders electrolytic estimation of antimony comparatively easy. For every part of antimony there must be in solution about two parts of mercury, though a larger quantity of mercury is not detrimental. The antimony amalgam deposited is steel-grey in appearance, and is unaffected by standing in the air. The estimation is not limited to small quantities. An ammoniacal solution of antimony (containing tartaric acid) gives no deposit whatever of amalgam; mercury alone is obtained, so that here a method of separating antimony from lead, bismuth, and other metals presents itself.

Deposition of Arsenic as Amalgam.—In the electrolysis of arsenic solutions it was found that arseniuretted hydrogen was given off; addition of potassium iodide, however, was instrumental in bringing about decomposition of such arseniuretted hydrogen with consequent deposition of most of the arsenic in the form of a dark brown amalgam. The quantitative deposition has not yet been obtained.—T. L. B.

Estimation of Molybdic and Tungstic Acids. E. F. Smith and R. H. Bradbury. Ber. 1891, **24**, 2930—2936.

An investigation is here made of the use of various salts in quantitative estimations of molybdic and tungstic acids. Both may be satisfactorily determined in neutral solution, the authors find, by precipitation with barium chloride. Precipitation is performed in the hot, and the whole is allowed to stand for a considerable time before filtering; washing of the precipitate must be performed with cold water, otherwise low results are obtained. The strontium salts are not suited to the quantitative estimations in question. Molybdic acid, but not tungstic acid, may be determined as the calcium salt in presence of alcohol, but the details of the process are much more considerable than in the case of the barium salt. Molybdate of lead forms a white granular precipitate, which is soluble in nitric acid and caustic soda. On heating, however, it takes a yellow colour, and is then unacted on by these reagents. Determination as lead salt is found to be excellent, as previously reported by Zettnow (Jahresb. 1867, 267), and Chatard (Amer. J. Sc. and Arts I. [3], 416). Lead tungstate forms a precipitate, which is extremely difficult to filter; the difficulty is to a certain extent modified by addition of ammonium nitrate. The cadmium salts are capable of being used for the estimation; but the silver salts cannot be used, on account of decomposition ensuing on heating.
—T. L. B.

Oxidation of Copper Glance by Aid of the Electric Current. E. T. Smith and D. L. Wallace. Ber. 1891, **24**, 2938—2939.

Previously the metallic sulphides with one exception, *copper glance* or *redruthite*, have been oxidised by the aid of the electric current (this Journal, 1890, 971). The authors have now succeeded in completely oxidising this sulphide also by the method in question. With 0·1 grm. of mineral they used 35 grms. of potassium hydrate; the oxidation was complete in 40 minutes.—T. L. B.

A New Method for the Quantitative Separation of Manganese and Nickel, Manganese and Cobalt, and of Manganese, Nickel, and Cobalt. P. Jannasch and C. J. Franzek. Ber. 1891, **24**, 3204—3205.

This is a preliminary notice of a new method for separating the above metals, the details of which the authors propose to give at a future date. Following up the method of MacGregory with one of the authors (Jour. Prakt. Chem. 1891, **43**, 402; this Journal, 1891, 659), for the separation of manganese and zinc, viz., by the precipitation of the manganese by hydrogen peroxide from a strongly ammoniacal solution of the metals and in the presence of a large amount of ammonium chloride, the authors find that manganese and nickel can be separated accurately and conveniently by the same process. The separation of manganese and cobalt cannot, however, be effected in this way, as the precipitate of hydrated manganese dioxide invariably carries down with it a considerable quantity of cobalt. By employing a solution of the double cyanides of manganese and cobalt rendered alkaline by potassium hydrate, hydrogen peroxide produces the precipitation of the manganese in a state absolutely free from cobalt. The separation of nickel may be effected equally well in the same way, and likewise the separation of nickel and cobalt from manganese when the three metals are present together. The authors mention that the reagents have to be used in certain definite proportions, and that the observance of certain precautions are essential to the carrying out of the method successfully, and these details they promise to give later.—H. S. P.

On the Solution of Chrome Iron Ore by Hydrochloric Acid under Pressure. P. Jannasch and H. Vogtherr. Ber. 1891, **24**, 3206—3208.

About 1 grm. of the finely-powdered mineral is sealed up in a tube of potash glass with 2 grms. of ammonium chloride and 10 cc. of hydrochloric acid (4 vols. of acid 1·119 sp. gr. to 1 vol. of water) previously saturated with ammonium chloride. The tube is then heated to a temperature of from 250° C. to 290° C. for 8—10 hours. Complete decomposition and solution of the ore take place under these conditions. The residue in the case of three varieties of chrome iron ore, after removing the silica by evaporation with hydrofluoric acid and sulphuric acid, was 0·17 per cent., 0·37 per cent., and 0·69 per cent. respectively, whilst in a fourth instance, where selected crystals of Maryland chrome iron ore sand were used, and no special care was taken to pulverise the mineral very finely, the residue weighed 1·22 per cent., some of which in this case consisted of undecomposed ore. The authors state that the length of time of heating, the temperature to be used, and the effect of using quite concentrated acid require further investigation.—H. S. P.

The Ammonia Process of Water Analysis. R. Haines. Journ. Franklin. Inst. 1891, **131**, 461—467.

In conducting this process the author finds it best to use half a litre of water, or when the water is very impure a smaller quantity diluted to half a litre with pure distilled water, the distillation being performed in a retort of one-third to one-half gallon capacity, supported at the neck by a large retort clamp, but not resting on a ring. The neck is inclined upwards at an angle of 25°, the end being either brought into close contact with the end of the inner tube of the condenser under the rubber tubing or bent down and fitted into the condenser tube, in either case the rubber tubing is tied down over the joint to prevent leakage. If a Liebig's condenser only is used the current of water should be so rapid that its temperature is not materially raised; if the temperature of the water supply is over 50°—60° F. it should, previous to use, be cooled by ice. A better plan is to attach to the end of the Liebig tube a Mohr's glass vertical coil condenser cooled by ice. The author finds that polluted waters containing large quantities of free ammonia yield four-fifths of their total ammonia in the first 50 cc. of distillate instead of three-fourths as stated by Wanklyn.—S. B. A. A.

Heat of Evaporation of Liquid Ammonia. H. von Strombeck. Journ. Franklin Inst. 1891, **131**, 470—476.

See under VII., *page* 1005.

New Method for the Analysis of Tin-Ores, and for the Separation of Copper and Cadmium. J. S. C. Wells, School of Mines Quarterly, 1891, **12**, 295—297.

Tin Ore.—This method consists in heating the finely-powdered tin-ore with zinc, hydrochloric acid, and platinum foil with frequent agitation. The tin is rapidly reduced to the metallic state, and when the reaction is judged to be over it is dissolved in hydrochloric acid, filtered, and the gangue again tested in the same way. The tin in solution is determined by any of the usual methods. The metallic tin may also be dissolved in ferric chloride and determined volumetrically.

Separation of Copper and Cadmium.—To the neutral solution of these metals (ammonium salts being absent) sodium thiosulphate is added until the solution becomes colourless, the cadmium is then precipitated as carbonate by the addition of sodium carbonate and filtered off; on acidifying the filtrate with hydrochloric acid, and boiling the copper is precipitated as sulphide. To apply this method in the ordinary course of analysis, the solution after removal of the bismuth must be evaporated to dryness and ignited to remove ammonium salts.—S. B. A. A.

The Iodometric Estimation of Chlorates. G. McGowan. Proc. Chem. Soc. 1891, 169.

Attention is called to Finkener's statement, that when Bunsen's method is applied to chlorates, less than the theoretical amount of chlorine is evolved. Experiments are then described, made in accordance with the method, which corroborate the results of de Koninck and Nihoul, and prove the accuracy of the Bunsen method; Finkener's error doubtless arose from a slight loss of chlorine. The author emphasises the importance of carrying out all such determinations in an apparatus in which the chlorine does come into contact with india-rubber.

ORGANIC CHEMISTRY.—QUALITATIVE.

The Examination of Phenacetin for p-phenetidin. F. Goldmann. Pharm. Zeit. 1891. **36**, 208.

The author finds that the iodine test for *p*-phenetidin, which Reuter (Phar. Zeit. **36**, 192; this Journal, 1891. 799) states is far less sensitive than the chloral-hydrate method, is improved by being carried out in the following manner: 0·5 grm. of phenacetin is dissolved warm in alcohol and 5 cc. of a solution of iodine in potassium iodide (0·01 grm. I in 200 cc.) added. The solidified mixture is heated to the boiling point until solution is complete, when the presence of *p*-phenetidin is shown by the rose-red colour of the solution. The colour is more pronounced when the phenacetin has again separated out.—F. H. L.

The Use of Lacmoid in Estimating the Affinities of Organic Acids. F. Röhmann and W. Spitzer. Ber. 1891, **24**, 3010—3015.

When a solution of an organic acid is titrated with soda the liquid turns red lacmoid paper blue, before all the soda theoretically required to convert the acid into normal salt has been added. Such a mixture, which is slightly alkaline to red paper, is, however, still strongly acid to blue lacmoid paper, and more soda must be added—although usually not the full theoretical amount—before the liquid ceases to affect blue paper. Under these circumstances, calling the free acid present in the liquid S, and the combined acid (the amount required to form normal salt with the soda added) S_1, the authors show that the ratio $\frac{S}{S_1}$ varies with different acids, and is inversely proportional to their respective affinities for alkali. To this ratio the name "*Coefficient of neutralisation*" is given. Below are given the results of experiments with various acids:—

10 cc. of a $\frac{N}{10}$ Solution of each of the following Acids taken.	Volume of $\frac{N}{10}$ Soda required to make the Solution Alkaline to Red Lacmoid Paper.	Ratio of Free to combined Acid.	Volume of $\frac{N}{10}$ Soda required to cause disappearance of Acid Reaction to Blue Lacmoid Paper.	Ratio of Free to combined Acid.	Volume of $\frac{N}{10}$ Soda required to render Liquid Alkaline to Litmus, Phenolphthalein, &c.
	Cc.		Cc.		
Formic acid	3·0	7·0 : 3·0	9·55	0·45 : 9·55	10 cc.
Acetic acid	1·0	9·0 : 1·0	8·5	1·5 : 8·5	
Propionic acid.....	0·9	9·1 : 0·9	8·4	1·6 : 8·4	
Butyric acid.....	0·8	9·2 : 0·8	8·35	1·65 : 8·35	
Isobutyric acid.....	0·75	9·25 : 0·75	8·35	1·65 : 8·35	
Valeric acid	0·85	9·15 : 0·85	8·5	1·5 : 8·5	
Lactic acid	2·5	7·5 : 2·5	9·45	0·55 : 9·45	
Oxy-isobutyric acid...	2·6	7·4 : 2·6	9·45	0·55 : 9·45	
Monochloracetic acid .	7·0	3·0 : 7·0	9·8	0·2 : 9·8	
Trichloracetic acid....	9·9 to 10	0·1 : 9·9 to 0 : 10 = 0	10·0	.. ..	
Methylsulphuric acid.	9·3	0·8 : 9·2	9·6	0·4 : 9·6	

In the following table the relative affinities deduced from the above figures are given, compared with formic acid, as well as with the numbers obtained by other methods taken from Ostwald's tables:—

Acids compared with Formic Acid.	Relative Affinities calculated from the Coefficient of Neutralisation for Red Lacmoid Paper.	Relative Affinities calculated from the Coefficient of Neutralisation for Blue Lacmoid Paper.	Calculated from Ostwald's Tables.		
			From the Rate of Decomposition of the Methyl Ether.	From the Electrical Conductivity.	From the Inversive Action on Cane Sugar.
Acetic acid	0·2592	0·267	0·2633	0·2523	0·2614
Propionic acid.....	0·2307	0·247	0·232	0·1934	..
Butyric acid.....	0·2028	0·238	0·229	0·1881	..
Isobutyric acid.....	0·1891	0·238	0·2045	0·1851	0·2189
Valeranic acid	0·2167	0·267	..	0·248	..
Lactic acid	0·777	0·808	0·687	0·619	0·6903
Oxy-isobutyric acid...	0·8198	0·82	0·7022	0·738	0·6928

Experiments were also made with dibasic acids. The authors find that the affinity of one of the COOH groups for alkali is much larger when the other COOH is free than when it is already saturated. The difference is greatest in the case of strong acids.—H. T. P.

ORGANIC CHEMISTRY—QUANTITATIVE.

The Quantitative Estimation of Pentoses in Plants. W. E. Stone. Ber. 1891, **24**, 3019—3021.

In this process the material to be tested is as usual distilled with hydrochloric acid of 1·06 sp. gr. The distillate is neutralised with soda, then slightly acidified with acetic acid, and diluted to a known volume. The furfurol in the liquid is estimated volumetrically by means of a solution of phenylhydrazine, containing 1 grm. of phenylhydrazine hydrochloride and 3 grms. of sodium acetate per 500 cc. This solution alters in strength rather quickly, and must, therefore, be frequently standardised on a solution of pure furfurol (1 grm pure furfuramide dissolved in a little acetic acid and diluted to 1,000 cc.). Titration is conducted as follows:—To 25 cc. of the distillate is added a known volume of phenylhydrazine solution. The mixture is rapidly boiled and cooled, and a small portion of the liquid (2 cc.) is filtered off *perfectly bright* from the precipitated hydrazone. The filtrate is mixed with twice its volume of Fehling's solution and boiled. In presence of the least excess of phenylhydrazine cuprous oxide is formed, and imparts to the liquid a characteristic greenish-yellow colour. When the furfurol is in excess no reduction occurs. Another titration is then made with a fresh portion of distillate, more or less phenylhydrazine being employed, according to the indications of the previous experiment. 4—6 trials usually suffice to approximate within 0·1 cc. of the true volume of standard solution required. Below are given some results obtained by the above method:—

Material Employed.		Furfurol Obtained. Per Cent.
Gum from maize	*a*	5[illegible]·88
	b	18·66
Wheaten bran	*a*	6·85
	b	7·16
Mixture of wheaten bran and maize flour	*a*	4·61
	b	4·64
Rabbit's dung, I.	*a*	7·99
	b	8·30
Rabbit's dung, II.	*a*	7·76
	b	8·62
Rabbit's dung, III.	*a*	10·59
	b	10·04

(See this Journal, 1890, 903; 1891, 473 and 577).
—H. T. P.

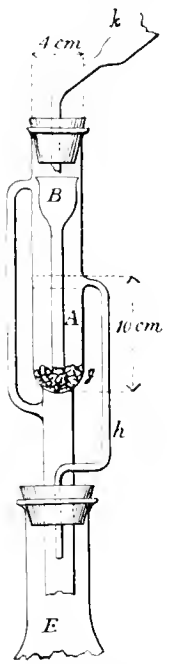
Determination of the Ash of Sugar. Alberti and Hempel. Zeits. f. angew. Chem. 1891, 486—492.

The authors replace the sulphuric acid method by the following:—Six or 7 grms. of roughly powdered quartz sand are heated in a platinum dish and weighed. Five grms. of sugar are then added, the whole is thoroughly mixed and ignition is performed in a muffle. Two experiments are carried out at the same time as a check. For ashing the time varies from about half an hour to an hour and a quarter. In the case of molasses 3 grms. only are necessary, and ignition in the muffle is preceded by a preliminary warming. Copious tables of results are given.—T. L. B.

The Determination of Unsaponifiable Matter in Fats. M. Hönig and G. Spitz. Zeits. f. angew. Chem. 1891, **19**, 565—568.

The authors prefer the following process for the determination of unsaponifiable matter in fats:—7—10 grms. of fat are saponified with alcoholic potash, if necessary, under a vertical condenser, 30—40 cc. of water added, the mixture boiled up, cooled, transferred to a separating funnel, the flask rinsed with 50 per cent. alcohol, and then with 50 cc. of petroleum ether, which is added to the contents of the funnel. The petroleum separates rapidly from the alcoholic soap solution, and after the latter has been run off, is washed with 10—15 cc. of 50 per cent. alcohol two or three times. The treatment with petroleum ether is repeated to extract the remainder of the unsaponifiable matter; usually three extractions suffice. The evaporation of the solution in petroleum ether is facilitated by using a product obtained by fractionating the commercial article and collecting the portion distilling between 50° and 70° C. Should the unsaponifiable matter contain no light mineral oil the evaporation of the solvent may be quickened by heating more freely than is otherwise safe. With materials only saponified with difficulty it is advisable to repeat the saponification and subsequent operations. The advantage claimed for the new process over the usual method consists in the greater ease with which the separation of the petroleum ether is effected—a result due to the use of liquids containing a considerable proportion of alcohol.

When any determinations have to be made the following modification is of service:—The saponified solution, which should not measure more than 50 cc., is mixed with 20 cc. of petroleum ether and transferred to the extraction vessel A of the apparatus shown in the Figure, the flask being rinsed



Apparatus for Extracting Soap Solution.

with petroleum ether and 50 per cent. alcohol. At the bottom of A is a layer of small glass beads *g*, into which dips the end of the short thistle-headed funnel B. The surface of the soap solution is brought to about $\frac{1}{2}$ cm. of the opening of the discharge tube *h*. The small extraction flask E is attached by a cork to the lower part of the apparatus and about 20 cc. of the petroleum ether introduced through the funnel B; the upper part of the apparatus is connected with a reflux condenser in the ordinary way, and the operation is conducted as with a Soxhlet extractor, until the petroleum ether running back into the flask is quite colour-

less, and the soap solution in A has become clear. During the extraction the petroleum ether in flask E becomes turbid from the presence of a little soap, on which account it must, at the end of the extraction, be shaken out two or three times with 50 per cent. alcohol in a separating funnel.

A rapid method of determining unsaponifiable matter where only approximate results are required, consists in performing the saponification and extraction in a flask having a bulb of known capacity blown on its neck to contain the layer of petroleum ether from which an aliquot portion can be drawn by a pipette, and the fat determined by evaporating and weighing as usual. Experiments made on known mixtures show that the method is reliable.

The determination of water and dirt in oils such as are used in wool manufacture, with which the authors have been chiefly concerned, can be effected by dissolving 20 grms. of the well-mixed sample in about 100 cc. of petroleum ether, allowing the solution to remain at rest for an hour, and filtering through a weighed filter, taking care to allow no drops of water to pass on to the filter with the petroleum ether; after washing several times with petroleum ether, both the filter and the flask in which the fat was dissolved are freed from the solvent by cautious evaporation and weighed, the water being afterwards driven off and its amount and that of the dirt determined by re-weighing.

Another method consists in dissolving from 15—20 grms. in petroleum ether, pouring the solution into a burette previously filled to the lowest mark with water, reading off the amount of water in the sample when it has separated by standing, and determining the dirt by filtration through a weighed filter in the ordinary manner.—B. B.

The Calorific Value of the Constituents of Food and of their Derivatives. F. Stohmann and H. Langbein. J. Prakt. Chem. 1891, **44**, 336—399.

See under XVIII.—A., *page* 1020.

Percentage of Iodine absorbed by Lard Oil by the Hübl Method. R. Haines. Journ. Franklin Inst. 1891, **132**, 67—74.

In a number of experiments on lard oil expressed by himself from pure lard the author finds the average absorption of iodine in different samples to be 75·14 per cent., 73·13 per cent., and 70·01 per cent. respectively. Extra prime lard oil of Chicago manufacture guaranteed pure gave an average of 74·02 per cent.

To obtain trustworthy results the author finds it necessary to keep the burette containing the solution of iodine and mercuric chloride in alcohol at a constant temperature, and to protect it from draughts. For the solution of the oil only the purest chloroform should be used; the period of absorption is with advantage prolonged to eight hours, but should not under any circumstances exceed 24 hours. It is advisable to leave a large excess of unabsorbed iodine, and for this purpose the liquid (after addition of a proportionately larger quantity of potassium iodide) should be diluted with 100 cc. of water, and not 150 cc. as prescribed by Hübl, as otherwise the quarter litre flasks are inconvenient to manipulate. Exactly the same quantities of chloroform and potassium iodide should be used in the oil tests and in the blank titration of the alcoholic iodine solution. The hyposulphite (thiosulphate) solution and the alcoholic iodine solution should be freshly prepared, the latter should be made up with very pure 95 per cent. alcohol.—S. B. A. A.

Analysis of Russian Waxes. J. Antouschevich. J. Russ. Chem. Soc. 1891, **23**, 223—235.

See under XII., *page* 1014.

ANALYTICAL AND SCIENTIFIC NOTES.

Cobalt Dioxide. G. Vortmann. Ber. 1891, **24**, 2744—2749.

By the action of hypochlorites and hypobromites of the alkalis a blackish precipitate is obtained sensibly differing in character from ordinary cobalt hydrate, $Co_2(OH)_6$. Carnot found such precipitate to be richer in oxygen than required by the sesquioxide formula (this Journal, 1889, 639). As this fact has an important bearing on the volumetric estimation of cobalt in presence of nickel, the author examined further into the question in the following manner:—Cobalt sulphate was gently warmed on the water-bath with decinormal iodine solution and caustic soda. An aliquot part after filtering was acidified with sulphuric acid, and the excess of iodine ascertained by the aid of thiosulphate solution: the results showed the relation of the number of cobalt atoms to the number of oxygen atoms to be 10 to 17, or in some cases 10 to 18; the relation 10 to 20 was never obtained. Oxidation with bromine water gave lower results—10 to 16. The high ratios obtained are considered to point certainly to the existence of the dioxide of cobalt. This dioxide is considered to be more unstable than the dioxide of manganese, which may be obtained by the same method.—T. L. B.

The Bismuth of Commerce and Purified Bismuth, together with some Remarks on the Atomic Weight of Bismuth. R. Schneider. J. Prakt. Chem. 1891, **44**, 23—48.

The paper contains a detailed reply to the criticisms of Classen regarding the purity of the bismuth employed by the author in his determinations of the atomic weight of the metal. The author's result gave Bi = 208 (O = 16), whilst Classen finds Bi = 208·89 (Ber. 1890, **23**, 938). The following analyses of commercial bismuth and of pure bismuth obtained from various makers are given as proof of the utter fallacy of the statement that such products contain copper, iron and lead amounting to units per cent., as maintained by Classen:—

Analyses of Commercial Bismuth.

Locality.	Saxony, Johanngeorgenstadt.		Bolivia.		Saxony, W.	Bohemia, Joachimsthal.	Peru.	Saxony, Blaufarbenwerken.	
Bismuth	99·931	99·890	99·953	99·969	99·77	99·32	99·372	99·791	99·745
Silver	0·092	0·188	0·083	0·021	0·05	0·38	..	0·070	0·066
Lead	..	..	..	..	..	0·30	..	0·084	0·108
Copper	0·308	0·090	0·258	0·156	0·08	Trace	2·058	0·027	0·019
Iron	..	..	..	..	Trace	Trace		0·017	Trace
Tin	..	..	..	..	..	..	4·57	..	..
Antimony	..	..	0·599	..	..	..		..	..
Arsenic	0·504	0·255	..	..	..	..	..	..	0·011
Tellurium	..	..	..	0·140	..	..	..	..	..
Selenium	Trace	..	..	..	..	..	..	..	..
Sulphur	..	..	..	..	0·10	..	..	Trace	0·012

Analyses of Purified Bismuth (Puriss).

	I.	II.	III.
Bismuth	99·922	99·849	99·892
Silver	..	0·047	..
Lead	..	0·049	0·065
Copper	0·016	0·019	0·032
Iron	Trace	Trace	Trace
Arsenic	0·025	0·024	Trace
	99·963	99·989	99·989

An experimental result is also given to show that the bismuth obtaining by precipitation as basic nitrate is free from all but traces of impurity. The analysis showed—

	Per Cent.
Bi	99·9893
Pb	0·0064
Cu	0·0043

The remainder of the paper is occupied with a discussion of the bearing of these results on the author's atomic weight determination (see following abstract).—C. A. K.

Reply (to R. Schneider's Paper on the Bismuth of Commerce, &c.) A. Classen. J. Prakt. Chem. 1891, **44**, 411—414. (Vide previous Abstract.)

The author maintains his view that both the variation in the physical properties of bismuth generally sold as *puriss* as well as chemical analysis point to the impurity of the metal. In one case 500 grms. of the sample were found to yield 10 grms. of chloride of lead on analysis, and in another 1·56 per cent. of copper and 0·45 per cent. of iron were found in addition to the lead, which was not determined. The melting point of four samples were found to vary from 265°—273° C, whilst the metal obtained electrolytically by the method employed by the author in his atomic weight determination melts at 264° C.—C. A. K.

Di-ammonium Semi-Sulphate. $(N_2H_4)H_2SO_4$. J. Curtius. J. Prakt. Chem. 1891, **44**, 101—102.

The di-ammonium sulphate $(N_2H_4)H_2SO_4$ previously described by the author (J. prakt. Chem. **42**, 521), is not the neutral sulphate of hydrazine, as previously stated, but an acid sulphate. The neutral sulphate $(N_2H_4)_2H_2SO_4$ is obtained by neutralising sulphuric acid with hydrazine hydrate and then concentrating in a vacuum. It forms large, glittering, anisotropic plates which melt at 85° C. It is readily distinguished from the acid sulphate, which is only soluble with difficulty, by its being very hygroscopic and neutral. Alcohol precipitates the salt from aqueous solution in the form of an oil which is transformed into a crystalline powder on stirring with a glass rod, or on the addition of a crystal of the substance.

—C. A. K.

New Book.

Chemische Technologie der Gespinnstfasern. Ihre Geschichte, Gewinnung, Verarbeitung und Veredlung. Von Dr. Otto N. Witt, Professor der Technischen Chemie an der Königl. Tech. Hochschule zu Berlin. Zweite Lieferung. Braunschweig. Druck and Verlag von Friedrich Vieweg und Sohn, 1891. London: H. Grevel and Co., 33, King Street, Covent Garden.

This book is purely a continuation of the first part already noticed (this Journal, 1888, 872), containing no title-page, but commencing abruptly with the 193rd page and concluding with an unfinished sentence on page 384. It contains seven beautifully executed wood-engravings. The book begins with a continuation of a description of the drugs and chemicals used in the treatment of fibres in bleaching and purification. Part II. commences with Tannic Acid. It then proceeds to a new group, that of 3, The Alkalis, Alkaline Salts and Earths. This is followed by 4, Solvents, Purifying Agents and Grease Purifiers; and we then arrive at 5, Bleaching, Oxidising, and Reducing Agents. Next follow 6, Mordants, and first the Metallic or Inorganic Mordants and then the Mordants of Organic Origin. There are then a few words on Assistants such as Water-glass and Sodium Phosphate, as also Cows' dung. Section or Chapter 7 is devoted to Thickening Agents, Adhesive and Finishing Materials, and Part II. ends with an uncompleted treatise on 8, The Dye-stuffs. It seems clear from the commencement of this chapter that the author's intention is to give a very complete and clear account of the Dye-stuffs and Pigment-colours, more especially in their connection with the Dyer and Calico-printers' arts.

Trade Report.

TARIFF CHANGES AND CUSTOMS REGULATIONS.

(*From the Board of Trade Journal.*)

Russia.

Customs Decisions.

Note.—Pood = 36 lb. avoirdupois. Rouble = 3*s.* 2*d.*

The following decisions affecting the classification of articles in the Russian tariff have recently been given by the Russian Customs authorities:—

Carbon cylinders for dry element batteries prepared of coal, graphite, and pyrolusite, under section 71, point 4.—Duty, 4 roubles gold per pood.

Powdered glass, under section 71, point 5, letter *b*.—40 copecks gold per pood.

Graphite crucibles, under section 74, point 1.—Duty, 30 copecks gold per pood.

The Russian Department of Customs notifies that marble and cryolite ground to powder shall be admitted under section 66, point 5, of the Customs tariff.—Duty, 10 copecks gold per pood.

United States.

Customs Decisions.

The following decisions respecting the construction to be given to Acts of Congress relating to the classification of articles in the Customs tariff, and the application of the Customs laws of the United States, have recently been given by the Customs authorities in that country:—

Memorandum tablets circular in shape, three inches in diameter, and consisting of three plain discs of collodion

protected by cardboard covers, each tablet being fastened by a single eyelet rivet, passing through one edge thereof, are dutiable at 60 cents per pound, and 25 per cent. *ad valorem*, under paragraph 21, N.T., as collodion or a compound of pyroxyline made into finished articles.

Liq opir. sed. is dutiable at 40 per cent. under paragraph 47, N.T., as a liquid preparation of opium not specially provided for.

Beberine sulphate, cocaine hydrochlorate, and hyoscamine sulphate are dutiable at 50 cents a pound as medicinal preparations in the preparation of which alcohol has been used.

Acetone is dutiable as a chemical compound at 25 per cent. under 76, N.T.

Dead oil produced by distillation from coal tar is dutiable at 25 per cent. *ad valorem*, under paragraph 76, Act of October 1st, 1890.

Photographic negatives are dutiable at 60 per cent.

EXTRACTS FROM DIPLOMATIC AND CONSULAR REPORTS.

Argentina.

Pharmaceutical Preparations.

The importation of medicinal and other drugs, perfumery, oils and varnishes has diminished largely, says the Austrian Consul, since the time when the Argentine Republic fell upon evil days financially. But at the same time there has been a constant increase in the importation of pitch, salt, stearin, bicarbonate of soda, and sulphuric acid. The production of the latter article, as well as of certain other heavy chemicals, has increased considerably in the Argentine Republic during the last few years.

Italy.

Sulphur Mining in Sicily.

There has lately (says our Consul at Palermo, in Sicily) been a remarkable rise in the prices of sulphur in Sicily, due to several causes, among them the gradual exhaustion of the stocks at the outports, the closing of several mines, and the lessened production of last year. Unfortunately, this has so elated the owners of some of the mines that they have begun to extract more mineral than is required, and prices are already going down. The exportation of brimstone from Licata in 1890 remained 6,000 tons short of what it was in 1889, but its value amounted to 96,075*l.* more than in the previous year. The rise in the prices of this mineral during the second half of 1890 was as important as it proved to be unexpected and brisk, and it is due to the smaller production of last year, which is reckoned to have been 15,000 tons less than in 1889. Many mines in the Licata district which for some years were compelled to check their production, and even stop work, attracted by the fair prospects of the present high prices, have recommenced active work, and during the autumn of 1891 will throw a great quantity of sulphur on the market. In the Girgenti district many of the mines were flooded in the winter of 1890, owing to heavy rains, and could not work. Altogether the season was a favourable one to those engaged in the trade. Those working the mines are content if the prices remain at 3*s.* 9*d.* per cwt., and, when one compares the present cost of transport and of miners' wages with what they were twenty years ago, this price may be considered excellent.

Russia.

The Duty on Chemicals.

Under the new Customs tariff the Russian duty on chemicals has been considerably increased; thus, caustic soda, hitherto 72 c. gold per pood, will now pay 90 c. gold; bleaching powder, from 52 c., is now dutiable at 70 c. gold; borax, from 11 c. gold, has been raised to 120 c. per pood. Business in these particular goods is said to be at a standstill, the consumers not being able to pay the increased price. The rates under this head are, in fact, prohibitive, as they are intended to be, with a view to benefiting the native manufacturers. To what extent that object was already attained under the old, and (compared with the new) moderate tariff, appears from the following rates of dividend yielded by some of the leading Russian factories. The return is for 1889:—Russian Seed-crushing Company, 25 per cent.; Thornton's Woollen Manufactory, 40 per cent.; Neva Cotton Mill, 40 per cent.; Artificial Mineral-water Company, 82 per cent.; Russian-American India-rubber Company, clear profit on foundation capital, 86·4 per cent.

No industry has grown in larger proportion in Russia, under the protective system of the last decade, than that of chemicals and dyestuffs. A comparative table of the value of the produce of Russian industries, recently compiled, shows that while the total output of manufactures in the principal industries of the Empire has risen from 317 to 562 millions of roubles, or 77·4 per cent., between 1876 and 1888, that of chemicals and dyestuffs has advanced from 5·5 to 15·6 millions of roubles, or by 183·6 per cent.

GENERAL TRADE NOTES.

Diminished Profits in the German Chemical Industry.

Two of the principal chemical works in Germany have just issued reports of their commercial transactions during a portion of the year, which have created considerable astonishment in consequence of the great diminution in profits which they reveal. Schering's Chemische Fabrik in Berlin reports that, on the second of this month, a meeting of the board of directors took place, at which the report was read concerning the work during the first ten months of this year, based upon the results of the stock-taking on November 1st. It is stated that the strong competition which has been experienced during the present year has prevented the factory from selling its produce at higher prices, which would have countervailed the great expenditure for coal and for wages, amounting together to 106,135 m. in excess of the corresponding period of last year. Prices of chemicals generally, in fact, were somewhat below those of 1890. Another important item was that more money has been spent upon buildings and the renewal of plant, and that the general expenses have also been much higher, principally owing to the introduction of certain patented processes for chemical manufacture during the present year. The directors hope that in the future the profit for the manufacture of these patents will be considerable; but in the meantime the net profit for the ten months ending November 1st has been 542,543 m., or 328,142 m. less than in the same period of 1890. The net profit for the whole year 1889 was 814,451 m., in 1890 it was 925,400 m. Supposing the profits for the two closing months of this year to be in the same proportion to those in the ten months already past, the total profit for the year 1891 will not exceed 650,000 m. The great position which Schering's chemical factory occupies in German industry is shown by the accurate knowledge which the Stock Exchange has of the working of the factory. Long before the report above referred to was read at the meeting of the directors the shares of the factory commenced to fall very considerably on the Stock Exchange. The second unfavourable report emanates from the Actien Gesellschaft für Anilin Fabrikation, the directors of which report that the profits of their factory have been reduced in consequence of the increase in wages and in cost of crude material, which has not been balanced by higher rates for the finished products. A similar state of things prevailed in 1890. The dividends of the factory amounted in 1889 to 15 per cent., and in 1890 to 10 per cent.—*Chemist and Druggist.*

Union of German Soap-Makers.

On December 6th a central association of German soap manufacturers was founded in Leipzig. The office of the Union is in Dresden, and its main objects are the promotion of the interests of the German soap-making industry, and the advancement of the technical education of those engaged in the business.—*Ibid.*

Salts of Strontium in Wine.

The Council of Hygiene for the department of the Seine has recommended the absolute prohibition of the use of salts of strontium in wine and treacle on account of their poisonous qualities. These salts are used by the wine growers of the South of France for removing plaster from wines. The process in use for the precipitation of sugar in treacle is also said to leave a considerable proportion of strontium in some treacles used for human food and for coffee-sweetening. The Council have deliberated upon the report of M. Riche on this subject, and have adopted his views, as above stated.—*Ibid.*

Post Office Notice.

Reduction of Postage on Newspapers, Books, Patterns, &c., for Places Abroad.

On and after January 1st, 1892, the postage chargeable on newspapers, books, printed papers, commercial papers, patterns, and samples for all destinations outside the United Kingdom, will be fixed uniformly at the undermentioned rates:—

For newspapers, books, and printed papers generally, ½*d.* per 2 oz.

For patterns and samples, ½*d.* per 2 oz., but with a minimum charge of 1*d.*, as at present.

For commercial papers, ½*d.* per 2 oz., but with a minimum charge of 2½*d.*

The postage on packets containing more than one newspaper will no longer be chargeable on each paper, but simply according to the bulk weight of the packet.

The above-named rates should in all cases be prepaid: no packet can be sent forward wholly unpaid; but if by inadvertence the postage is insufficiently prepaid, double the deficit will be chargeable on delivery.

Papers of Interest to Technologists and Manufacturers.

The following articles in the *Board of Trade Journal* for December will repay perusal:—

"The Tin-Plate Industry in the United States," p. 650.
"The Mining Industries of Mexico," p. 655.
"Industrial Openings in Bolivia," p. 661.

BOARD OF TRADE RETURNS.

Summary of Imports.

	Month ending 30th November	
	1890.	1891.
	£	£
Metals	1,802,300	2,100,415
Chemicals and dyestuffs	458,182	400,814
Oils	601,428	628,085
Raw materials for non-textile industries.	3,536,514	3,481,450
Total value of all imports	37,152,273	43,851,389

Summary of Exports.

	Month ending 30th November	
	1890.	1891.
	£	£
Metals (other than machinery)	3,783,999	2,733,013
Chemicals and medicines	754,491	745,032
Miscellaneous articles.....	2,915,877	2,488 023
Total value of all exports.....	21,025,553	18,790,949

Imports of Metals for Month ending 30th November.

Articles.	Quantities.		Values.	
	1890.	1891.	1890.	1891.
			£	£
Copper:—				
Ore ..... Tons	10,513	10,192	89,934	76,236
Regulus ..... „	5,901	7,508	182,069	194,788
Unwrought .... „	4,758	6,058	278,469	298,199
Iron:—				
Ore..... „	267,669	248,904	211,037	181,806
Bolt, bar, &c.... „	7,633	8,830	74,054	83,497
Steel, unwrought.. „	614	715	7,611	7,070
Lead, pig and sheet „	11,583	14,841	158,613	175,363
Pyrites ..... „	52,956	46,954	97,301	84,742
Quicksilver..... Lb.	30,451	57,194	5,080	5,863
Tin ..... Cwt.	52,865	63,363	253,044	288 322
Zinc ..... Tons	5,925	5,356	130,939	122,630
Other articles ...Value £	..	..	395,188	581,899
Total value of metals	..	..	1,802 300	2,100,415

Imports of Chemicals and Dyestuffs for Month ending 30th November.

Articles.	Quantities.		Values.	
	1890.	1891.	1890.	1891.
			£	£
Alkali..... Cwt.	4,275	6,039	3,327	5,678
Bark (tanners, &c.) „	24,764	31,586	6,184	13,887
Brimstone ..... „	19,254	42,375	12,837	12,353
Chemicals..... Value £	..	..	119,476	124,895
Cochineal ..... Cwt.	457	733	24 84	4,830
Cutch and gambier Tons	3,059	858	73,239	26 390
Dyes:—				
Aniline ..... Value £	..	..	23,562	19,240
Alizarine ..... „	..	..	29,912	29,595
Other ..... „	..	..	727	899
Indigo ..... Cwt.	957	530	14,602	8,274
Madder ..... „	1,648	724	2,271	1,054
Nitrate of soda.... „	77,780	50,906	31,682	22,912
Nitrate of potash . „	22,210	15,025	20,677	14,267
Valonia ..... Tons	1,028	1,647	19,008	27,180
Other articles... Value £	..	..	97,064	91,430
Total value of chemicals	..	..	458,182	400,814

IMPORTS OF OILS FOR MONTH ENDING 30TH NOVEMBER.

Articles.	Quantities.		Values.	
	1890.	1891.	1890.	1891.
			£	£
Cocoa-nut..... Cwt.	11,787	8,326	22,081	9,952
Olive ..... Tuns	519	1,129	20,282	45,182
Palm ..... Cwt.	94,859	95,058	117,185	109,754
Petroleum ..... Gall.	10,701,400	12,772,516	232,091	230,141
Seed ..... Tons	2,149	2,692	59,356	73,554
Train, &c..... Tuns	1,364	1,782	27,270	34,301
Turpentine ..... Cwt.	12,972	14,094	61,983	56,208
Other articles .. Value £	..	..	60,280	71,593
Total value of oils ...	..	..	601,428	628,087

IMPORTS OF RAW MATERIALS FOR NON TEXTILE INDUSTRIES FOR MONTH ENDING 30TH NOVEMBER.

Articles.	Quantities.		Values.	
	1890.	1891.	1890.	1891.
			£	£
Bark, Peruvian .. Cwt.	8,764	7,820	23,757	17,065
Bristles..... Lb.	262,455	262,173	50,060	36,591
Caoutchouc..... Cwt.	28,324	23,539	359,072	273,355
Gum :—				
Arabic..... „	7,725	5,865	23,565	13,090
Lac, &c..... „	9,755	8,313	44,802	35,930
Gutta-percha .... „	5,477	3,620	66,389	43,161
Hides, raw :—				
Dry..... „	38,059	28,110	91,420	73,972
Wet ..... „	41,787	47,707	95,956	107,778
Ivory..... „	1,012	770	55,585	41,326
Manure :—				
Guano..... Tons	1,858	380	6,687	2,867
Bones..... „	9,977	6,219	31,799	20,434
Paraffin..... Cwt.	46,874	39,126	34,674	26,749
Linen rags..... Tons	2,247	3,424	25,782	34,209
Esparto..... „	18,344	17,084	99,678	85,420
Pulp of wood .... „	13,657	14,482	70,132	84,898
Rosin..... Cwt.	92,970	80,976	22,356	21,770
Tallow and stearin „	64,578	80,012	83,180	107,352
Tar..... Barrels	8,147	11,147	7,457	7,940
Wood :—				
Hewn ..... Loads	182,870	162,760	398,201	349,770
Sawn ..... „	430,870	463,010	900,021	883,589
Staves ..... „	13,899	14,453	51,726	51,421
Mahogany ..... Tons	3,852	4,030	54,098	42,787
Other articles.... Value £	..	..	881,949	1,084,435
Total value	..	..	3,566,244	3,484,451

Besides the above, drugs to the value of 75,553*l.* were imported, as against 58,877*l.* in November 1890.

EXPORTS OF METALS (OTHER THAN MACHINERY) FOR MONTH ENDING 30TH NOVEMBER.

Articles.	Quantities.		Values.	
	1890.	1891.	1890.	1891.
			£	£
Brass..... Cwt.	8,030	7,240	41,780	35,618
Copper :—				
Unwrought ..... „	76,926	62,095	243,360	163,914
Wrought..... „	20,137	26,932	74,937	89,353
Mixed metal .... „	25,159	27,126	71,660	73,889
Hardware ..... Value £	..	..	218,557	213,892
Implements..... „	..	..	110,817	108,960
Iron and steel..... Tons	239,477	221,315	2,519,518	1,802,447
Lead ..... „	4,171	3,591	61,992	49,271
Plated wares... Value £	..	..	39,688	39,216
Telegraph wires, &c. „	..	..	246,378	25,143
Tin ..... Cwt.	10,510	8,181	52,423	38,872
Zinc ..... „	10,180	10,518	11,143	11,252
Other articles .. Value £	..	..	91,737	81,816
Total value	..	..	3,783,690	2,733,043

EXPORTS OF MISCELLANEOUS ARTICLES FOR MONTH ENDING 30TH NOVEMBER.

Articles.	Quantities.		Values.	
	1890.	1891.	1890.	1891.
			£	£
Gunpowder..... Lb.	875,800	728,100	17,779	22,541
Military stores.. Value £	..	..	91,813	62,381
Candles..... Lb.	1,276,800	1,468,700	25,881	27,813
Caoutchouc ..... Value £	..	..	102,627	102,996
Cement..... Tons	47,295	34,611	96,992	68,046
Products of coal Value £	..	..	113,710	114,676
Earthenware ... „	..	..	177,318	107,323
Stoneware ..... „	..	..	18,358	9,769
Glass :—				
Plate..... Sq. Ft.	224,735	279,811	12,068	18,517
Flint..... Cwt.	8,738	9,275	23,105	21,327
Bottles..... „	73,611	55,212	33,852	25,719
Other kinds.... „	15,262	18,696	12,990	17,326
Leather :—				
Unwrought .... „	12,456	13,612	115,902	126,211
Wrought ..... Value £	..	..	30,815	29,936
Seed oil..... Tons	6,395	5,377	141,907	111,593
Floorcloth ..... Sq. Yds.	1,120,600	1,876,600	53,483	72,234
Painters' materials Val. £	..	..	123,683	116,105
Paper ..... Cwt.	78,449	80,793	132,326	116,865
Rags..... Tons	4,491	4,799	33,236	34,984
Soap..... Cwt.	39,328	47,103	46,205	53,641
Total value	..	..	2,915,877	2,488,020

EXPORTS OF DRUGS AND CHEMICALS FOR MONTH ENDING 30TH NOVEMBER.

Articles.	Quantities.		Values.	
	1890.	1891.	1890.	1891.
			£	£
Alkali..... Cwt.	641,363	547,185	225,517	199,895
Bleaching materials „	161,858	151,738	17,680	54,223
Chemical manures. Tons	16,336	26,291	117,859	173,133
Medicines..... Value £	..	..	84,273	89,394
Other articles... „	..	..	279,072	228,387
Total value	..	..	754,491	745,032

Monthly Patent List.

* The dates given are the dates of the Official Journals in which acceptances of the Complete Specifications are advertised. Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the said dates.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

APPLICATIONS.

19,845. E. Brownhill. Improvements in taps for regulating the flow of gas. November 16.

19,983. J. K. Broadbent. Improvements in apparatus for regulatiog the supply of air to furnaces. Complete Specification. November 18.

20,049. H. J. White. Improvement in melting and heating furnaces. November 18.

20,065. T. Langer. Improvements in smokeless furnaces. Complete Specification. November 18.

20,118. A. S. Caldwell. Improvements in apparatus for evaporating and incinerating spent or used alkaline lyes or similar waste products. November 19.

20,123. T. Inman. An improved auger, manufactured of crucible cast steel for use in gas or chemical works. November 19.

20,125. G. Y. Blair. Improvements in apparatus for evaporating, condensing, and the like. November 19.

20,142. J. C. Mewburn.—From The Maschinenfabrik Grevenbroich, Germany. *See* Class XVI.

20,311. R. Cunliffe. Improvements in means for consuming smoke and destroying gases resulting from furnaces or gases from chemical operation. November 23.

20,413. G. Bamberg. *See* Class XI.

20,677. W. R. Jones. Improvements in furnaces. November 27.

20,736. R. Marshall and J. Westray. Improvements in furnaces. November 28.

20,788. E. Goedicke. Improvements in reverberatory furnaces. November 28.

20,852. P. L. Dermigney. An improved cooling and freezing apparatus. November 30.

20,904. C. H. Fitzmaurice. Improvements in apparatus and appliances for softening, purifying, and filtering liquids. December 1.

21,072. G. Johnston. Improvements in apparatus for drying moist substances or materials. December 3.

21,104. R. H. Leaker. *See* Class XVII.

21,157. J. Dawson. Improvements in thermometers. December 4.

21,248. W. Butlin. An improved tuyere. December 5.

21,307. J. A. Mays. A process and apparatus for centrifugally effecting the concentration or separation of solids. December 5.

21,459. C. C. Leathers. A new or improved evaporating apparatus. Filed December 8. Date applied for June 30, 1891, being date of application in France.

21,507. J. Brotherton. Improvements in bottles or holders for the storage and conveyance of quicksilver, gas, and other fluids under high pressure and in the method of manufacture thereof. December 9.

21,518. H. S. Elworthy. Improved cooling apparatus. Complete Specification. December 9.

21,548. T. Gaunt. Improvements relating to the evaporation and distillation of dry or liquid substances. December 9.

21,730. M. F. Purcell and G. Purcell. Improved apparatus for the purification of gaseous fumes, air, and the like, and the deposition of solid particles therefrom. December 11.

COMPLETE SPECIFICATIONS ACCEPTED.*

1891.

957. H. Chilcott. Apparatus for intercepting and separating oleaginous and other matters from the water of condensation from surface condensers. November 25.

1385. A. Haigh and J. Thewlis. Apparatus employed in the drying of animal or vegetable fibres. December 16.

1540. W. H. Webb. Compression pumps for gaseous or vaporous fluids. December 2.

1579. L. H. Armour. *See* Class III.

2099. E. Blass. Apparatus for treating materials by a circulating current of heated gases. December 16.

2141. W. T. Cotton and E. L. Garrett. Improved evaporation and surface condenser for producing pure distilled water. December 9.

2142. W. T. Cotton and E. L. Garrett. Improved apparatus for distilling water and other liquids. December 9.

6798. A. J. Boult.—From L. Falaseoni, Italy. Kilns or furnaces. December 2.

18,216. S. Smithson. Apparatus for drying dyewoods, myrabolan grain, fuller's earth, night soil, and other pulpy matter. December 2.

18,483. T. Phipps. Stop valve for liquids, vapours, or gases. December 16.

18,901. E. Hesketh and O. J. Ellis. Improvement connected with the employment of carbonic acid gas in refrigerating apparatus. December 9.

II.—FUEL, GAS, AND LIGHT.

APPLICATIONS.

20,044. T. Littlehales. Improvement in the art or process of manufacturing heating and illuminating gases. November 18.

20,420. H. H. Lake.—From W. H. Harris, United States. Improvements relating to the manufacture of gas, and to apparatus therefor. November 24.

20,514. C. F. Claus and J. A. Elsner. Improvements relating to the production of oxygen, and to apparatus therefor. November 25.

20,573. J. Hargreaves. Improvements in feeding fuel to gas producers and in the generation of combustible gas. November 26.

20,780. A. Jabs. Improved method of manufacturing producer and water gas. November 28.

21,178. J. T. B. Bennett. Improved process of treating ashes or coal slack. December 4.

21,223. W. R. Alpe. The solidification of coal-dust or pit-slack. Complete Specification. December 5.

21,249. E. Drorg. Improvement in apparatus for charging inclined retorts for use in the manufacture of coal-gas, and for similar purposes. December 5.

21,337. S. J. Woodhouse. Improvements in or in connection with the furnaces of gas retorts. December 7.

21,481. O. G. Blunden. Improvements in apparatus for and the method of preparing peat or turf for use as fuel. December 8.

21,563. W. Bagley. Improved apparatus for feeding coal to gas producers. December 9.

21,598. V. B. Lewes. Improvements in the manufacture or production of carburetted hydrogen for illuminating purposes and apparatus therefor. December 10.

Complete Specifications Accepted.

1890.

19,501. F. J. Jones. Production of coke for foundry and other purposes. November 25.

1891.

1237. A. L. Keller. A new fuel. December 2.

1563. T. Clapham. Construction of condensers applicable for use in the manufacture of illuminating or other gases. December 9.

1909. J. W. Ormiston, A. R. Ormiston, and J. Ormiston. Manufacture and distribution of gaseous fuel, and arrangements and apparatus therefor. December 9.

2235. T. Williams. Combination or employment of ingredients for the manufacture of fire-lighters. December 9.

11,885. J. Bartlett. Fuel block and fire-lighter combined. December 2.

13,089. P. Dvorkovitz, The Kerosine Co., Lim., and The Tank Storage and Carriage Co., Lim. A new or improved method of and apparatus for distilling liquid hydrocarbons. December 16.

15,469. H. Fourness. Manufacture and storage of illuminating and heating gas. November 25.

17,222. W. Croswick. Improved arrangement of coke ovens and retorts for the manufacture of coke and illuminating gas. November 25.

17,652. H. H. Lake.—From The Thomson-Houston International Electric Co. Carbons for electric arc lamps. November 25.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

Application.

20,753. F. H. Pickles and R. H. Pickles. Improvements in the purification of pyroligneites. November 28.

Complete Specification Accepted.

1891.

1579. L. H. Armour. Improvements connected with ovens, furnaces, or retorts used for the making of coke or charcoal, or for distilling or roasting carbonaceous matter, or otherwise subjecting carbonaceous matter to the action of heat. November 25.

IV.—COLOURING MATTERS and DYES.

Applications.

19,062A. B. Willcox.—From the Farbenfabriken vormals F. Bayer and Co., Germany. Improvements in the manufacture of colouring matters. Filed December 7. Date claimed under Rule XIX., November 4, 1891.

19,802. Read, Holliday, and Sons, Lim., and T. Holliday. Improvements in the manufacture of azo colouring matters. November 16.

19,847. O. Imray.—From The Farbwerke vormals Meister, Lucius, and Brüning, Germany. Manufacture of colouring matters from protocatechuic acid and phenols. November 16.

20,010. H. N. F. Schaeffer. Improvements in the manufacture of alizarin colours, and in the method of employing same in the process of dyeing. Complete Specification. November 18.

20,275. J. Y. Johnson.—From The Badische Anilin und Soda Fabrik, Germany. Improvements in and relating to the manufacture and production of azo-dyes, and of materials therefor. November 21.

21,717. B. Willcox.—From The Farbenfabriken vormals F. Bayer and Co., Germany. The manufacture and production of new derivatives of alizarin and its analogues. December 11.

Complete Specifications Accepted.

1890.

20,563. B. Willcox.—From the Farbenfabriken vormals F. Bayer and Co. Manufacture of indigo carmine from phenyl-glycocoll and its salts or ethers. December 2.

1891.

1354. O. Imray.—From the Farbwerke vormals Meister, Lucius, and Brüning. Production of a blue-green and red-violet colouring matter from alizarin blue. December 2.

2682. I. Levinstein. New or improved material for use in the production of colouring matters. December 2.

17,635. C. Dreyfus. Manufacture and production of colouring matters. November 25.

V.—TEXTILES, COTTON, WOOL, SILK, Etc.

Applications.

20,149. H. H. Doty. Improvements relating to the waterproofing of canvas and other materials, and to compositions therefor. November 19.

20,610. E. Viarengo and E. Casper. Improvements in the treatment of rhea, and in apparatus therefor. November 26.

20,625. W. Bottomley.—From G. E. Armstrong, United States. Improvements in apparatus and processes for treating fibrous material. November 27.

Complete Specification Accepted.

1891.

8644. C. Stephens. Improved means for damping, drying, dyeing, starching, or chemically treating and drying paper, silk, felts, and other like fabrics. December 9.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

Applications.

20,010. H. N. F. Schaeffer. Improvements in the manufacture of alizarin colours, and in the method of employing same in the process of dyeing. Complete Specification. November 18.

20,103. P. G. Wild, G. Bentley, J. B. Jackson, and A. A. Whitley. A new or improved method of stamping and tinting textile fabrics and in apparatus for effecting same. November 19.

20,554. R. Hanson. Improvements in dyes or dyeing hat felts. November 26.

20,574. J. Longmore and R. Williamson. Improvements in or relating to the dyeing of silk and other fibres. November 26.

20,737. C. H. Nevill. An improved process for producing designs upon calico and other woven fabrics. November 28.

20,841. O. Imray.—From the Actien Gesellschaft fur Anilin Fabrikation, Germany. Process of dyeing cotton with nitroso compounds. November 30.

20,866. F. Hughes. — From A. Tiberghien, Belgium. Improvements in and in means for dyeing, mordanting, or bleaching textile fibres. Complete Specification. November 30.

20,899. W. Blackburn, R. E. Bray, and L. Clayton. Improvements in machinery for scouring and dyeing hanks of yarn. December 1.

20,931. L. Weldon. Improvements in yarn-dyeing machines. Complete Specification. December 1.

Complete Specifications Accepted.

1891.

478. H. A. Foster and J. Frost. Method of dyeing or colouring wool, silk, hair, fur, feathers, and other animal or vegetable fibres, or plain, cut pile, raised pile, or looped fabrics composed thereof. December 9.

11,692. J. Bertrand-Leplat. Apparatus for dyeing or bleaching textile materials. November 25.

17,887. F. Odernheimer. Process for printing and dyeing textiles, fibres, hair, feathers, and the like, by means of metal salts. November 25.

VII.—ACIDS, ALKALIS, AND SALTS.

Applications.

20,037. C. Kellner. Improved process and apparatus for the manufacture or production of bleaching powder. November 18.

20,060. C. Kellner. Improved process and apparatus for the manufacture or production of hydrogen and chlorine from hydrochloric acid. November 18.

20,251. A. T. Hall and W. J. Wigg. *See* Class X.

20,636. C. Kilpatrick and The Ferric Sewage and Water Purification Co. Means and apparatus for manufacturing ferric chloride and other saturated solutions of oxides, metals, and the like. November 27.

20,713. C. Kellner. Improvements in the manufacture or production of chlorine and alkaline carbonates. November 27.

21,026. J. Raschen. Improvements in the manufacture of bicarbonate of soda. December 2.

21,130. A. Shearer. *See* Class XV.

21,328. J. Turner. The production and manufacture of certain cyanides, especially those of barium and potassium. December 7.

21,333. G. Dean and W. Ince. Chloride of lime by precipitation. December 7.

21,464. F. M. Lyte. Improvements in the production of chlorine, in the purification of certain base metals, in the recovery of precious or other metals with which the base metals may be associated, and in means or apparatus employed therein. December 8.

21,482. C. Simkin and C. G. Picking. Improvements in apparatus for concentrating sulphuric acid. December 9.

21,555. H. H. Lake.—From A. Raudnitz, Austria. Improvements relating to the manufacture of yellow prussiate of potash and to furnaces for use therein. December 9.

Complete Specifications Accepted.

1890.

20,012. F. Ellershausen. Treatment of soda waste. December 9.

1891.

962. J. W. Kynaston. Manufacture of sulphate of alumina. November 25.

1168. M. N. d'Andria. Manufacture of barium chloride and strontium chloride. December 2.

1261. O. Imray. — From La Société Anonyme des Anciennes Salines Domaniales de l'Est. Process for bleaching and purifying aluminium sulphate. December 2.

1824. I. Lifschutz. Process for the simultaneous production of cellulose and oxalic acid from vegetable fibrous substances. December 9.

2449. W. C. Heraeus. Apparatus for concentrating acids. December 2.

17,933. W. P. Thompson.—From J. A. Bradburn and J. D. Pennock. Manufacture of alumina. December 2.

18,324. L. Brunner and A. Zanner. Process for manufacturing nitrate of ammonia or chloride of ammonia, and simultaneously obtaining either precipitated phosphate of lime or an enriched phosphate of lime. December 2.

19,215. J. L. Kessler. Apparatus for the concentration of sulphuric acid. December 16.

19,382. C. Bigot and J. Schreiter. Manufacture of sodium borates. December 16.

19,453. A. J. Boult.—From C. E. Ongley and O. D. Ballert. Preparation of salt. December 16.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

Applications.

20,066. T. H. Sharpe. Improvements in the manufacture of articles moulded from clay or other plastic material, and in the apparatus employed therein. November 18.

20,096. J. P. Wilson. Improvements in kilns for drying and burning bricks and the like. November 19.

20,137. T. Walton. Improvements in the method of and apparatus for making blown glass ware. November 19.

20,200. W. H. Turner. Improvements in means employed for supporting plates and other articles in the glost oven and enamelling kiln. November 20.

20,280. Craven, Dunnill, and Co., Limited, and F. R. Smith. Improvements in the manufacture of tiles and the like, and in apparatus therefor. November 21.

20,415. L. West. Improvements in the manufacture of plate and other glass and apparatus therefor. November 24.

20,437. W. P. Thompson.—From R. S. Pease, United States. Improvements in the method of and apparatus for manufacturing plate glass. Complete Specification. November 24.

20,438. W. P. Thompson.—From R. S. Pease, United States. Improvements in the method of and apparatus for manufacturing glass plates, sheets, and films. Complete Specification. November 24.

20,439. W. P. Thompson.—From R. S. Pease. New or improved method of and apparatus for the manufacture of glass plates, cylinders, pipes, and certain other bodies. Complete Specification. November 24.

20,440. W. P. Thompson.—From R. S. Pease, United States. Improvements in the method of and apparatus for producing cylinders, pipes, and other tubular or hollow bodies of glass. Complete Specification. November 24.

20,523. F. Plant. Improvements in enamelling and hardening kilns for use in the manufacture of pottery. November 25.

20,641. H. Meller. Improvements in the application of photo-mechanical printing processes, for the decoration of every description of glass and pottery, and the production of photo-ceramic enamels, and the ornamenting of every description of enamel surface. November 27.

20,771. J. Slack. Improved means of producing decorative or other designs upon ceramic ware and the like. November 28.

20,861. J. E. G. Meran. A new product to serve as a substitute for pottery, for filtering purposes, and for the manufacture of tobacco pipes and the like. November 30.

21,350. F. Welz. Process of making rose or orange-red stained glass. Complete Specification. December 7.

21,742. A. B. Carter and H. C. Hughes. Improvements in the manufacture of stained glass for windows and other transparencies and mural decoration. December 9.

Complete Specifications Accepted.

1891.

943. H. L. Doulton and S. H. Leech. Forming undercut projections and recesses in tiles and other articles of pottery and apparatus therefor. November 25.

7909. Craven, Dunnill & Co., Limited, and F. R. Smith. Manufacture of tiles, ceramic, mosaic, and the like, and in apparatus therefor. December 9.

14,381. C. Garcés-Losada. Baking ceramic plates and pottery. November 25.

18,189. T. Edwards.—From K. Goetz. Improvements in the liquid material or "slip" used in the manufacture of porcelain stone ware and the like. December 2.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

Applications.

19,841. H. J. White. The improvement in manufacture of slag wool and cement. November 16.

20,096. J. P. Wilson. See Class VIII.

20,269. L. Hartmann. Means for securing asphalt mastic as a coating or stopping upon all descriptions of buildings and building materials. November 21.

20,291. C. Doelter. Improvements in the manufacture of corundum or alumina from emery. November 21.

20,646. H. Parry. Improvements in kilns for burning lime. November 27.

20,740. J. H. Blakesley. Improvements in fireproof floors, roofs, girders, joists, and the like. November 28.

20,743. J. T. Abell. Improvements in paving. November 28.

21,162. J. J. Carr. An improvement in or relating to the manufacture or treatment of whiting (carbonate of lime) and cements (sulphate of lime) and colours to be used for plastering or coating surfaces, also for modelling and moulding ornamental work. December 4.

21,199. R. Norwood. The manufacture of an improved compound for coating walls and other surfaces, and for the production of casts or mouldings, and for analogous purposes. December 4.

21,374. R. Norwood. The manufacture of an improved compound for coating walls and other surfaces, and for analogous purposes. December 7.

21,483. B. Peffard. Improvements in the manufacture of bricks to be used without mortar. December 9.

21,520. T. D. Harries. An improved artificial stone. December 9.

21,616. G. I. J. Wells. Improvements in the manufacture of cement, and the utilisation of the lime mud residue of the ammonia-soda process therefor. December 10.

Complete Specifications Accepted.

1890.

18,899. L. C. Delabraye. Improved method of enriching phosphated chalk and other calcareous phosphates. November 25.

1891.

1115. W. R. Taylor. Apparatus for the manufacture of cement. November 25.

1750. C. von Forell. Manufacture of artificial Roman cement. November 25.

X.—METALLURGY, MINING, Etc.

Applications.

19,860. P. L. A. Montgolfier. Improvements relating to the manufacture of steel and other metal. Filed November 16. Date applied for June 11, 1891, being date of application in France.

19,928. A. Figge. Improvements in the manufacture of iron, steel, or copper, and a material to be used in the said manufacture. November 17.

19,992. S. Ward, W. Guest, and W. Miller. Improved manufacture of semi-divided bars of steel, and the like. November 18.

20,003. H. Y. Castner. Improvements in the manufacture of the oxides of the alkaline metals. November 18.

20,115. W. A. Briggs. An improved alloy for use in the manufacture of bicycles and tricycles. November 19.

20,131. C. T. J. Vautin. Improvements in the method of and apparatus for hardening, tempering, or annealing metallic wire or tape. November 19.

20,220. P. Williams. Improvements in the manufacture or purification of iron. November 20.

20,251. A. T. Hall and W. J. Wigg. Improvements in the utilisation of certain residuals obtained in the manufacture of copper. November 21.

20,461. E. K. Dutton.—From A. Mathies, Germany. Improvements in the production of hollow steel ingots, and in apparatus therefor. November 25.

20,856. O. Vogel. Improvements relating to the treatment of zinc and of alloys known as "hard spelter" or "hard zinc," produced in the coating of metal articles with zinc. November 30.

20,908. A. G. Meeze and R. Meikle. Manufacture of steel or homogeneous metal of higher grade from crude iron and the ores thereof. December 1.

20,977. J. B. Hunt. Improved method of reducing the bulk of scrap iron or other metals. Complete Specification. December 1.

21,114. E. Norton. Improvements relating to the coating of metals. December 3.

21,568. E. Hanff. Improvements in compound metal plates. December 9.

21,737. M. Lancon. New or improved manufacture of metallic alloys for soldering aluminium. December 11.

21,748. J. W. King, A. Colley, and J. Colley. Improvements in the removal of metals and metalloids previous to being charged into refining furnaces. December 12.

COMPLETE SPECIFICATIONS ACCEPTED.

1890.

15,830. J. T. King.—From T. S. Blair, jun. Reduction of ores. December 9.

18,898. T. D. Nicholls and The Cape Copper Company, Limited. Method of extracting copper from ores or compounds containing the same. November 25.

20,944. S. Elliott. Method of condensing lead and other metallic fumes arising from furnaces. December 2.

1891.

500. R. Heathfield. Process of coating metals. November 25.

1047. W. West. Apparatus and process for treating zinc ores. November 25.

1526. C. H. Aston. Method of utilising the calcined hot blast stove and boiler flue dust made in connexion with iron-making furnaces. December 16.

2000. P. Hart. Treatment of composite ores containing zinc. November 25.

4396. J. Strap. Separation of copper, nickel, and silver from mattes or alloys containing the same, and the treatment of the residues resulting therefrom. December 16.

7585. H. L. Herrenschmidt. Processes for the treatment of silicated nickel ores and pyritic ores of nickel and copper, or nickel, copper, and cobalt. December 2.

13,906. J. H. Darby. Basic-lined furnaces. December 9.

16,544. H. H. Lake.—From H. A. Harvey. Manufacture of armour plates. November 25.

17,933. W. P. Thompson.—From J. A. Bradburn and J. D. Pennock. *See* Class VII.

19,599. A. Fairley and J. F. Fairley. Manufacture of hollow ingots or other hollow castings from steel or ingot iron. December 16.

XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY

APPLICATIONS.

19,900. W. P. Thompson.—From C. L. Coffin, United States. Improvements in or relating to welding or working metals electrically. Complete Specification. November 17.

19,901. W. P. Thompson.—From C. L. Coffin, United States. Improvements in or relating to welding or working metals electrically. November 17.

20,312. J. M. Moffat. Improvement in the form of electrical battery cells, boxes, or vessels. November 23.

20,413. G. Bamberg. Improved electrolytic apparatus, more particularly applicable for manufacturing caustic soda and other products from salt, but also applicable to other purposes. November 24.

20,837. C. H. Woolf, A. E. Haymen, and A. D. R. Jameson. Extracting gold and silver from sea-water by electrolysis. November 30.

20,922. C. Lütcke. Improvements in storage batteries or accumulators. December 1.

20,969. T. J. Holland. Improvements in electrolytic tanks. December 1.

21,442. H. H. Lake.—From I. L. Roberts, United States. Improvements in secondary or storage batteries. Complete Specification. December 8.

COMPLETE SPECIFICATIONS ACCEPTED.

1890.

18,523. H. Zerener. Apparatus for heating, welding, melting, or gasifying solid bodies by electricity. November 25.

1891.

49. W. Wensky. Galvanic batteries for producing constant currents. November 25.

899. H. T. Eager and R. P. Milburn. Electric cells or batteries. December 2.

1035. S. W. Marquay. Primary batteries. November 25.

3198. F. Poudroux. Galvanic batteries. November 25.

17,994. B. Scheithauer. Electric batteries. November 25.

18,431. M. Waddell, J. B. Entz, and W. A. Phillips. Secondary batteries. December 9.

18,522. W. P. Thompson.—From C. L. Coffin. Method and apparatus for welding or working metals electrically. December 2.

19,458. W. P. Thompson. — From N. H. Edgerton. Electric accumulators or storage batteries. December 16.

XII.—FATS, OILS, AND SOAP MANUFACTURE.

APPLICATIONS.

20,415. H. E. Walter. An improved cleansing material. November 24.

20,512. R. R. Graf. A new or improved method of treating oils used for lubricating and tempering purposes to render the same incombustible or fireproof. Complete Specification. November 25.

20,590. E. J. T. Digby. Improvements in the manufacture of soap. November 26.

20,974. C. D. Abel.—From C. N. Scott and H. Hennebutte, France. Improved method of, and apparatus for, purifying or treating soapy liquids for regaining therefrom soaps and fatty acids. December 1.

21,043. J. A. Wanklyn and W. Johnstone. Improvement in the manufacture of soap. December 2.

21,294. E. Simpson, C. H. Simpson, and H. McPhail. Improvements in the treatment of spent soap lyes for the purpose of obtaining glycerin and other products therefrom. December 5.

21,438. C. L. Field. An improved manufacture of superfatted soap. December 8.

COMPLETE SPECIFICATION ACCEPTED.

1891.

17,553. H. H. Lake.—From J. Ketchum. Lubricating compound for the chains and bearings of cycles and for other purposes. November 25.

XIII.—PAINTS, PIGMENTS, VARNISHES, AND RESINS.

APPLICATIONS.

20,253. R. Ripley. Improvements in or appertaining to the form or get-up of bag-blue. November 21.

20,274. R. Lender. Improved rust and acid-proof paint. Complete Specification. November 21.

20,407. R. Pape. Improvements in the manufacture of a hard insulating material. Complete Specification. November 24.

21,203. J. C. Chapman.—From J. M. James, Japan. A process of and materials for coating metallic surfaces for the prevention of fouling and corrosion, and reducing surface friction. December 4.

21,241. G. H. Smith. Improvements in the treatment of gums for the preparation of varnishes therefrom. December 5.

21,279. W. J. Wigg. Improvements in the manufacture of Venetian red. Complete Specification. Filed December 5. Date applied for May 7, 1891, being date of application in United States.

21,545. E. Waller and C. A. Sniffen. Improvements in the manufacture of white lead and neutral lead acetate from lead ores. Complete Specification. December 9.

21,654. W. Morley. An anti-fouling composition for the bottoms of ships, yachts, and other vessels. December 10.

Complete Specifications Accepted.

1890.

13,864. A. A. Blandy. Combination and treatment of certain materials for the production of substances as a substitute for india-rubber and leather, and for other substances and purposes for which it may be applicable. December 9.

1891.

1267. W. N. Hartley and W. E. B. Blenkinsop. Manufacture of an improved preparation of driers or siccative material for mixing with paints. November 25.

17,566. C. Dreyfus. Manufacture of coloured rubber goods or rubber-coated goods, and a material or preparation to be used in the said manufacture. December 9.

18,072. W. P. Thompson. From A. Freiherr (Baron) von Pereira. Manufacture or preparation of resinous paints. December 2.

XIV.—TANNING, LEATHER, GLUE, and SIZE.

Applications.

20,452. O. C. Hagemann. Improvements in the extraction and purification of tannin. November 24.

20,755. W. P. Thompson.—From F. Kranseder and A. Leutsch, Germany. Improvements in apparatus or appliances for use in drying sheets of glue, gelatin, and the like. November 28.

21,587. T. J. Haslam. An improved substitute for whalebone. December 10.

21,774. G. van Haecht and C. Obozinksi. A new process for tanning, and apparatus relating thereto. December 12.

Complete Specification Accepted.

1891.

1631. J. Sadler. Making an improved artificial leather. November 25.

XV.—AGRICULTURE and MANURES.

Application.

21,130. A. Shearer. Improvements in the treatment of phosphates of alumina, or products containing such phosphates, to render them suitable for use as manures, or for the obtainment of soluble phosphates therefrom. December 3.

XVI.—SUGARS, STARCHES, GUMS, Etc.

Applications.

20,119. J. Drummond. Improvements in apparatus for separating impurities from sugar. November 19.

20,142. J. C. Mewburn.—From The Maschinenfabrik Grevenbroich, Germany. Improvements in centrifugal machines or hydro-extractors for extracting sugar juice from crystals, and for other purposes. November 19.

20,887. D. Stewart. Improvements in evaporating or concentrating saccharine liquids, and in apparatus therefor. December 1.

21,059. C. Kleyer and C. Kappesser. *See* Class XIX.

21,370. L. Kern. Improvements in and relating to the production of adhesive substances soluble in water, from the gum exuded from almond, cherry, peach, and other trees. December 7.

21,477. W. P. Thompson.—From J. Hirsch, Germany. Improvements relating to the manufacture of cube, loaf, and similar sugar. December 8.

XVII.—BREWING, WINES, SPIRITS, Etc.

Applications.

19,849. P. A. Roche. Improvements relating to manufacture of beer. November 16.

19,986. W. S. Squire. Improvements in the manufacture of yeast. November 18.

20,556. W. P. Thompson.—From O. E. Nycander and G. Francke, Germany. Improved process for the production of yeast and spirit by the employment of ozonised air or oxygen. November 26.

20,649. C. Hof.—From Schneider, Germany. Improvements relating to the production of malt. Complete Specification. November 27.

20,733. G. Stadler. Improvements in barrels for sterilising beer. November 28.

21,059. C. Kleyer and C. Kappesser. *See* Class XIX.

21,104. R. H. Leaker. An improved method of and apparatus for condensing the vapour produced in brewers' coppers and like vessels, and for recovering the resultant liquid. December 3.

21,698. P. A. Attout, called Tailfer. Improvements in distilling, and in apparatus therefor. Filed December 11. Date applied for, May 16, 1891, being date of application in France.

21,708. S. Pitt.—From A. Savall, Sons and Co., France. Improvements in apparatus for distilling and rectifying. Complete Specification. December 11.

21,731. G. S. Kelsey. A new or improved instrument or apparatus for sampling or testing worts, and for other like purposes. December 11.

Complete Specifications Accepted.

1891.

852. F. König. Process and apparatus for the manufacture of champagne and other beverages charged with carbonic acid. November 11.

17,681. R. H. Leaker. An appliance for distributing and aërating brewers' wort. November 25.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

Applications.

A.—Chemistry of Foods.

2444A. L. Smith. Improvements in means for storing and preserving food for domestic uses. Complete Specification. Filed November 28. Date claimed, February 10, 1891.

19,817. H. S. Elworthy. Improvements in means for preserving meat, fruits, and such like perishable articles in store or in transit. Complete Specification. November 16.

19,859. E. R. Kobert. An improved blood-forming substance and method of producing the same. November 16.

20,419. J. E. Alen. An improved method of preventing the curdling of albuminous solutions. Complete Specification. November 24.

20,436. W. P. Thompson. — From Moser and Co., Germany. Improvements in and connected with the process of extracting cocoa, or rendering it soluble for the preparation of soluble cocoa, or the manufacture of cocoa powder, chocolate, or the like preparations. Complete Specification. November 24.

20,602. J. Montgomerie. Improvements in and relating to the drying and roasting or treatment of celery and like vegetable matter, and appliances therefor. November 26.

20,694. B. Corrick. New or improved manufacture of substances or compositions for use as condiments. November 27.

21,317. J. Longshaw. Improvements in the method of and means for preserving eggs. December 7.

21,372. J. Carnrick. An improved process of manufacturing kumyss compounds or kumyss tablets. Complete Specification. December 7.

21,391. D. Evans.—From A. A. Freeman and G. Evans, United States. An improvement in the method or process of preserving oysters and other bivalves in the shell. December 8.

21,708. S. Pitt.—From The Farbwerke vormals Meister, Lucius, and Brüning, Germany. Process for preserving organic substances, and for disinfection. December 11.

B.—Sanitary Chemistry.

19,803. H. P. Boulnois and J. A. Brodie. Improvements in and relating to refuse destructors. November 16.

20,682. J. Price. Improvements in the treatment of sewage. November 27.

20,726. J. Norris. Improvements in the disposal of sewage and apparatus connected therewith. Complete Specification. November 28.

20,748. F. Scudder. Treatment of and production of valuable products from sludge obtained by electrical treatment of sewage. November 28.

21,029. P. Hart. Improvements in treatment of sewage, fœcal, and other like matters by means of galvanised waste iron chloride liquors. December 2.

21,090. H. Lockwood. Improvements in the materials used in the purification of sewage and other foul water. December 3.

21,292. F. P. Candy. *See* Class XVIII.—*C.*

C.—Disinfectants.

20,395. A. Robertson. The Highland sheep dip. November 24.

21,292. F. P. Candy. Improvements in the manufacture of materials for the treatment of sewage and other polluted waters. December 5.

21,706. O. Imray.—From The Farbwerke vormals Meister, Lucius, and Brüning, Germany. *See* Class XVIII.—*A.*

Complete Specifications Accepted.

A.—Chemistry of Foods.

1891.

2207. M. P. Hatschek, G. A. Clowes, and L. Briant. Preparation of peptone extracts, and application of the same to various useful purposes. December 9.

3481. J. Hillaby. A preparation of extract of malt in combination with extract of liquorice and other substances. November 25.

17,717. B. J. B. Mills.—From A. M. de la Visuville. Process for preserving eggs. November 25.

17,899. J. Kay. Method of preserving fruit. December 2.

18,615. J. Quaglio. Process for roasting pure coffee and for condensing the steam produced during the roasting operation in coffee substitutes or in sugar for the purpose of the extracting the aroma and products therefrom. December 9.

B.—Sanitary Chemistry.

1890.

15,405. J. Hardwick and L. A. Newton. The treating of sewage and sewage sludge. December 2.

1891.

1225. H. Tatham. Treatment of sewage and sewage deposits. December 2.

5330. E. E. Scruby. Process for purifying sewage effluents and other impure liquids, and apparatus therefor. December 16.

C.—Disinfectants.

1891.

8629. W. H. Spencer. Apparatus for vaporising oils and other liquids for medicinal and disinfecting purposes. December 2.

18,434. S. B. Mores and T. F. Bourne. Sulphur candles. December 2.

18,913. A. Lembach, U. Schleicher, and C. J. Wolff. Improvements in and relating to soluble quinoline antiseptics. December 9.

XIX.—PAPER, PASTEBOARD, ETC.

Applications.

20,163. A. Watkins. *See* Class XXI.

20,224. T. Lumb. Improvements in machinery or apparatus for the manufacture of press papers, glazed boards, and the like. November 20.

20,225. C. Kellner. Improvements in the treatment of short fibres, particularly paper pulp, forming therefrom rovings and other goods. November 20.

21,059. C. Kleyer and C. Kappesser. Improvements in the treatment of peat for the production of cellulose, sugar, and alcohol. Complete Specification. December 2.

21,340. J. Longshaw. Improvements in the treatment of strawboards and millboards. December 7.

Complete Specifications Accepted.

1891.

927. R. N. Redmayne. Manufacture of pulp for paper-making and other purposes. November 25.

2872. J. Beveridge. Treatment of fibrous plants for the manufacture of paper pulp. November 25.

15,222. C. W. Robinson. Machine for making parchmentised fibre and the like. November 25.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES, AND EXTRACTS.

Application.

20,851. R. A. Cheesebrough. Improvements in the manufacture of perfumes. November 30.

Complete Specifications Accepted.

1890.

21,044. A. Foelsing. Process for the preparation of hop extract. November 25.

1891.

588 H. H. Lake.—From Ichthyolgesellschaft Cordes, Hermanni and Co. Coatings for therapeutical purposes. November 25.

17,493. A. Bang.—From G. A. Dahl. New anti-pyretic and anti-neuralgic chinolin derivative (to be called "Analgen-Du Vis") and process for the production of the same. November 25.

17,654. C. D. Hellstrom. Method and apparatus for extracting fatty particles from emulsions. November 25.

XXI.—PHOTOGRAPHIC PROCESSES AND MATERIALS.

Applications.

20,068. H. M. Campbell. Improvements in and connected with photographic sensitised plates. November 18.

20,163. A. Watkins. Improvements in sensitive papers for actinometers. November 20.

20,557. T. H. Powell. An improvement in the method of, and materials or compound employed, in toning photographic prints on paper, glass, or other surfaces. November 26.

20,600. R. Kopp. Improvements relating to photography in natural colours. Complete Specification. November 26.

20,690. J. Hauff. The use of aromatic amido compounds, and of derivatives of pyrogallol for the development of photographic images. November 27.

21,381. J. T. Sandell. An improvement in the manufacture of photographic plates and films or other sensitive media. December 7.

21,497. J. J. E. Mayall. Improvements connected with colouring photographic impressions, and in the mixing and preparing of the colours used therewith. December 9.

Complete Specification Accepted.

1891.

18,592. E. Haekh. Photographic apparatus. December 9.

XXII.—EXPLOSIVES, MATCHES, Etc.

Complete Specifications Accepted.

1891.

336. Y. Y. Johnson.—From Zellstoff fabrik Waldhof. Treatment of cellulose nitrates or gun-cotton. November 25.

843. G. G. André and C. H. Curtis. Manufacture of gunpowder, and in apparatus therefor. November 25.

2,044. N. Erbsloh. New or improved fuse for igniting the explosive charges of shells and other projectiles. December 9.

11,713. M. Reuland. Manufacture of explosives. December 9.

XXIII.—ANALYTICAL CHEMISTRY.

Applications.

20,339. H. S. Keating. Apparatus for determining specific gravities of liquids. November 23.

20,632. W. I. Chadwick. Improvements in condensers used in instruments for optical projection. November 27.

20,956. W. Johnstone. Improvements in detection of foreign fats in butter. December 1.

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